Hinkley Point C | Development Consent Order Application

Environmental Statement
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Environmental Statement - Volume 2

Hinkley Point C Development Site

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CHAPTER 1: EXISTING SITE AND SURROUNDING AREA

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1. EXISTING SITE AND SURROUNDING AREA

1.1 Introduction

1.1.1 This chapter provides an overview of the existing Hinkley Point C (HPC) development site and surrounding area which have the potential to be affected by the proposed new nuclear power station.

1.2 Location of the Hinkley Point C Development Site

1.2.1 The HPC development site is located on the coast of Somerset, 25km to the east of Minehead and 12km to the north-west of Bridgwater. The HPC development site falls within the parish of Stogursey in the district of West Somerset.

1.2.2 As illustrated in **Figure 1.1** the HPC development site is approximately centred on the National Grid Reference 320300, 145850 and occupies a total land-based area of 175.2 hectares (ha). The proposed area for the permanent land-based development will be approximately 67.5ha (the permanent development site).

1.2.3 Immediately to the east of the development site, the land is occupied by two nuclear power stations, Hinkley Point A and Hinkley Point B, which form the existing Hinkley Point Power Station Complex. Hinkley Point A operated between 1965 and 2000 and is currently undergoing decommissioning by the Nuclear Decommissioning Authority (NDA). Hinkley Point B, owned by EDF Energy, has operated since 1976 and is scheduled to continue generating until at least 2016.

1.2.4 The surrounding area is predominantly agricultural with scattered settlements, representative of the Vale of Taunton and Quantock Fringes National Character Area (NCA) including:

- Stolford approximately 2km to the east of the development site (as denoted by the red line boundary).
- Wick approximately 800m to the south east of the development site.
- Shurton adjacent to the south of the development site.
- Burton approximately 600m to the south-west of the development site.
- Stogursey approximately 1.5km to the south of the development site.
- Knighton approximately 500m to the west of the development site.

1.2.5 The villages of Combwich and Williton are located approximately 5km and 12km to the south-east and west of the site respectively. These villages have been identified as sites to accommodate the proposed off-site associated development. Further off-site, associated development will be located in the village of Cannington 8km to the south-east, at Bridgwater and in the vicinity of Junctions 23 and 24 of the M5.

1.2.6 The site is bounded to the north by the Bridgwater Bay, part of the Severn Estuary from which it is separated by a low cliff.

1.3 Hinkley Point C Development Site

1.3.1 As illustrated in **Figure 1.2**, the HPC development site is divided into three compartments for the purposes of the Environmental Impact Assessment (EIA) comprising:

- The Built Development Area East (BDAE) comprising land in the north-east part of the site, adjacent to the existing Hinkley Point Power Station Complex to be used for the built development and main construction works areas.
- The Built Development Area West (BDAW) located to the west and south of BDAE and which will be occupied by the built development and main construction works areas.
- The Southern Construction Phase Area (SCPA) located to the south of the Built Development Areas East and West and extends to the southern boundary. The northern part of this area between Green Lane and latitude 144750mN will accommodate areas for contractors, stockpiling, the on-site accommodation campus and other facilities throughout the construction period. The area south of 144750mN will accommodate early landscaping works, the emergency access road and a bridge over Bum Brook.

1.3.2 The majority of land within the development site is agricultural in nature and consists of a mix of arable and pasture fields, delineated by a mixture of fence lines and mature hedgerows. Five small broad-leaved woodlands are located within the coastal fields, with other woodland being limited to Branland Copse (on the western side of the existing Hinkley Point Power Station Complex) and a block of semi-natural plantation towards the southern boundary of the site.

1.3.3 The BDAE comprised predominantly agricultural land, until 1957 when a small sewage works was constructed towards the western boundary. A central part of this area was also subject to the deposition of spoil arising from the construction of the Hinkley Point A power station. The deposited spoil formed the large, double humped mound still present on site. During construction of the Hinkley Point B power station, a campus and fabrication area with associated electrical substations were developed on the southern section of the BDAE. These have since been removed. More recently, the north western part of this area was used as a temporary stockpile for material arising from the construction of the new Intermediate Level Waste (ILW) store on the Hinkley Point A site.

1.3.4 During 2011 the development site was subject to a series of separate planning permissions as detailed in **Volume 1** including:

- the construction of new bat barn on the western boundary of the site to mitigate for the loss of potential bat roosts within three derelict barns located within Built Development Areas East and West during early site clearance; and
- site remediation of known contamination within the spoil mound and surrounding areas within BDAE. See **Figure 1.3**.

1.3.5 In addition, a replacement car-park serving Hinkley Point B power station was constructed on existing operational land within BDAE through permitted development rights under The Town and Country Planning General Permitted Development Order 1995.

1.3.6 The topography of the development site is typical of that in the wider locality comprising mostly open, gently rolling, mixed lowland farmland with a series of east-west trending ridges from the coast extending inland. **Figure 1.4** illustrates the general landform. In essence, land rises from the coast up to Green Lane and then drops down again into the Holford valley before rising again in similar fashion before falling towards Bum Brook and the village of Shurton.

1.3.7 There are no substantial waterbodies within the development site boundary, although there are a number of watercourses including Bum Brook and Holford Stream which run west-east under the C182 and connect to the watercourses in Wick Moor. To allow for a development platform to be created, Holford Stream will be culverted. Further details are provided within the **Construction Method Statement**.

1.3.8 A minor unnamed ditch (referred to as the Hinkley Point C drainage ditch) arises to the west of the site and runs through Built Development Areas West and East before discharging to the intertidal zone.

1.3.9 Smaller standing water is also limited in extent, with a scrub-encroached pool towards the north-western edge of the site boundary, and further small pools to the south of the plant sewage works and near Pixies Mound to the east of the development site.

1.3.10 The development site is well served by a network of public footpaths and bridleways, including:

- part of the West Somerset Coast Path which links the River Parrett Trail at Steart in Bridgwater Bay with the South West Coast Path National Trail at Minehead;
- Green Lane, as described in 1.3.6 above; and
- a number of smaller, interconnecting footpaths running north-south and east-west.

1.3.11 The development site is bounded to the north by Bridgwater Bay, part of the Severn Estuary from which it is separated by a low cliff, between around five and ten metres in height. At low tide, the shore adjacent to the site comprises a relatively narrow platform of rock, cobbles and pebbles, interspersed with and fringed by muddy sand. Intertidal areas to the west include more extensive areas of mobile sand, while to the east, adjacent to the built nuclear power stations, the intertidal rock platforms, mud and sand extend up to 500m from the upper shore at low water. The Severn Estuary is recognised for its international and national nature conservation importance. Further details are provided below in section 1.4.

1.3.12 The Severn Estuary is a typical outer estuarine area that experiences a moderate variation in salinity regime throughout the tidal cycle. However, due to its extremely high tidal range, it is in most other respects atypical. Turbidity levels (the amount of fine silt suspended in the water) are extremely high. A significant feature is associated with the neap/spring tidal cycle, where some of these fine silts are deposited widely across the rock platform and in subtidal areas during the more extreme neap tides and remobilised at higher tidal ranges. This is a distinctive feature of Bridgwater Bay and the extreme turbidity and tidal regimes both have a significant influence on ecology and water quality. Another significant influence on water quality is the nearby Parrett Estuary, a large sub-estuary of the Severn, especially during extremes of river run-off when the freshwater plume can extend for some distance off-shore.

1.4 Designated Sites

1.4.1 As illustrated in **Figure 1.5** there are a number of designated sites in proximity to the HPC development site. The Severn Estuary is recognised for its international and national nature conservation importance and designated as:

- a Ramsar site under the Ramsar Convention on Wetlands of International Importance;
- the Severn Estuary Special Protected Area (SPA) under the EC Directive (79/409/EEC) on the Conservation of Wild Birds; and
- the Severn Estuary Special Area of Conservation (SAC), under the EC Directive (92/43/EEC) on the Conservation of Natural Habitats and of Wild Flora and Fauna.

1.4.2 The Severn Estuary SPA and Ramsar Sites covers all intertidal and inshore marine habitat adjacent to the northern boundary of the Built Development Areas and also extends inland and includes Wick and North Moor to the east.

1.4.3 Bridgwater Bay SSSI, which includes Bridgwater Bay National Nature Reserve (NNR), lies to the east of the site, south of the existing Hinkley Point Power Station Complex and comprises a succession of habitats ranging from mudflats, saltmarsh, shingle beach, and grazing marsh. It supports internationally and nationally important numbers of wintering and passage wildfowl and is an integral part of the Severn Estuary eco-system, as well as forming a link to the Somerset Levels.

1.4.4 A relatively extensive area of land on the southern side and small areas of ground to the east and west of the existing Hinkley Point Power Station Complex have been subject to land management and are non-statutorily designated for their conservation value as a County Wildlife Site (Hinkley CWS). Approximately 60% of the designation is within the BDAE.

1.4.5 Further details on the sites designated for the nature conservation value are provided within **Chapters 19** and **Chapter 20** of this Volume on Marine and Terrestrial Ecology, respectively.

1.4.6 Adjacent to the western boundary of the BDAW frontage, lies the ‘Blue Anchor to Lilstock’ SSSI which is designated for the unique cliff stratigraphy which comprises interbedded limestones, shale and mudstones of the Lower Blue Lias units. The exposed strata are considered to be amongst the best examples of the Blue Lias outcrop in Europe. Furthermore, the SSSI also has a geomorphological designation for the exposed limestone rock pavement on the foreshore.

1.4.7 There are no local landscape designations within the site, however, a Historic Landscape, Green Wedge, Historic Parks and Gardens and a Conservation Area are present within the wider study area. Within 5km of Hinkley Point there are three Scheduled Monuments (Wick Barrow Pixies Mound, Stogursey Castle and Village Cross) and three historic Parks and Gardens (Fairfield, St. Audries House and Crowcombe Courts). The presence of these features indicates historic activity in the area immediately surrounding the development site, and also immediately off-shore. As such the area is likely to be considered as being of high archaeological importance.

1.4.8 Located within 5km of the development site, to the west and south west, is the Quantock Hills Area of Outstanding Natural Beauty (AONB), which covers an area of 99km^2, from the vale of Taunton Deane to the Bristol Channel Coast. The AONB contains large areas of heathland, oak woodlands, ancient parklands and agricultural land. The existing Hinkley Point Power Station complex is visible from parts of this nationally designated landscape. Exmoor National Park and Mendip Hills AONB are also located within 20km of the development site.

1.5 Access to the Hinkley Point C Development Site

1.5.1 The main access road serving the existing Hinkley Point Power Station Complex is the C182 which is a single carriageway road passing from Hinkley Point south-east to the village of Cannington. The C182 routes to the east of Shurton and to the west of Combwich and passes through the centre of Cannington to join the A39 to the south of the village.

1.5.2 The A39 runs westwards towards Williton and Minehead and south-eastwards towards Bridgwater and then eastward to Glastonbury.

1.5.3 The A38 routes through Bridgwater on a predominantly north - south alignment. The A38 provides access to Bristol to the north and Taunton to the south. The M5 motorway bypasses Bridgwater to the east of the town with two interchanges at Junctions 23 and 24. Junction 23 is located north of Bridgwater and Junction 24 south east of the town.

1.6 Highway Improvements

1.6.1 A range of improvement works will be implemented across the highway network in the early stages of construction. The works will be located on the main transport routes to the HPC development and comprise two principal types, being modifications to existing road alignments or junction/roundabout arrangements or enhanced safety measures at the following locations:

- A38 Bristol Road/The Drove Junction, Bridgwater.
- A39 Broadway/A38 Taunton Road Junction, Bridgwater.
- A38 Bristol Road/Wylds Road Junction, Bridgwater.
- Wylds Road/The Drove Junction, Bridgwater.
- A39 New Road/B3339 Sandford Hill Roundabout.
- M5 Junction 23 Roundabout.
- Washford Cross Roundabout.
- Claylands Corner Junction.
- C182 Farringdon Hill Lane, Horse Crossing.

- Cannington Traffic Calming Measures.
- Huntworth Roundabout.

1.6.2 All works will be of a limited spatial scale and the baseline environment for each of the sites is described where relevant in the technical assessment chapters in this volume.

CHAPTER 2: DESCRIPTION OF PROPOSED DEVELOPMENT

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2. DESCRIPTION OF PROPOSED DEVELOPMENT

2.1 Introduction

2.1.1 Part 1, 17 (a) of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 requires that a "description of the physical characteristics of the whole development" is provided.

2.1.2 This chapter describes the permanent Hinkley Point C (HPC) development, the landscaping proposals and the off-site highway improvements. It provides an overview of the physical characteristics and functions of the components of the development. Further details on the operation of HPC, together with commissioning activities, are provided in **Chapter 4** of this volume.

2.2 Permanent Site Layout

2.2.1 The permanent HPC built development and building layout, located in the north part of the HPC development site, is shown in **Figure 2.1**. The rest of the land within the HPC development site would be landscaped following completion of the construction works.

2.2.2 HPC will comprise a range of buildings as well as seabed and sub-surface structures and related facilities including:

- Two Nuclear Islands each comprising a UK EPR reactor and associated buildings.
- Two Conventional Islands, each including a Turbine Hall, located adjacent to the Nuclear Islands.
- A Cooling Water Pumphouse for each UK EPR reactor unit with related infrastructure.
- Sea bed cooling water intakes and outfall structures together with tunnels connecting these to the cooling water pumphouses and turbine halls.
- Fuel and waste management facilities, transmission infrastructure including the National Grid 400kV substation, staff facilities, administration, storage facilities and other plant.
- A Public Information Centre (PIC) to provide education and public information facilities.
- A Sea Wall incorporating a public footpath.
- Access and parking facilities for workers, visitors and deliveries for the main power station and the National Grid 400kV substation.

2.2.3 The permanent built development will be distributed over level platforms generally at 14m and 20m AOD. Elsewhere, the permanent landform will be in accordance with the topography presented in the landscape restoration proposals detailed later in this chapter. Illustrative cross-sections of the HPC development are provided in **Figures 2.2a – 2.2b.**

2.2.4 The main development platform will accommodate the Nuclear Islands, Conventional Islands, onshore cooling water infrastructure and other ancillary and storage buildings. This platform will have an elevation of 14m AOD, which will be attained above a slope behind the sea wall ranging in width from 11 to 29m along the site frontage.

2.2.5 Details on the layout and design of specific development components are provided in the sections below.

2.3 HPC Buildings and Structures

2.3.1 HPC will comprise two UK EPR reactor units each with its own reactor buildings; the dimensions of essential buildings and infrastructure are described below. Detailed plans and elevations are provided for each building in the **Application Plans**. As described in **Volume 1, Chapter 7,** although detailed permission is being sought for the majority of buildings**,** some uncertainties are likely to remain up to the point of commencing construction of individual buildings. Thus there is a necessity to allow for some flexibility in the plans and elevations.

2.3.2 The Environmental Statement (ES) has assessed HPC as detailed in the submitted drawings. These provide both detailed designs and alternative maximum and minimum parameters for some structures as shown in **Figure 2.3**. The potential need for flexibility is not anticipated to generate any major change in the characteristics of the development or to have a significant impact on any of the assessment topics. Where appropriate the technical assessments have undertaken a sensitivity analysis to demonstrate this.

2.3.3 **Table 2.1** and **Plate 2.1** provides the maximum dimensions and heights of buildings and structures, where applicable. The dimensions and heights provided are the overall external dimensions of buildings or structures. Dimensions are at ground level, where the length and width are based on the largest dimension in either direction. The height is based on the measurement from the ground level to the highest point of the building or structure. It should be noted that projections, such as heating and ventilation plant are not included.

2.3.4 A number of facilities are shared between the two UK EPR units. In the table below these are denoted “shared facilities”.

Table 2.1: Maximum Dimensions and Heights of Buildings and Structures

Building and Structures	Number	Maximum Dimensions (m)	Maximum Height (m) from the Appropriate Platform Level
Nuclear Island			
Reactor Building	One per unit	57 x 57	64
Fuel Building	One per unit	See **Plate 2.1**	36
Safeguard Building West	One per unit		38
Safeguard Building East	One per unit	See **Plate 2.1**	38
Safeguard Buildings	Two per unit		35
Nuclear Auxiliary Building	One per unit		35

Building and Structures	Number	Maximum Dimensions (m)	Maximum Height (m) from the Appropriate Platform Level
			(stack height 70m)
Access Tower	One per unit		27
Fuel Building Hall	One per unit		14
Boron Storage	One per unit		8
Radioactive Waste Storage Building (Unit 1)	Shared facility	26 x 33	17
Radioactive Waste Process Building (Unit 1)	Shared facility	37 x 39	14
Radioactive Waste Treatment Building (Unit 2)	One (Unit 2)	22 x 29	13
Hot Laundry (Unit 1)	Shared facility	39 x 19	12
Hot Workshop, Hot Warehouse, Facilities for Decontamination (Unit 1)	Shared facility	98 x 24	16
Effluent Tanks (Unit 1)	Shared facility	28 x 25	16
Emergency Diesel Generator	Two per unit	46 x 26	28
Conventional Island			
Turbine Hall	One per unit	123 x 64	46
Sky Bridges	One per unit	49 x 44	21
Non-Classified Electrical Building	One per unit	39 x 33	21
Gas Insulated Switchgear	One per unit	32 x 13	15
Main Transformer	One per unit	37 x 16	15
Unit Transformer	One pair per unit	13 x 8 (each)	12
Auxiliary Transformer	One per unit	13 x 8	12
Hydrazine and Ammonia Storage	One per unit	27 x 11	5
Auxiliary Feedwater Storage	One per unit	25 x 20	13
Operations			
Operational Service Centre	Shared facility	83 x 67	36
Cooling Water Pumphouse and Associated Buildings			
Cooling Water Pumphouse	One per unit	84 x 57	19
Forebay	One per unit	79 x 41	4
Outfall Pond (Surge Chamber)	One per unit	47 x 43	11
Filtering Debris Recovery Pit	One per unit	27 x 9	2
Fire-Fighting Water Building	One per unit	46 x 31	7
Remaining Balance of Plant and Other Plant			
Attenuation Pond	Shared facility	17 x 11	3
Demineralisation Station	Shared facility	39 x 32	14
Auxiliary Boilers	Shared facility	26 x 24	18
Hydrogen Storage	One per unit	45 x 14	4

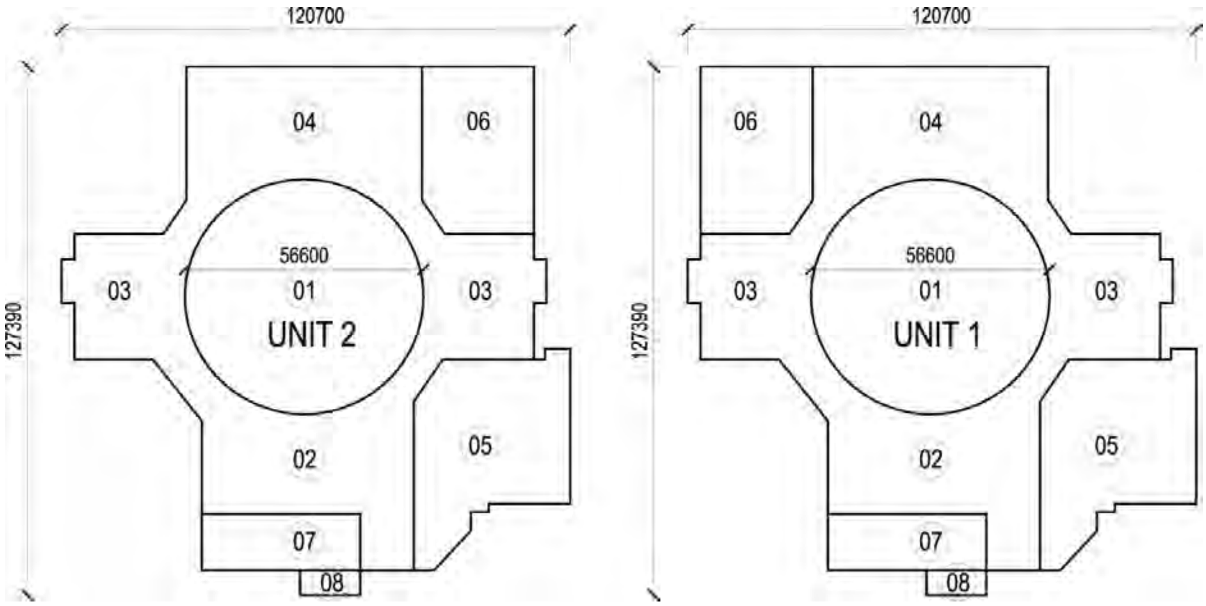
Building and Structures	Number	Maximum Dimensions (m)	Maximum Height (m) from the Appropriate Platform Level
Oxygen Storage	One per unit	14 x 4	4
Chemical Products Storage	Shared facility	30 x 26	7
Sewage Treatment Plant	Shared facility	8 x 4	3
Conventional Island Water Storage Tank (x2)	Shared facility	38 x 38	20
Nuclear Island Water Storage Tank	Shared facility	12 x 12	13
Fuel and Waste Storage			
Interim Spent Fuel Store	Shared facility	150 x 65	25 (stack height 55m)
Access Control Building	Shared facility	29 x 17	5
Intermediate Level Waste Interim Storage Facility	Shared facility	137 x 37	16 (stack height 20m)
Ancillary , Office and Storage			
Main Access Control Building	Shared facility	39 x 36	6
Entry Relay Building	Shared facility	39 x 17	6
Off-Site Vehicle Search Area	Shared facility	7 x 6	4
Auxiliary Administration Centre	Shared facility	38 x 29	15
Medical Centre	Shared facility	41 x 38	5
EDF Site Offices	Shared facility	65 x 65	10
Garage for Handling Facilities	Shared facility	56 x 23	8
Oil and Grease Storage and Oil Ancillary Building	Shared facility	38 x 29	10
AREVA Warehouse	Shared facility	80 x 44	14
Raw Water and Potable Water Supply	Shared facility	n/a	Underground
Meteorological Station	Shared facility	11 x 11	5
Outage Access Control Building	Shared facility	29 x 17	4
Contaminated Tools Storage (x2)	Shared facility	65 x 29	13
Conventional Waste Storage	Shared facility	59 x 38	7 (Hardstanding-Height of canopy)
Transit Area for Very Low Level Waste and Low Level Waste	Shared facility	45 x 23	4 (Hardstanding-fenced area)
Public and Training			
Simulator Building/Training Centre	Shared facility	99 x 40	11
Public Information Centre	Shared facility	32 x 31	19
National Grid Substation			
National Grid Substation GIS Hall and Annex	Shared facility	90 x 25	15

Building and Structures	Number	Maximum Dimensions (m)	Maximum Height (m) from the Appropriate Platform Level
Amenity Building	Shared facility	11 x 13	4
Other Site Structures			
Helipad	Shared facility	49 x 27	0 (Hardstanding)
Sea Wall (incorporating Coastal Path)	Shared facility	760 (length)	
Car Parks	Shared facility	n/a	n/a
Meteorological Station Mast	Shared facility	3 x 3	50
EDF Energy Pylons	Shared facility	Various	Various

Notes: A 'shared facility' is a building or structure shared between both UK EPR Reactor units

- *All dimensions are rounded up to the nearest metre.*
- *For precise dimensions of the proposed buildings/structures, please refer to the relevant application plans.*

Plate 2.1: Maximum Dimensions of the Reactor and Associated Buildings



2.4 Nuclear Island

2.4.1 Each of the two Nuclear Islands will comprise a reactor building surrounded by its associated safeguard buildings and fuel building. Each of the two Nuclear Islands will be shaped like a cross, with the reactor building at its centre and surrounded by the fuel building and safeguard buildings.

2.4.2 Other structures within the Nuclear Island associated with each reactor include the:

- Nuclear Auxiliary Building.
- Fuel Building Hall.
- Boron Storage.
- Hot Laundry (shared facility adjoining Unit 1).
- Hot Workshop, Hot Warehouse, Facilities for Decontamination (shared facility adjoining Unit 1).
- Effluent Tanks (shared facility adjoining Unit 1).
- Emergency Diesel Generator Buildings.
- Radioactive Waste Storage and Process Buildings (shared facility adjoining Unit 1).
- Radioactive Waste Treatment Building (Unit 2); and
- Access Tower.

2.4.2 The following sub-sections describe these structures in more detail.

a) The Reactor Building

2.4.3 There will be a reactor building housing a UK EPR reactor in the centre of each of the two Nuclear Islands. The reactor building will also contain the main components of the Nuclear Steam Supply System. The reactor building is cylindrical in shape with an ellipsoidal dome approximately 64m in height above platform level.

2.4.4 The reactor comprises a steel pressure vessel containing the nuclear fuel (reactor core) and four cooling loops, each consisting of a reactor coolant pump and a steam generator together with interconnecting pipework. One loop is connected to a pressuriser vessel.

2.4.5 Other components of the reactor buildings include:

- safety systems and equipment;
- a refuelling water storage reservoir;
- an area for the chemical and volume control system;
- a steam-generator blowdown system;
- main steam lines and main feedwater lines; and
- access to the containment inter-space.

2.4.6 **Figure 2.4** illustrates the southern elevation of the Reactor Building for Unit 2.

b) Fuel Building and Fuel Building Hall

2.4.7 Each UK EPR reactor unit will have a Fuel Building which houses a fuel storage pool for new and spent fuel and associated fuel handling equipment. Adjoining the Fuel Building is the Fuel Building Hall which will be used for the reception of new fuel and dispatch of casks containing spent fuel.

c) Safeguard Buildings

2.4.8 The major safety system consists of four sub-systems or 'trains' to provide quadruple redundancy. The purpose of the safety train is to control and remove residual heat from the reactor in the event of abnormal operation. Each train is capable of performing all of the necessary safety functions independently. There will be four safeguard buildings per UK EPR reactor unit, each with one train. The four safeguard buildings will be physically separated to prevent simultaneous common-mode failure of the trains. Access by personnel to these buildings will be strictly controlled.

d) Nuclear Auxiliary Building

2.4.9 The Nuclear Auxiliary Building will be built next to the Fuel Building for each UK EPR reactor unit. This will house the nuclear operation support systems and the maintenance areas. The main systems installed in the Nuclear Auxiliary Building are the following:

- the treatment system for primary effluents;
- the pool-water treatment system;
- the gaseous effluent treatment system;
- part of the steam generator blow-down treatment and cooling system; and
- the operational ventilation and chilled water systems of the nuclear auxiliary building.

2.4.10 All air exhausts from the radiological controlled areas are routed, collected, controlled and monitored within the Nuclear Auxiliary Building prior to release through a vent stack 70m high.

e) The Access Tower

2.4.11 The main function of the access tower on each unit is to enable controlled access to the Nuclear Island. The building will contain a number of operational and technical rooms.

f) Boron Storage

2.4.12 Each UK EPR reactor unit will have a boron preparation and storage area, located to the south of the Fuel Building. Boric acid will be stored and prepared before dosing the primary circuit water to control the reactivity of the core.

g) Radioactive Waste Storage, Process and Treatment Buildings

2.4.13 The waste buildings, collectively termed the effluent treatment building (ETB), will serve both UK EPR reactor units and will be used for the collection, storage, treatment and disposal of liquid and solid radioactive waste. The ETB is adjacent to the Nuclear Auxiliary Building for Unit 1. A waste treatment facility is provided at Unit 2.

2.4.14 The waste buildings, which are made of reinforced concrete, will be divided into two sections; one for the storage of solid waste and the other for liquid effluent and solid waste treatment.

h) Hot Laundry

2.4.15 The Hot Laundry is used to launder radiologically contaminated garments or potentially contaminated garments; that is the protective clothing worn by employees when working in contamination controlled areas.

i) Hot Workshop, Hot Warehouse, Facilities for Decontamination

2.4.16 The Hot Workshop, Hot Warehouse and Decontamination Facilities are encompassed in a single structure adjacent to the Hot Laundry.

2.4.17 The Hot Workshop is the facility for engineering work on radiologically activated or contaminated plant components such as valves, pipes and pumps.

2.4.18 The Hot Warehouse is designed to store activated or contaminated tools and components such as the multi-stud tensioner or spare reactor coolant pump motors.

2.4.19 The Decontamination Facility is designed to reduce or remove radioactive contamination of tools, components or wastes. Decontamination of equipment enables reuse of tools and minimisation of the volume of radioactive materials requiring disposal.

j) Effluent Tanks

2.4.20 The Effluent Tanks for the various liquid effluent systems adjoin the Unit 1 Waste Processing Building. Liquid effluent undergoes different treatment depending on its source; primary effluent treatment, spent effluent treatment or turbine hall drainage water treatment. The different types of effluent are sent to three specific types of tank for temporary storage and checking before discharge.

k) Emergency Diesel Generator Buildings

2.4.21 There will be two Emergency Diesel Generator buildings (EDGs) associated with each reactor. Each diesel building houses two main diesel generators and a station black out diesel generator. Each main diesel generator is dedicated to one of the safeguard trains in the event of a loss of off-site electrical power. The purpose of the blackout diesel generator is to provide a short duration back up to the main diesel generators. EDGs are located on either side of the reactor structures.

2.4.22 **Figure 2.5** illustrates the southern elevation of an Emergency Diesel Generator building.

2.5 Conventional Island

2.5.1 The Conventional Islands for each UK EPR reactor unit will comprise a Turbine Hall, Non-Classified Electrical Building, power transmission platform, Hydrazine and Ammonia Storage, and Auxiliary Feedwater Storage, as described below.

a) Turbine Hall

2.5.2 Each Turbine Hall is located adjacent to the Reactor Building for each UK EPR reactor unit, and contains components which form part of the steam-condensate-feedwater cycle, including the turbine and generator set (turbo-generator) and the main condensers.

2.5.3 **Figures 2.6** and **2.7** illustrate the east and west elevations of the turbine hall respectively.

b) Non-classified Electrical Building

2.5.4 The Conventional Island's electrical plant building (one per unit) houses electrical distribution panels, which provide the permanent power supplies to the Nuclear Island and the Conventional Island systems, together with the instrumentation and control system which monitors and manages these systems.

c) Power Transmission Platform

2.5.5 The function of the power transmission platform (one per unit) is to process and transmit the electrical power generated to the National Grid Substation. The power transmission platform is located adjacent to the Turbine Hall and houses the following key plant items:

- gas insulated switchgear.
- a main transformer;
- a unit transformer; and
- an auxiliary transformer;

2.5.6 Electricity generated from the turbo-generator is stepped up to 400kV via the main generator transformer and this power is then transferred to the National Grid 400kV substation via overhead lines and towers (pylons).

d) Hydrazine and Ammonia Storage

2.5.7 Bulk storage of hydrazine and ammonia is provided for adding to the secondary circuit water to achieve the correct pH and oxygen level to minimise corrosion.

e) Auxiliary Feedwater Storage

2.5.8 Additional feedwater storage tanks and an associated process building are provided to accommodate changes in the secondary circuit water inventory, particularly during start-up and shut-down of the turbine.

2.6 Cooling Water Pumphouse and Associated Buildings

2.6.1 The key components of the open circuit cooling water infrastructure are illustrated in **Figure 2.8** and described in more detail below.

a) Cooling Water Intake Tunnels, Intake Headworks and Associated Fish Deterrent System

2.6.2 Seawater for cooling will be abstracted from Bridgwater Bay via a series of seabed intake structures and tunnels. Each UK EPR reactor unit will have a single dedicated intake tunnel with two dedicated seabed intakes. At either end of the tunnels there will be vertical shafts that provide connection on the landward side to the onshore cooling water infrastructure and at the seaward end to the seawater intake heads. The tunnels extend approximately 3.5km and 3.4km from the foreshore high water mark for the Unit 1 and Unit 2 intakes respectively (see **Figure 2.9**) and at a depth of approximately 20m below the seabed. At their seaward extent, the two intake tunnels will be some 480m apart. The two seabed intake heads associated with each intake tunnel will be separated by approximately 200m.

2.6.3 Each intake head will comprise a main rectangular structure with a length of 35.5m, a width of 10m and a depth of 2.8m. Tapered sections (4.2m long) will be provided at either end of the rectangular structure to deflect tidal flows (see **Figures 2.10** and **2.11**).

b) Acoustic Fish Deterrence System

2.6.4 An Acoustic Fish Deterrent (AFD) system will be associated with each intake head. The AFD acts as a behavioural deterrent which would provoke an avoidance reaction amongst certain groups of fish. The AFD will compromise two modular sound projector arrays, one at each end of the structure. A series of amplifiers with associated sound projectors will be built into each module. Each module will incorporate a number of sound projectors. Piles will provide a means both of securing the modules in the appropriate positions and depths at each end of the intakes, and for their ready removal and replacement. The projectors will be positioned at the same level as the mid point of the intake head (see **Figure 2.12**).

2.6.5 The AFD modules will be streamlined and will also incorporate cowled tidal turbines that will provide power for the sound projectors.

c) Forebay

2.6.6 There will be one Forebay for each UK EPR reactor unit. The forebays will receive water from the intake tunnels and will be located to the north of the cooling water pumphouses. Each Forebay will have a depth of 29m. The front of each Forebay will be formed by a reinforced concrete wall. A single cooling water intake tunnel will feed directly into each open Forebay. Two underground tunnels of 2.5m diameter will run inland of the sea wall parallel with the shoreline and link the forebays of the two units; these are referred to as 'forebay link tunnels' (see **Figure 2.8**).

d) Cooling Water Pumphouse

2.6.7 There will be two cooling water pumphouses (one for each UK EPR reactor unit) that will draw water from the forebays. The cooling water pumphouses will contain equipment supplying seawater as coolant for:

- the Nuclear and Conventional Islands' auxiliary cooling water systems; and
- the condenser cooling system that cools the turbine exhaust steam and condenses it to liquid water for reuse as feed water within the secondary cycle.

2.6.8 Each Cooling Water Pumphouse will be divided into four distinct trains or channels fed with water from the forebay (detailed below). Each Pumphouse will thus be served by a separate sub-seabed cooling water intake tunnel linking it to two off-shore seabed intake structures.

2.6.9 Each Pumphouse will incorporate screening systems (including drumscreens and band screens) specifically designed in order to prevent the blockage of key elements of plant further downstream, primarily the heat exchangers and main condensers.

2.6.10 **Figure 2.13** illustrates the north and south elevations of the cooling water pumphouse, forebay, outfall pond and filtering debris recovery pit.

i. Cooling Water Supply Channels

2.6.11 Each Cooling Water Pumphouse has four distinct trains:

- Two central trains each separated into four waterways (narrow passages), which then recombine before feeding to the two main drum screens, which will primarily supply the essential service-water systems and the condenser cooling water.
- Two lateral trains each including a single waterway, each fitted with a band screen, which will supply the essential service-water systems and the conventional auxiliary cooling water systems.

2.6.12 Each waterway, leading both to the drum screens and band screens, will incorporate a fixed vertical coarse screen with spacings of 50mm in order to block larger elements of debris. Each will be maintained by a timer/pressure differential-driven trash rake. Sluice gates within the system may be closed within these waterways in order to isolate downstream elements of the cooling water system for maintenance purposes.

ii. Drum Screens

2.6.13 Each of the two cooling water pumphouses will have a rotating drum screen to remove finer debris from a flow of approximately 30m^3/sec prior to passage through the main cooling water pumps and the fine bore condenser and other heat exchanger tubing that follows.

2.6.14 Each drum screen will be made up of a horizontal axis drum whose outer circumference will be made up of panels of a smooth ('fish friendly') fine (<6mm) mesh. Aligned with the inner circumference of each drum screen are elevator ledges or 'buckets', which lift debris and marine organisms including fish clear of the seawater surface. Continuous wash-water sprays will then flush the collected material and organisms to collection troughs from which they will then be flushed to a gully. In normal operation the drum screens will rotate at a slow speed but if there is any indication of blockage both the rate of rotation and the flow rate of wash-water will be increased.

iii. Band Screens

2.6.15 Each of the two pumping stations will also have a rotating band screen to remove finer debris.

2.6.16 The screen is made up of a continuous belt of linked mesh plates which are rotated around two horizontal rollers, one positioned at the foot of the waterway and one above, and similarly aligned with a catch bucket and gully.

e) Filtering Debris Recovery Pit

2.6.17 A plant for managing screen debris is positioned next to each Cooling Water Pumphouse. It consists of a pre-discharge section and a pre-discharge basin. The pre-discharge section involves the continuation of the series of washwater gullies that will run from the drum and band screens to collect the fish and other marine organisms directed from the screens, together with materials from the raking screens.

2.6.18 The bottom of the basin will be at around 7m AOD in order to maintain a minimum water depth of 0.5m within the structure. The fall height of water from the channels into the basin will be less than 1m. The basin will be designed so as to channel fish to the base of an Archimedean screw pump system as illustrated in **Figure 2.14**.

2.6.19 A culvert will transfer the returning volume from the discharge basin at the top of the Archimedean screw pumps to a centrally located chamber prior to discharge to the dedicated FRR return tunnel.

f) Fish Recovery and Return System

2.6.20 A Fish Recovery and Return (FRR) system will be provided as a component of the open circuit cooling water infrastructure to recover and return fish and crustaceans drawn in with the cooling water and caught on the screens.

2.6.21 The general principles applied to the design of the system will be in accordance with general guidance published by the Environment Agency (Ref. 2.1 and 2.2) The overall arrangement of the FRR system is illustrated in the sectional drawing provided in **Figure 2.15**.

g) Return Tunnel

2.6.22 The return tunnel will be approximately 500m long from the shore. The tunnel will extend to a location which ensures that the outfall remains underwater at all times i.e. where the seabed is below the level of the Lowest Astronomical Tide of -6.1m OD. The tunnel will have an internal diameter of approximately 0.8m. Any bends in the tunnel will have a radius of 3m or greater.

h) Cooling Water Outfalls and Associated Tunnels

2.6.23 The single outfall tunnel associated with HPC will have a diameter of 7m and will be located approximately 1.8km off-shore at a depth of approximately 10m below OD. See **Figure 2.9.** The headworks will be aligned at 75 m intervals.

i) Fire-fighting Water Building

2.6.24 The fire-fighting water buildings, one for each unit, provide the fire fighting water supply, and also houses an emergency water provision for Nuclear Island facilities' cooling.

2.7 Permanent Drainage System

2.7.1 HPC would be provided with a number of permanent drainage systems comprising:

- surface water drainage;
- plant drainage;
- foul drainage; and
- groundwater drainage.

2.7.2 Surface water drainage would be removed by two separate systems, one dedicated to removal of roof water which is of high quality and the other to remove runoff from roads and paved areas. Surface water and plant drainage systems would be routed to the attenuation pond for treatment as required. Waste water (black and grey water) drainage would be removed by a foul water drainage system for treatment at a sewage treatment plant.

2.7.3 There will be penetrations in the Sea Wall to the foreshore to discharge the cooling water forebay overflow.

2.7.4 Groundwater levels would be controlled through a passive groundwater collection gallery that would extend around the southern and western boundary of the main development platform. The gallery would collect groundwater at a level of about 8m AOD, i.e. 6m below the surface of the main development platform and route it to the forebay prior to discharge with the cooling water.

2.7.5 Further details on drainage are provided in the **Hinkley Point C Site Drainage Strategy**. See **Appendix 2A**)

2.8 Remaining Balance of Plant and Other Plant

a) Attenuation Pond

2.8.1 The attenuation pond, located between the two pumphouses, collects and processes the waste water on the permanent development site and is shared between the two units. This will include a containment tank, and a settler/oil separator. This pond will ensure that any polluted effluent, including that generated from accidental spillages, is not discharged to the environment without prior treatment. The containment tank will permit time for analysis and treatment of the effluent before discharge. The function of the settler/oil separator will be to isolate and separate any oil from oil-contaminated water, before discharging only treated water to the effluent water discharge system.

b) Demineralisation Station

2.8.2 A demineralisation station will be provided on site to process raw water delivered via the local water company mains. This demineralised water will be used in the UK EPR reactor for cooling purposes.

c) Auxiliary Boilers

2.8.3 The Auxiliary Boilers will provide steam for heating the deaerator and turbine gland sealing for startup for both UK EPR reactor units and would be located in a single building adjacent to Unit 1.

d) Hydrogen, Oxygen and Chemical Products Storage

2.8.4 Within the site there will be gas storage compounds for hydrogen, nitrogen, oxygen and other process gases, and a chemical products storage building. These will all be separate from the Nuclear and Conventional Islands.

e) Sewage Treatment Plant

2.8.5 On the site there will be a facility to process domestic effluents. The Sewage Treatment Plant is located near to the Cooling Water Pumphouse of Unit 1.

f) Nuclear Island Water Storage Tank and Conventional Island Water Storage Tanks

2.8.6 The Nuclear Island Water storage tank stores treated water which is required for use in the Nuclear Island. There are two Conventional Island water storage tanks, which house treated water used in the steam cycle which power the turbines.

2.9 Fuel and Waste Storage

a) Interim Spent Fuel Store and Access Control Building

2.9.1 The Interim Spent Fuel Store (ISFS) is a facility that will provide long term safe and secure underwater storage for irradiated (spent) fuel assemblies that have been transferred from the Fuel Building until they are removed from site. The ISFS will be designed for a life of up to at least 100 years and the design will be such that this lifetime could be extended through fabric and plant refurbishment, if required. The building contains facilities for receipt, storage and retrieval of spent fuel, together with water supply and clean-up systems and heat removal systems.

2.9.2 The location of the ISFS will be adjacent to the Intermediate Level Waste Interim Storage Facility (ILW) building in order to facilitate security zoning during the station operation and after station decommissioning.

2.9.3 The ISFS and associated Access Control Building are at an early stage of design and the appearance and layout details are not fixed. Parameter plans have been provided for the ISFS and associated Access Control Building which indicate the minimum and maximum dimensions for these structures.

2.9.4 The ISFS envelope consists of the Interim Spent Fuel Store itself, protection shell, a gaseous discharge stack (footprint within envelope) and ancillary plant including air-water heat exchangers and a potential requirement for diesel unit(s), although it remains to be determined whether the ISFS will require dedicated diesel units.

However, provision has been made for this in the design. The ISFS building would be a strong building that protects it from external hazards (for example, aircraft crash) and this is contained within the envelope. The stack is defined as 55m in height based on dispersion modelling carried out to date. The final height will be determined following detailed dispersion modelling but it is not expected that it will be above 55m. The requirements for the ISFS, and similarly the Access Control Building, will be contained within the parameters provided.

2.9.5 The Access Control Building is sized based on the requirement to contain the security and access functions and is similar in size to the Outage Access Control Building.

b) Intermediate Level Waste Interim Storage Facility (ILWISF)

2.9.6 ILW generated during the operational phase will be placed in the ILWISF which will be designed for a life of about 100 years. Further details on the management of spent fuel and radioactive waste are provided in **Chapter 7** of this volume.

2.10 Remaining Buildings on Site

2.10.1 There are a number of ancillary buildings located across HPC required for security s, training, office and storage purposes. These are summarised in **Table 2.2** below.

Table 2.2: Summary of Remaining Buildings

Building Type	Building(s)	Description
Operations	Operational Service Centre	Multi-purpose building that is the operational service centre for the power station. It accommodates access areas to the Nuclear Island, storage areas, workshops and storerooms, laboratories, offices, a data centre, and associated support and welfare facilities, including the staff restaurant.
Ancillary, Office and Storage	Main Access Control Building	Primary access and control of daily entrance and exit of personnel and visitors, and vehicles on-site.
	Entry Relay Store	Facility for receiving small packages or deliveries. The building is positioned near the site entrance and straddles the perimeter fence so as to enable deliveries to be made without entering the power station site.
	Off-Site Vehicle Search Area	Building will be used to control the movement of all vehicles on Wick Moor Drove approaching or leaving the site.
	Auxiliary Administration Centre	Multifunctional building that includes ancillary facilities for operational staff and administration.
	Medical Centre	Building to be used to monitor the health and well-being of the workforce during construction and the operational lifespan of the nuclear power station.
	EDF Site Offices	Office facilities for site personnel during the construction period and continued usage during operation, including during outage periods. The EDF Site Offices are located to allow easy access to and from the site.
	Garage for Handling Facilities	Building used for the garaging of special handling equipment and vehicles throughout the operational

Building Type	Building(s)	Description
		period.
Ancillary, Office and Storage	Oil and Grease Storage and Oil Ancillary Building	Building for the storage of oil and grease during operation. The building will also accommodate the vehicles for the transfer of the oil to the required locations.
	AREVA Warehouse	Warehouse to be used by AREVA during the construction phase. After the construction phase, it is proposed to be retained for office, storage and workshop facilities.
	Raw Water and Potable Water Supply	Facility which provides a balancing (buffer) tank for the raw water supply from the local water company and will also supply raw water to downstream users.
	Meteorological station	Facility for housing environmental monitoring and recording equipment.
	Outage Access Control Building	A security facility for access to and from the site during construction and as a secondary access point during outages.
	Contaminated Tools Storage (x2)	Store for contaminated tools.
	Conventional Waste Storage	Store for conventional waste.
	Transit Area for Very Low Level Waste and Low Level Waste	Buffer stores for sorting and interim storage before collection and removal off-site.
Public and Training	Simulator Building/ Training Centre	An ancillary building which provides specialist training facilities.
	Public Information Centre (PIC)	Facility to help inform the general public and other interested parties about the nuclear process of producing electricity and its infrastructure. The PIC is located outside the perimeter fence, but inside the site boundary.
National Grid Substation	National Grid 400kV Substation	Facility to connect the nuclear power station to the national grid high voltage transmission system. Further details provided in **Section 2.13** below.
Other Site Structures	Helipad	Helipad for operational safety or security usage.
	Sea Wall	Incorporating the coastal footpath, the sea wall extends the length of the permanent development site. Further details provided in **Section 2.14** below.
	Car parking	Facilities for site personnel and visitors. Further details provided in **Section 2.15** below.
	Meteorological Station Mast	A meteorological instrumentation mast is provided to the north of the meteorological station to carry instruments to measure environmental conditions such as wind speed, direction and air temperature.
	EDF Pylons	Pylons are provided on-site to transport the power from the generators via the power transmission platform and along lines to the National Grid Substation.

2.10.2 In addition to these structures, there is a network of underground service tunnels across the site, which enable cabling, pipework and other services between buildings and plant and which also enable plant and personnel access. Maintenance access to these service tunnels would be obtained via the above ground surface Service Access Buildings.

2.11 Fencing

2.11.1 A perimeter fence will enclose the majority of the permanent development site as illustrated in **Figure 2.1**. This excludes the car parks, the National Grid substation, the Public Information Centre (PIC), and the Simulator Building/Training Centre. Additional High Security Area (HSA) fencing will be provided within the permanent development area around the Nuclear Island and ISFS facility and Access Control Building. A separate fence is provided for the National Grid substation. An illustrative fencing plan is shown in **Figure 2.16**. [

2.12 Lighting

2.12.1 External lighting will be provided for the permanent development site with lighting levels generally at the minimum necessary to enable safe operation. Lighting levels will vary from 5 lux for roads and paths to task lighting of up to 100 lux for limited areas. The security fence areas will be lit to the required security standards. Further detail is provided in the Operational Lighting Strategy (see **Appendix 2B)**.

2.13 Transmission Infrastructure

2.13.1 A new National Grid 400,000 Volt (400kV) Gas Insulated Switchgear (GIS) substation is required to connect the Hinkley Point C power station to the national grid high voltage transmission system. The substation will be installed to the south-east of the permanent development site. As illustrated in **Figures 2.17** and **2.18** this substation compound will comprise:

- GIS switch hall with an annex.
- Amenity building.
- Earth store.
- Workshop.
- Diesel generator building.

2.13.2 An internal tarmac roadway will extend around the periphery of the compound along the eastern, northern and western sides to facilitate vehicular access for delivery, removal and maintenance of plant and equipment. Car parking within the compound will be provided in designated spaces for six vehicles.

2.13.3 The substation will normally be unmanned, being controlled and monitored remotely by National Grid from their Electricity National Control Centre, other than when plant maintenance is undertaken.

a) Connection to the National Grid High Voltage Transmission System

2.13.4 Four overhead line gantries will be sited along the southern side of the substation compound to facilitate the transition from overhead line to gas insulated busbar and subsequent through wall entry into the switchgear building as indicated on **Figures 2.1** and **2.18**. These four line entries will form connections to the main interconnected transmission system at Taunton and Bridgwater-Melksham. Two further overhead line gantries will be sited along the eastern boundary of the substation compound and will form the overhead line interconnection with the existing Hinkley Point B 400kV Air Insulated Switchgear substation.

2.13.5 All proposed National Grid overhead lines and towers, including the terminal towers and substation connecting downleads, will be subject to a separate DCO application by National Grid following public consultation.

2.13.6 On the northern side of the compound will be two overhead line landing gantries to transfer EDF Energy overhead line connections between the power transmission platform and the substation and two EDF Energy underground cable circuits to connect the Auxiliary Transformers to the substation.

2.14 Sea Wall

2.14.1 The Sea Wall will be approximately 760m in length (see **Figure 2.19**) and will comprise:

- In-situ cast, non-reinforced, gravity mass concrete wall orientated along the alignment of the existing cliffs in order to protect the proposed new nuclear development site from coastal erosion.
- A pre-cast reinforced wave return wall on top of the mass concrete wall.
- Rock protection at the foot of the sea wall in order to absorb wave impact during storm events and thus protect the foundation of that structure from scour and consequent beach down-cutting.
- 50m long secant piled return walls at the eastern and western extent of the wall;
- Two stepped pedestrian access points to the foreshore.
- A maintenance vehicle access point.
- A parapet located at the crest of the sea wall to provide a further increment of protection against wave overtopping to the coastal footpath lying immediately behind. This will include a handrail or other similar safety-related feature.

a) Integration with Existing Sea Wall and Topography

2.14.2 As illustrated in **Figure 2.20**, the Sea Wall will have a crest height of 13.5m AOD. The ground level behind the wall will range from 12.3 to 12.4m AOD compared with the main power station development platform which will be 14m AOD.

2.14.3 At its western and eastern ends, the wall will turn inland and run for approximately 50m at the design crest level of 13.5m AOD. The retain sections of wall will comprise reinforced concrete piles constructed to form continuous walls.

b) Toe Scour Protection

2.14.4 Scour protection will be needed at the toe of the Sea Wall in order to absorb the impact of storm waves. The design in **Figure 2.20** illustrates a typical rock toe cross-section. This protection will be provided in the form of two layers of rock armour that will rest within a narrow excavated area of the foreshore immediately in front of the sea wall. These two layers will have a total thickness of approximately 2.5m along the 760m length of the wall. The armour will also be extended for a distance of 50m past the western end of the wall to provide increased erosion protection to the base of the natural cliff in that area. The armour will comprise rocks with a nominal diameter of 1.35m.

c) Maintenance Vehicle Access Ramp

2.14.5 At the western end of the Sea Wall, an access ramp will be provided for maintenance vehicle access to the foreshore (see **Figure 2.21**).

d) Pedestrian Access

2.14.6 Although there is no formal public access to the foreshore from the footpath along the cliff at present, the design of the HPC Sea Wall will allow for safe access once the structure is complete. As illustrated in **Figure 2.22**, steps will be provided at locations 250m and 510m from the eastern end of the wall. They will be accessed at these points via breaks in the crest of the wall to ensure that the upper step platforms (set at 12.3m AOD) are level with the coastal footpath (Public Right of Way WL 23/95).

e) Drainage

2.14.7 Drainage of the backfill will be achieved by the provision of 150mm diameter drainage pipes extending through the wall at spacings of one hole per 10 linear metres. The holes will have an invert level of between 4.5 to 5.5m AOD at the rear face of the wall and the outlets at the front of the wall will be 0.5m lower than the landward side. The pipes will ensure that groundwater does not exceed the 6m AOD sea wall design level.

2.14.8 To the rear of the pipes there will be a 1.5m deep imported fill drainage layer separated from the permeable backfill above by a geotextile layer which will prevent the washing in of fine material that could otherwise cause blockage. Both ends of the drainage pipes will be fitted with a metal grille to prevent blocking by debris.

2.15 Access and Parking

a) Access Arrangements

i. Site Access

2.15.1 The existing access road into the Hinkley Point Power Station Complex will also be the main access for the proposed development. As illustrated in **Figure 2.1** two roundabouts are proposed along this route. The first to the east of the HPC permanent development site will provide access to site personnel and deliveries. The second, to the south-east of the site, will provide access to the southern part of the HPC development site during the construction phase, and during the operational phase will provide visitor access to the Public Information Centre (PIC) and Simulator Building/Training Centre (STC) and as an alternative means of access to HPC.

ii. Emergency Access Road and Junction onto Existing Highway

2.15.2 In addition, it is proposed to construct an emergency access road from the south of the HPC development site as an alternative means of accessing HPC. This is only required for use in exceptional circumstances such as for the emergency services to respond to an incident at the power station. It is not intended to be used during the construction period.

2.15.3 The design of the road will have a load capacity sufficient for the largest/heaviest emergency vehicles and will have sufficient passing places to allow incoming and outgoing emergency vehicles to pass. The roadway will be of low-maintenance design, suitable for occasional use and compatible with the proposed landscaping of the surrounding area. There is no requirement for kerbs, footpaths or lighting along the road, but the design will provide adequate indication of the edges of the road and the location of passing places. The elevation of the road will be no less than 10m AOD and sufficient land drainage shall be provided to preclude the possibility of flooding making the road impassable.

2.15.4 There will be locked gates at the ends of the access road where it joins roads open to general use, to prevent unauthorised access of motor vehicles. Separate provision is made for pedestrian access.

iii. Bum Brook Bridge

2.15.5 Where the emergency access road crosses Bum Brook, a bridge will be provided sufficient to allow the largest/heaviest emergency vehicle to cross. The design of the bridge, as illustrated in **Figure 2.23**, would present minimal resistance to floodwater flow in order to avoid exacerbating the flooding potential of Bum Brook.

iv. Internal Road Layout

2.15.6 The main road access within the HPC site is provided by a ring road around the major buildings (the main circulatory road). This would be supplemented by additional roads within the power station site to service the ancillary buildings and secondary roads for vehicle access to buildings, as necessary.

v. Car Parking

2.15.7 A car park for operational staff would be located to the south-east of the HPC site, adjacent to the substation. This would comprise 505 vehicle parking spaces for operational staff and staff from the existing Hinkley point Power Station Complex.

2.15.8 In addition, a second permanent car park would be located to south of the site (south of the PIC and STC) and would comprise a total of 508 parking spaces for additional workers who would be required during the planned ‘outages’ (i.e. maintenance periods), and car and coach parking for visitors to the PIC and the Simulator Building/Training Centre.

2.15.9 A further smaller car park, comprising 180 spaces, will be provided to the east of the site to replace the existing Hinkley Point Power Station Complex overflow car park. Disabled parking will be included within the car parking provision.

2.16 Public Rights of Way and Bridleways

2.16.1 The restored landscape has been designed to provide a network of public rights of way (PRoW) and permissive paths to link with the surrounding network.

2.16.2 Green Lane would be stopped up during construction for safety reasons. At the completion of construction, the section of Green Lane that crosses the HPC development site would be upgraded to a bridleway. The coastal footpath would be closed for a maximum of three years during construction. The coastal footpath adjacent to Hinkley Point C will be incorporated into the Sea Wall. A new permissive footpath would be created along Bum Brook during construction to provide access for streamside walks. This would be retained once the station becomes operational.

2.16.3 All footpaths will be well managed, kept clear of vegetation and clearly signposted. The proposals for the PRoW and permissive paths consider the needs of less able people. Self-closing bridle gates are proposed rather than stiles, to avoid creating barriers.

2.17 Landscape Proposals

2.17.1 When the construction of HPC permanent development is complete, the wider HPC development site would no longer be required for construction purposes. The landscape proposals for this wider site are presented in **Figure 2.24** and summarised below.

a) Land Form

2.17.2 The landscape scheme would build up existing ridges and valleys to a maximum height of 35m AOD, have smooth transitions at the edges, and use characteristic shapes and gradients typical of the local landscape character. The landform would extend around the HPC permanent development site.

b) Landscaping Plan

2.17.3 The landscaping plan for the HPC development site would comprise:

- Retention of the majority of the Green Lane ridge and hedgerows, together with the majority of site boundary hedgerows.
- The landscape would be structured with an angular field pattern defined by hedgerow field boundaries. The pattern would be based on existing field patterns adapted to site requirements, linking to the surrounding hedgerow network. Additional hedgerows would be added to replace some of those lost due to changes in agricultural practices.
- Three extensive woodlands – Haysgrove Brake on the coastal slopes, and Bishops Wood and Shurton Wood on the inland ridge – would be arranged within the angular field boundary pattern, and would represent a substantial increase in extent of woodland on the site.
- Extensive wildflower meadows would include south facing calcareous grassland to the south of Green Lane, lowland meadows and wet meadows in Holford Valley and along Bum Brook.
- Five wildlife friendly ponds with marginal planting would increase wetland on site.
- Areas of coastal scrub on the coastal slopes and hedgerow/scrub woodland edges inland would provide an increase in this habitat.
- A wide palette of native or naturalised plant species. **Table 2.3** provides a summary of proposed land uses and habitat types.

Table 2.3: Summary of Proposed Land Uses and Habitat Types

Areas	Existing	At Restoration
Broad-leaved woodland	3.5 ha	39.7 ha
Plantation woodland	3.5 ha	n/a
Scrub (including scrub/hedges)	1.1 ha	0.9 ha
Calcareous Grassland (*including Bishop's Wood)	*3.5 ha	17.7 ha
Improved Grassland	30.6 ha	n/a
Species-poor semi-improved grassland	16.1 ha	n/a
Semi-improved grassland/ Species rich hay meadow	n/a	30.9 ha
Arable (**Farmland Birds Annual Cover Crop)	97.6 ha	**3.8 ha
Wetland (including ponds)	<0.01 ha	0.43 ha
Linear Features		
Native Species-rich Hedgerow	7.74 km	13.10 km
Species-poor Hedgerow	3.40 km	n/a
Watercourses (excluding Bum Brook and including Holford Valley ditches)	2.02 km	1.2 km

c) Holford Stream Culvert

2.17.4 The Holford Stream culvert would be retained after the construction phase to allow for excess material from the ground terracing and construction phase to be retained on-site and used within the landscaping area to the west of the permanent development site.

2.18 Off-site Highway Improvements

2.18.1 A range of improvements will be implemented across the highway network which may be influenced by construction traffic related to the HPC Project, as illustrated in **Figure 2.25**. These improvements will be permanent, that is, they will not be decommissioned and removed following completion of construction of HPC. All improvements will generally be of a limited spatial scale and the majority would be carried out within the existing highway boundary.

2.18.2 A physical description of each of the highway improvements proposed is provided below. The justification for each of the improvements is set out in the **Transport Assessment**.

2.18.3 The improvements are of two principal types, including:

- modifications to existing road alignments or junction/roundabout arrangements; and
- enhanced safety measures.

2.18.4 Details of the individual works elements are presented in **Figures 2.26 – 2.35** and described in more detail below.

a) A38 Bristol Road/The Drove Junction, Bridgwater

2.18.5 As illustrated in **Figure 2.26** the proposed works at the A38 Bristol Road/The Drove junction comprise a very small increase in the width of the highway to improve the operation of the junction, through increasing the width of the right turn lane from Bristol Road into the Drove and to reduce queuing.

b) A39 Broadway/A38 Taunton Road Junction, Bridgwater

2.18.6 As illustrated in **Figure 2.27** there would be signal improvements at the A39 Broadway/A38 Taunton Road junction, which would include very minor works including the modification and possible replacement of the traffic signals and their associated control equipment, to improve the operation of the junction and reduce queuing.

2.18.7 These works would also include improvements to pedestrian facilities at the junction of the A39 Broadway and the A38 Taunton Road to the north-east of the existing Morrisons store. These works would comprise:

- various new tactile paving;
- minor carriageway realignment to the southern, western and eastern junction approaches;
- minor curb realignment; and
- minor changes to pedestrian islands.

c) A38 Bristol Road/Wylds Road Junction, Bridgwater

2.18.8 As illustrated in **Figure 2.28**, the proposed works at the A38 Bristol Road/Wylds Road junction comprise an increase in the width of the carriageway to increase the width of the right turn lane and provide for thee lanes, each 3.5m wide. The works also include an improvement to cycle routes along Bristol Road.

d) Wylds Road/The Drove Junction, Bridgwater

2.18.9 As illustrated in **Figure 2.29**, the proposed works at the Wylds Road/The Drove junction relate to various improvements to improve the operation of this junction and would comprise:

- provision of a left-turn slip road from Western Way into Wylds Road;
- new tactile paving; and
- realignment of existing pedestrian islands.

e) A39 New Road/B3339 Sandford Hill Roundabout

2.18.10 As illustrated in **Figure 2.30**, these proposals comprise a new four-arm roundabout at the junction of Quantock Road, Charlynch Lane, Sandford Hill and New Road, approximately 1km to the south-east of Cannington and would comprise:

- minor realignment of existing carriageway;
- provision of new four-arm roundabout;

- Some vegetation clearance to south west of Sandford Hill to achieve satisfactory visibility splays;
- provision of new signage and road markings;
- provision of new street lighting; and
- surface to be tarmacked with new kerbing.

f) M5 Junction 23 Roundabout

2.18.11 As illustrated in **Figure 2.31**, the M5 Junction 23 roundabout proposals relate to minor physical works required to facilitate partial signalisation of the junction. The proposals would be entirely within the existing carriageway and would comprise:

- minor carriageway widening;
- installation of traffic signals including signal control loops in approach carriageways;
- application of anti-skid coatings, road markings and additional signage; and
- provision of new street lighting.

2.18.12 These works also include minor improvements to the lane markings at Dunball Roundabout which will improve links to J23 of the M5, although these do not comprise physical works and therefore are not included as part of the DCO application. They have however been assumed to be part of the package of highway improvements for the purposes of the **Transport Assessment**.

g) Washford Cross Roundabout

2.18.13 As illustrated in **Figure 2.32**, the proposals provide for a new, four-arm roundabout at the existing junction of the B3190 and A39, approximately 1.5km to the west of Williton. These proposals would comprise:

- realignment of existing carriageway and creation of a new, four-arm roundabout;
- new full-depth carriageway constructed off the line of the existing road;
- existing carriageway to be broken out and area grassed or landscaped at eastern approach;
- existing carriageway at northern, southern and western approaches to be resurfaced;
- clearance of existing vegetation and removal of hedgerows;
- extension of field access to new boundary at northern approach;
- provision of new signage and road markings; and
- provision of new street lighting.

h) Claylands Corner Junction

2.18.14 As illustrated in **Figure 2.33**, there would be minor junction realignment works at Claylands Corner, approximately 500m east of Hillside Farm and 2km to the east of Stogursey. The works would comprise:

- minor widening at eastern edge of carriageway opposite junction;
- relocation of existing give-way line, approximately 2m to east;
- minor relocation of kerb line to western edge of carriageway by approximately 1m;
- widened carriageway strip to be finished in tarmac to match existing;
- finish with new edging strip; and
- provision of various new signage.

i) C182 Farringdon Hill Lane, Horse Crossing

2.18.15 As illustrated in **Figure 2.34**, there is a proposal for a new horse crossing at the junction of the C182 and Farringdon Hill Lane, to the east of Shurton, approximately 1.5km south of the HPC development site. The proposals would comprise the following works:

- existing trees and vegetation to be cleared to accommodate horse holding area;
- existing surfacing material to be removed within holding area and replaced with hard surfacing;
- push buttons to activate equestrian crossing warning sign to be located 10m back from edge of C182 to north and south;
- equestrian crossing warning signs adjacent to each side of carriageway on C182, before approach to horse holding area; and
- hedgerow to be removed or cut back along C182 to achieve necessary visibility splays.

j) Cannington Traffic Calming Measures

2.18.16 As illustrated in **Figure 2.35**, there around be improvements to pedestrian facilities and minor physical works to implement highway safety improvements, including a 20mph speed restriction, within the existing highway in Cannington.

2.18.17 The proposals would comprise the following works:

- a new footway to the northern edge of High Street, opposite Clifford Park;
- provision of skid-resistant surfacing;
- revised parking and waiting restrictions;
- a new puffin crossing at High Street;
- provision of tactile paving and widening of existing uncontrolled crossing at junction of Church Street and High Street;
- new speed restriction signs enforcing existing speed restrictions;
- new zebra crossing on Rodway before junction with Toll House Road; and
- tactile paving at junction of Rodway and Toll House Road.

2.18.18 In addition to these physical works, Somerset County Council are also proposing to implement two Traffic Regulation Orders to enforce parking controls and speed limits on the C182. These do not comprise physical work, other than signage and road markings, and therefore are not included as part of the DCO application. They have however been assumed to be part of the package of highway improvements for the purposes of the **Transport Assessment**.

k) Huntworth Roundabout

2.18.19 As illustrated in **Figure 2.36** the proposals for the Huntworth Roundabout comprise minor carriageway widening to reduce queuing at the junction and improve pedestrian crossing facilities. The proposals would be entirely within the existing carriageway and would comprise:

- widening of carriageway at eastern arm of roundabout;
- removal of part of existing verge and trimming back vegetation as necessary;
- provision of 2m wide footway between eastern and southern arms of roundabout;
- reconfiguration of existing traffic splitter island, including improved pedestrian crossing;
- adjustment of footway to north of eastern arm; and
- revision of white lining as appropriate.

References

2.1 Turnpenny, A.W.H, Coughlan, J, Ng, B, Crews, P and Rowles, P, 2010. Cooling water options for the new generation of nuclear power stations in the UK. Environment Agency Science Report SC070015/SR, Environment Agency, Bristol.

2.2 Turnpenny, A W H and O'Keeffe, N, 2005. Screening for intake and outfalls: a best practice guide. Environment Agency, Science report SC030231.

CHAPTER 3: CONSTRUCTION

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TABLES

PLATE

FIGURES

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3. CONSTRUCTION

3.1.1 This chapter provides information on the construction of Hinkley Point C. It sets out the following:

- the HPC construction programme; and
- summary of construction land use and physical parameters.

3.1.2 A description of construction activities and indicative phasing of work is provided in the **Construction Method Statement**. See **Annex 2**.

3.2 HPC Project Construction Programme

3.2.1 The HPC construction programme is anticipated to commence with the site preparation works in late 2011, followed by the main construction in early 2013, through the Development Consent granted by the IPC. The overall construction phase is anticipated to take approximately nine years, with the first UK EPR reactor unit operational in 2019, and the second UK EPR reactor unit operational approximately 18 months later. However, completion of the spent fuel store will extend some two years beyond initial operation of Unit 2. Some landscaping works to the south of the southern construction area will be undertaken early in the construction phase. The final landscape works will commence once the construction phase is complete and HPC is operational.

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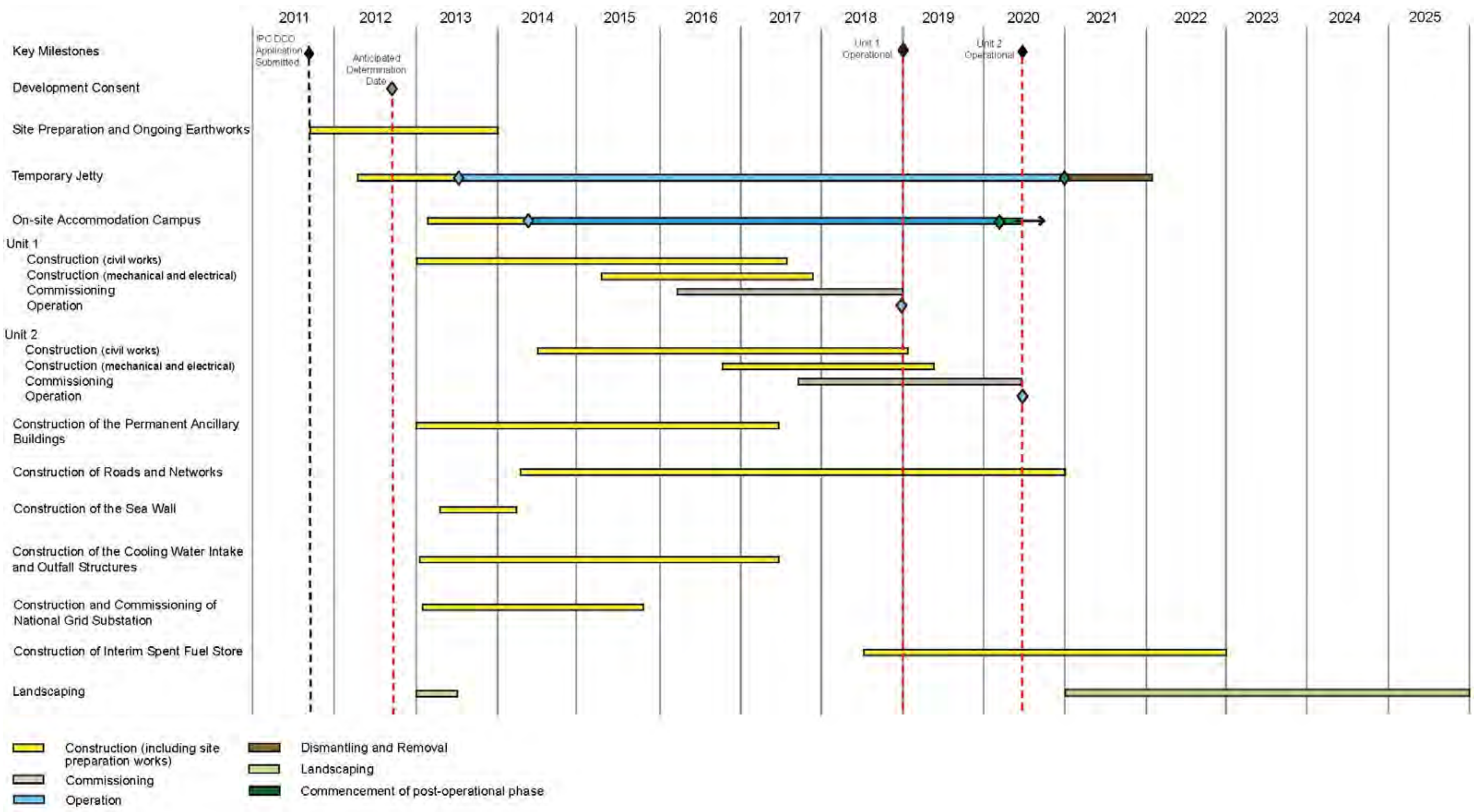
Plate 3.1: Hinkley Point C Indicative Construction Programme



3.3 Summary of Construction Land Use and Physical Parameters

a) Land Use

3.3.1 This section sets out construction land use and describes the physical characteristics of the development across the site.

3.3.2 The layout of the site will vary over the construction period but, taking this into account, the anticipated principal uses of the overall land area at the peak phase of construction, in 2016, are presented in **Table 3.1** below.

Table 3.1: Proposed Areas of Land Use during the Peak Phase of Construction

Land Use	Area (ha)
Final permanent power station area	67.5
Construction contractor accommodation, working and storage	28.4
Landscape screening and protected areas/reserves	27.5
Construction site entrance and access roads	20.6
Stockpile of material for re-use	13.3
Topsoil storage	9.7
On-site accommodation campus	3.7
Low-lying land unsuitable for construction use	2.8
Sea wall foreshore construction area	1.7
Total	**175.2**

b) Physical Parameters

3.3.3 The height of the temporary buildings and structures will vary across the HPC development site depending on specific requirements. **Figures 3.1** and **Figure 3.2** show in plan and cross-section the height limits for various areas of the development site.

3.3.4 Zone 1 is the area where the main power station buildings and structures would be located, and includes the area immediately to the west which would be used by the main construction contractors. Zone 2 is within Zone 1 and includes the Nuclear Island buildings, Conventional Island buildings and the areas immediately to the south and west where liner fabrication would be undertaken. Zone 2 is where very large mobile cranes (including a polar crane) would be used for installation of the liner roof and main exhaust stack.

3.3.5 Zone 3 includes the area to the west of Zone 1 where aggregates, sand and cement brought in by the jetty would be stored and the main construction contractors would site their storage and prefabrication facilities. Zone 3 also includes the area south of Zone 1 where the platform level is +20m AOD and various ancillary power station buildings would be constructed. It also includes an area where the main nuclear steam supply systems contractor would be based.

3.3.6 Zone 4 is the area of the National Grid substation at +14m AOD and includes the temporary works area for the National Grid contractors.

3.3.7 Zone 5 is the area where the main mechanical and electrical installation contractors would be based. During the early construction works, this area may also be used by the main civil works contractor for laydown and storage.

Table 3.2 summarises the heights and uses applicable to each of the zones.

Table 3.2: Construction Zones and Height Parameters

Construction Zone	Explanation of Parameter	Construction Zone Parameter (Max. Height)[1]
Zone 1: Construction of the main nuclear island, conventional island, balance of plant and ancillary buildings.	Working envelope for main building construction requirements. Structures to include: temporary buildings, construction warehousing and storage buildings; and tower cranes, mobile cranes and other specialised lifting equipment.	140m AOD
Zone 2: Construction of the main nuclear island and conventional island - Exceptional Structures	Working envelope for exceptional structures that are required for the lifting and installation of reactor domes and other time limited activities that require specialised cranes or lifting equipment that go above the height parameters set out in Construction Zone 1. Typically these would include large mobile cranes for installation of the dome associated with the two reactor units.	175m AOD
Zone 3: Contractor areas to the north of green lane.	Working envelope for liner fabrication facilities, workshops, storage buildings, offices and mess facilities, concrete batching plants and associated aggregates stockpiles, covered stockpiles and cement/pulverised fuel ash silos.	75m AOD
Zone 4: National Grid sub-station area.	Working envelope for substation construction, transmission tower erection, workshops, storage buildings, offices and mess facilities.	80m AOD
Zone 5: Contractor areas to the south of green lane.	Working envelope for workshops, storage buildings, offices, mess facilities and fixed cranes.	55m AOD
Zone 5: Contractor areas to the south of green lane - Exceptional Structures	Working envelope for exceptional structures in Zone 5, such as mobile cranes.	75m AOD
Zone 6: On-site accommodation campus	Working envelope for the onsite accommodation campus.	32m AOD
Zone 6: On-site accommodation campus - Exceptional Structures	Working envelope for exceptional structures in Zone 6, such as mobile cranes.	55m AOD

Note: Exceptional buildings and structures comprise very large cranes and similar equipment which will be used for relatively short periods during the construction works for specific activities, such as lifting in the reactor building liner dome roof, and will then be removed.

[1] Figures quoted are height above ordnance datum level

3.3.8 Zone 6 includes the southern site entrance, the on-site accommodation campus and an area for offices and laydown/storage. Maximum heights within this area would be limited in order to minimise the visual impact on the village of Shurton.

c) HPC Accommodation Campus

3.3.9 A workers accommodation campus is proposed within the HPC development site. The location of the campus and general layout arrangement is shown in **Figure 3.1** and cross section BB in **Figure 3.2** illustrates the heights of key structures in relation to the landform.

3.3.10 The primary function of the campus is to provide living accommodation and facilities for the workforce involved in the construction of the power station. It would consist of the following:

- 15 three-storey accommodation buildings housing up to 510 workers;
- a two-storey multi-purpose amenity building;
- car parking for 319 cars, including accessible parking bays and motorcycle parking;
- external recreational space consisting of two, all-weather, 5-a-side football pitches surrounded by a fenced enclosure;
- single-storey plant and utilities enclosures and refuse compounds; and
- soft and hard landscaped areas providing both functional and amenity spaces.

3.3.11 The proposed Masterplan of the campus is shown in **Figure 3.3**.

3.3.12 Upon completion of construction, the campus will be removed and the land will be landscaped in accordance with the site wide Landscape Restoration Plan as described in **Chapter 2** of this volume.

CHAPTER 4: OPERATION

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APPENDICES

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4. OPERATION

4.1 Introduction

4.1.1 This chapter provides a description of the operation of HPC which will have a design life of 60 years. Unit 1 is scheduled to commence operation in 2019 and Unit 2 18 months later in 2020. A summary of the process of electricity generation is presented together with a description of the sources and characteristics of liquid discharges and gaseous emissions during normal operation and plant commissioning. The anticipated workforce and visitor profile during the operational phase is described along with vehicle parking arrangements for staff and visitors.

4.2 Electricity Generation

4.2.1 Electricity will be generated at HPC from heat energy produced from the two UK EPR reactors. The heat will be used to raise steam which will then be utilised to power turbines to generate electricity. The expected electrical output of HPC will be approximately 1,630 megawatts (MW) per unit giving a total site capacity of 3,260MW net of the electricity used on the site by plant such as the reactor coolant pumps.

4.2.2 Electricity generated in the two turbine halls (one for each UK EPR reactor) will be converted by transformers to high voltage (400kV), before being exported by two EDF Energy overhead lines connected to the National Grid 400kV substation. Connections to the 400kV main interconnected national grid transmission system will be made via six overhead line gantries and three overhead line terminal towers (pylons). These will be situated along the southern and eastern sides of the National Grid substation. Details of the proposed National Grid substation and associated infrastructure are provided in **Chapter 2** of this volume.

a) Heat Energy Generation

4.2.3 A UK EPR reactor is capable of producing approximately 4,500MW of heat from nuclear fission which takes place in the reactor core. The core is contained within a thick-walled steel pressure vessel which is approximately 10m high and 5.5m in diameter. Diverse systems are installed for the safe shutdown of the reactor in the event of any faults. Within the core of each UK EPR reactor there will be 241 fuel assemblies each containing a 17 by 17 array of fuel rods comprising uranium dioxide pellets in a sealed cladding tube. The uranium is enriched in the fissile isotope Uranium-235 (U-235) from its naturally occurring level of 0.7% up to 5%. A fissile isotope is an isotope where, when it collides with a low energy neutron, its nucleus splits (“fissions”) into smaller fragments (“fission products”) and releases further neutrons together with energy. In a nuclear reactor, these neutrons are slowed down (“moderated”) to the point where they can cause a further nucleus to fission which results in a sustained chain reaction and the release of nuclear energy as heat.

4.2.4 The UK EPR design is such that once the fuel is loaded in the reactor core the reactor can operate at full power continuously in a ‘fuel cycle’ of up to 18 months. Spent fuel removed from the reactor core will undergo 10 years of storage to cool in the pools inside the plant before transfer to the Interim Spent Fuel Store (ISFS).

b) Refuelling and Maintenance Outages

4.2.5 During the 60 year operational life HPC will undergo refuelling and maintenance shutdowns (otherwise known as 'outages') at regular intervals. The length of these outages will vary according to the maintenance and inspections required.

i. Refuelling Outage

4.2.6 During each refuelling outage all fuel assemblies will be temporarily offloaded into the fuel storage pool (one for each reactor). When returned to the core, a proportion of the fuel assemblies, normally a quarter to a third, will be replaced with new fuel. Thus, each fuel assembly will normally spend three 18 month cycles in the reactor before being replaced. Refuelling outages will take place approximately every 18 months.

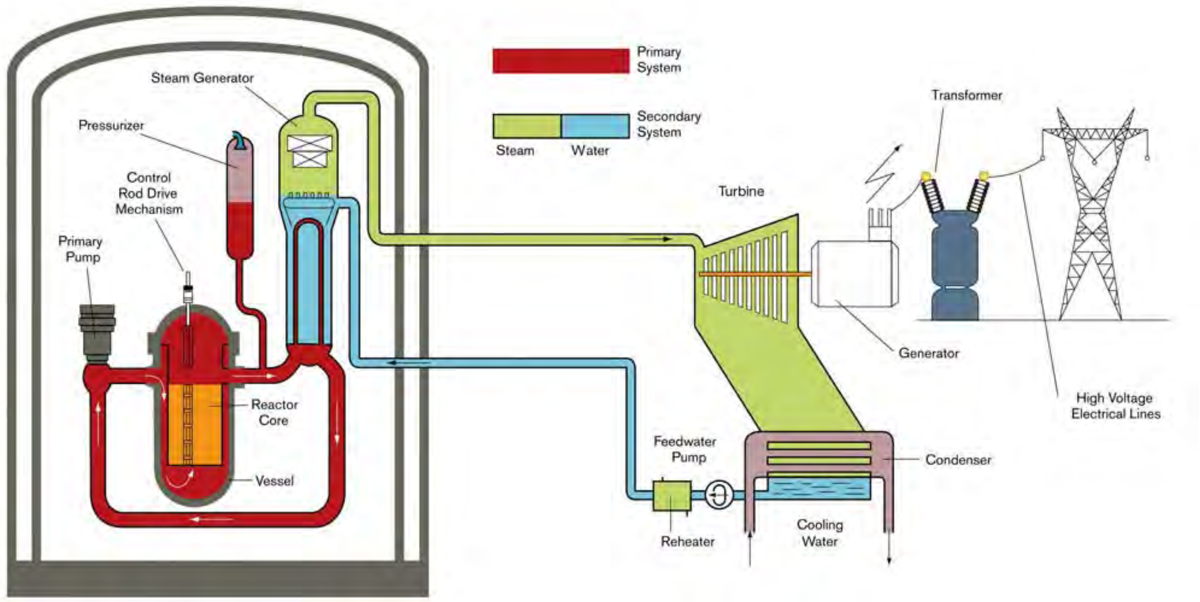
ii. Maintenance Outage

4.2.7 Maintenance outages will include 'preventative maintenance' incorporating inspections, tests, maintenance, repairs and replacements of equipment in order to comply with the Nuclear Site Licence and other regulatory requirements. The aim is to ensure that, throughout the installation's service life, the objectives of nuclear and industrial safety, environmental protection, and security are achieved. Maintenance outages will normally be undertaken in conjunction with refuelling outages. The length of the maintenance outage will vary depending on the scope of the work required.

4.3 Cooling Systems

4.3.1 For the UK EPR reactors at Hinkley Point there will be three cooling systems, comprising primary, secondary and open circuit systems. These are shown schematically in below.

Plate 4.1: Schematic Illustration of the Functioning of the UK EPR reactor



a) Primary System

4.3.2 The primary system, housed in the reactor building, is a closed water-filled pressurised system which enables the heat produced by the nuclear fission reaction inside the fuel assemblies in the reactor core to be extracted. The system comprises the reactor pressure vessel and four separate cooling loops, each containing a reactor coolant pump and a steam generator. The high pressure conditions of the system, which are controlled by a single pressuriser, prevent the cooling water from boiling even though the temperature of the water is around 330°C. The water within the system, which is heated by the fission occurring in the reactor, passes through tubes within the steam generators. The generators act as heat exchangers whereby heat is transferred through the tube walls into the water of the separate secondary system which flows outside and between the tubes. The primary coolant water, having passed through the steam generators is then pumped back to the reactor vessel. The metal cladding of the fuel assemblies, the reactor vessel and primary circuit and the containment building all form barriers to the potential release of radioactivity.

4.3.3 The water in the primary circuit also slows down (moderates) the neutrons released in the nuclear fission process, which is necessary to sustain the fission reaction. Control is achieved by inserting control rods from the top of the reactor and through changing the concentration of boron in the primary coolant. Both the control rods and the boron absorb neutrons and therefore reduce the rate of fission.

b) Secondary System

4.3.4 The secondary system is a closed system which is independent of the primary system and it operates at a lower pressure. Consequently, when heated by the primary system in the steam generators, the water in the secondary system boils to produce saturated steam. The steam is first dried inside the steam generators and then delivered to the turbine halls (one turbine hall for each UK EPR reactor unit). Here it powers a single large turbine rotating at 1,500 revolutions per minute (rpm). The turbine is coupled to the generator which produces electricity. After leaving the turbine, the steam is cooled and condensed back to liquid water in the condenser. It is then returned as feedwater to the steam generators.

c) Open Circuit System

4.3.5 The open circuit cooling system is independent of the primary and secondary systems and draws water directly from the sea. It absorbs heat from the secondary system in the condenser and the heated water is then discharged back to the sea.

4.3.6 Sea water will be supplied through the two off-shore intake tunnels, each of which has two intake heads. The relative positions of the intake heads associated with the two tunnels will ensure that no two intakes would abstract sea water from the same tidal streamlines, on either ebb or flood tide.

4.3.7 Each intake head will be designed to abstract 32.5m^3/sec of sea water (a flow rate that will, in practice, vary according to tidal state because of the consequent change in head at the cooling water pumps). The two intake heads for each tunnel and reactor unit will therefore provide for a combined flow of approximately 62.5m^3/sec of cooling water.

4.3.8 At its onshore end, each intake tunnel feeds directly into the forebays (one for each reactor unit). The intake cooling water will contain a high degree of suspended solids, which may accumulate to some extent in the forebays. It is common practice in the UK power industry at coastal sites to undertake periodic desilting of the forebays. Should desilting be required at HPC, the preferred option will be to return the sediment to the cooling water system for discharge back to the Bristol Channel.

4.3.9 The intake water is filtered as it is drawn from each forebay into an adjacent pumping station (which supplies the cooling water for one UK EPR reactor unit) in order to prevent the blockage of key elements of plant further downstream, primarily the main condensers and other allied heat exchangers. Coarse raking screens within the intake channels directly downstream of the forebay remove debris and larger marine organisms which will be routed to the filtering debris recovery pit which is periodically lifted and emptied. Further screening of material is then achieved using rotating coarse (drum) screens and fine (band) screens. The drum screens provide for the capture (impingement) and retrieval of fish, smaller marine organisms and remaining debris before being channelled to a pre-discharge basin, lifted above the level of the perimeter of the pumping station by Archimedean screw, and then returned to sea via the dedicated fish return tunnel under the seawall and intertidal shore.

4.3.10 The filtered cooling water from the pumping station is pumped through underground pipes routed in galleries to the turbine hall and Nuclear Island. The cooling water pipework is divided between different galleries based on the segregation requirements of the safety systems. Once the cooling water has served its heat removal function and passed through the condensers or other heat exchangers it is returned to the sea via two outfall ponds (also referred to as ‘surge chambers’). The outfall ponds serve to regulate the water level and control the pressure head on the discharge side of the Cooling Water Outfall Tunnel. The outfall ponds also receive waste water and effluents from different systems around the site after they have received any treatment that may be required.

4.3.11 Two onshore discharge culverts carry the water from the outfall ponds towards the head of a common discharge tunnel which extends approximately 1.8km offshore. The water is discharged offshore via two outfall structures, or ‘headworks’ which will be located approximately 75m apart at the end of the offshore outfall tunnel.

4.4 Operational Liquid Discharges

4.4.1 In normal operation all liquid effluents will be discharged to the sea in Bridgwater Bay via the outfall ponds and the cooling water outfall infrastructure. Sources and characteristics of liquid effluents which will be generated and discharged with the cooling water are described below and details are presented in **Appendix 4A**.

a) Production of Demineralised Water

4.4.2 The primary and secondary circuits both require a feed of fresh demineralised water. Demineralised water would be produced from mains water using a combination of membrane technology and ion exchange resins. This process will be undertaken in the Demineralisation Plant and will generate effluents characterised by either high acidity or alkalinity as a result of the use of sulphuric acid and sodium hydroxide to regenerate the resins and membranes. Batch treatment of these effluents using acids and alkalis would result in a neutral pH.

4.4.3 No further treatment of demineralisation effluents is proposed and the discharge will contain dissolved solids removed from the mains water as well as substances such as sulphates, sodium and chlorides.

b) Primary Cooling System and Other Radioactive Liquid Effluents

4.4.4 Increases in the boron concentration for controlling fission in the reactor core are achieved by dosing the primary coolant with boric acid. To counteract any changes in pH, the primary coolant is also dosed with small amounts of lithium hydroxide. Decreases in the boron concentration are achieved by topping up the primary coolant with low concentration borated water and releasing primary coolant to a coolant storage and treatment system.

4.4.5 There are also a number of corrosion products associated with the primary circuit including iron, nickel, cobalt, chromium, manganese, antimony and silver. These corrosion products are minimised at source through the careful selection of materials that are used to make the reactor systems and those components in contact with the primary coolant. The corrosion products can become activated by neutrons as they pass through the reactor in the primary circuit. Treatment prior to discharge will be undertaken to minimise the amount of corrosion products discharged.

4.4.6 Some further radioactive elements may be generated in the primary coolant by activation or fission processes. Measures are taken to minimise the generation of these radioactive elements at source. Once generated, abatement systems are used to minimise the amount of radioactive effluent discharged. Note that in addition to the primary circuit, radioactive effluents may also be generated from the fuel pool purification systems, the operation of a radioactive laundry facility and washings from plant decontamination. Techniques are applied to minimise the amount of radioactivity produced. In each case, the plant is designed and will be operated taking all reasonably practicable steps to minimise the generation and discharge of radioactive materials, in accordance with the environmental permits granted by the Environment Agency.

4.4.7 There are three main systems which remove contaminants from the water in the primary circuit and to treat effluents prior to discharge:

- Chemical and volume control system – this maintains the chemistry of the primary coolant by taking some of the primary coolant, known as let-down, cleaning it and returning it back to the system. Water is treated by the use of ion exchange resins and filters. Boric acid and lithium chemistry can be modified as required to meet the prescribed conditions in the reactor. This system also provides volume control for the primary coolant and contains any leaks from reactor coolant pump seals.
- Coolant storage and treatment system – this treats the liquid effluent from the primary circuit. The purpose of treatment is that, as far as possible, the boron and water may be recycled through the primary reactor circuit. Treatment for recycling involves demineralisation by ion exchange resins and filtration, evaporation and degassing. The evaporator is used to recover the enriched boric acid for re-use within the reactor coolant system.
- Liquid waste processing system - this is designed to ensure optimisation of the management of effluents by enabling treatment through a variety of techniques,

such as filtration, ion exchange and evaporation. The system allows effluents to be retreated and pass through different treatment techniques before being sampled and monitored and, if acceptable, discharged.

- After treatment to reduce the radioactive content of the effluent, it is sampled and monitored prior to final discharge with the cooling water.

c) Secondary Cooling System

4.4.8 A small proportion of the condensed water is bled continuously from the secondary circuit and replaced with fresh demineralised water. This is to prevent saturation of the secondary circuit with dissolved salts and to prevent the formation of foams or solids in the system that would make it difficult to dry the steam before it enters the turbine, which is required to prevent damage to the turbine. The water bled out of the system is known as 'blowdown' which is largely made up of demineralised feedwater.

4.4.9 The secondary circuit may also be dosed with hydrazine, ammonia, morpholine and ethanolamine which would be added to prevent corrosion and control the pH in the secondary circuit, as follows:

- Ammonia, morpholine and ethanolamine may be added to control pH, which helps to prevent corrosion; and
- Hydrazine would be added, as it is a very effective oxygen scavenger and therefore prevents corrosion associated with oxidation of metals in the steam generator (i.e. rusting). During shutdown, hydrazine may also be used to condition the steam generators.

4.4.10 The blowdown water from the steam generators will be processed and treated to remove non-radioactive corrosion products and dissolved salts before the water is recycled in the secondary circuit. Treatment involves filtration and the use of ion exchange resins.

4.4.11 As with the primary system the non-recyclable blowdown effluent would be transferred to a separate system which monitors and further processes effluents where required, before discharge. If necessary, this would be subject to hydrazine destruction; the method for hydrazine destruction would be determined during detailed design of the plant.

d) Oily Water Drainage System

4.4.12 There are a number of areas on the site where oils or hydrocarbon fuels will be used and stored, including the following:

- Back-up diesel generators.
- HPC and National Grid transformer compounds.
- Electrical substations.
- Oil and grease store.
- Oil and hydrocarbon fuel offloading areas.
- Workshops.

4.4.13 The drainage infrastructure (see also **Site Drainage Strategy**) in these areas will be segregated from other drainage, preventing the contamination of other effluents and clean surface water runoff. Any oily water in the segregated drainage system will be routed via a settling tank located in the Attenuation pond building. Once the tank reaches a predetermined level the contents would be pumped to an oil/water separator, following which the oil would be pumped to a mobile container and disposed of off-site at an appropriately licensed waste management facility. The treated effluent will have a hydrocarbon content of < 5 mg/l and will be discharged via the outfall pond.

e) Sanitary Effluent Treatment

4.4.14 The on-site workforce would generate sanitary effluent which would be treated in a Sewage Treatment Plant before being discharged. The Sewage Treatment Plant will be designed and sized to accommodate peak numbers of people on-site, for example during a major outage (shutdown for maintenance purposes), as well as operating effectively to treat effluent from the lower numbers of people expected during normal operations. The foul water drainage network would send effluent to the Sewage Treatment Plant where it would be treated a before being discharged via the Outfall Pond.

4.4.15 The sewage system will typically collect black and grey wastewater from lavatories. After treatment in the Sewage Treatment Plant; the discharge would typically be characterised by a relatively high five-day Biochemical Oxygen Demand (BOD_5 - a measure of the quantity of dissolved oxygen required to break down the residual organic material in the water) when compared to the other effluent streams generated at the site.

f) Surface Water

4.4.16 As described in **Chapter 2** of this volume (and the **Site Drainage Strategy**), there will be a surface water drainage system which will comprise two separate elements, one dedicated to the collection and removal of uncontaminated rainwater gathered from the roofs of buildings and the other to remove runoff from roads and paved areas. No treatment of drainage generated from roofs will be undertaken under normal circumstances although the retention and treatment of such drainage in the HXO building prior to discharge to the outfall pond will be possible. The drainage infrastructure for roads and car parks will be provided locally with oil/water separators for the higher risk areas where minor spills and leaks (principally from road vehicles) could occur. Again retention and treatment within the HXO building will be possible under abnormal conditions.

g) Groundwater

4.4.17 To prevent excessive groundwater pressure building up upon the sub-surface structures and foundations, groundwater levels would be controlled through a passive groundwater collection gallery that would extend around the southern and western boundary of the main development platform. The culvert would collect groundwater at an appropriate level (around 8m AOD) and route it to the Forebay of Unit 2 and then to the outfall pond. No treatment of groundwater is expected to be required prior to discharge. If this proves to be necessary, retention and treatment would be undertaken in the building.

h) Cooling Water Discharge

4.4.18 Operational requirements determine that at full operating load the cooling water will be discharged at 10 to 12.5°C above the intake water temperature, and the combined cooling water volume for both UK EPR units will be approximately 125 m^3/s. In practice, both the temperature and volume would vary tidally due to variable load on the cooling water pumps themselves: where pumping rates are reduced there is a corresponding increase in discharge temperature. For the purpose of the EIA, the twin outfall headworks discharging a flow rate varying tidally between 116m^3/s and 134m^3/s during normal operation has been assumed.

4.4.19 In addition to the substances associated with the effluents described above, the returned cooling water may also contain residual biocides arising from low-level chlorination (if a need is found to control biological fouling) of that cooling water stream.

4.4.20 Low level chlorination is one of the most commonly used and effective means of preventing untoward biological growth within cooling water circuits. The biocide may be introduced either in the form of sodium hypochlorite solution, or produced *in situ* by electrolysis of seawater. It is possible that the routine operation of HPC will not require chlorination because of the prevailing conditions in the Bristol Channel, and in particular the extreme turbidity regime which will limit the growth of biofouling organisms. The required elements of a chlorination system will none the less be fitted in case the need arises.

4.5 Commissioning and Associated Liquid Discharges

4.5.1 Prior to full operation, commissioning tests will be undertaken to demonstrate that HPC is capable of performing in accordance with its design specification and safety and environmental requirements.

4.5.2 Commissioning activities at HPC are anticipated to commence during the construction phase in 2015 and continue until the two units are operational. Early commissioning activities include the commissioning of the demineralisation plant and cooling water system, with commissioning of the reactor units anticipated to commence in 2017 and 2019 for reactor Units 1 and 2 respectively. The commissioning of the reactor units comprises two key phases including:

- Non-active commissioning, which will start with demonstration of equipment functionality and gradually build up to tests of the integrated function of the plant focusing on safety related systems and components. This stage includes hot functional testing, where the plant and equipment is put through its design envelope up to and including full temperature and pressure conditions, as far as practicable without nuclear fuel being in place. These tests are completed before fuel is loaded into the reactor and therefore no radioactive effluents are generated as a result of these activities; and
- Active commissioning which commences with fuel delivery and active commissioning of the reactor components e.g. testing the fuel storage systems before fuel loading, loading of fuel into the reactor vessel, initial criticality and power ascension testing, where the reactor is progressively increased in power and the operational and safety performance is verified.

a) Non-active Commissioning Discharges

4.5.3 With regards to discharges, the non-active commissioning of HPC can be broken down into two distinct phases, i.e. cold testing and hot functional testing (HFT).

i. Cold Testing

4.5.4 Cold testing involves the cleaning and initial preparation of various plant components. The main activity in this phase is cold flushing of pipe work (using demineralised water) to remove surface deposits and residual debris from installation including rust.

4.5.5 The discharges from this phase will primarily comprise water containing suspended solids and iron oxide (rust) and small quantities of conditioning chemicals including:

- Ammonia.
- Ethanolamine.
- Hydrazine.
- Phosphate.

4.5.6 During this phase of commissioning for Unit 1, the cooling water pumps will not have been commissioned therefore the cooling water system will not be available as a discharge route of these effluents (the cooling water system will be static (no significant flow) and unsuitable for receiving effluent for discharge through the cooling water outfall). This means that that discharges will be made via the temporary discharge route to the Foreshore Outfall following the necessary treatment to meet the relevant Environmental Quality Standards at point of discharge. Treatment may be required for ammonia, ethanolamine, hydrazine, phosphate, iron oxide and iron. Hydrazine will not be discharged during commissioning until the cooling water system and outfall tunnel is available as a discharge route. During the cold testing phase for Unit 1 hydrazine will be routed to a specific storage tank; storage will enable the hydrazine to decompose before being discharged via the outfall to the intertidal area.

4.5.7 The maximum combined cold-flush commissioning discharge will be 267m^3 per day (11.13m^3/h).

4.5.8 When Unit 2 undergoes cold testing, the cooling water system for Unit 1 and the common outfall tunnel will be available, and therefore the Unit 2 discharges will be routed through the Cooling Water outfall tunnel and not via the Foreshore outfall.

ii. Hot Functional Testing

4.5.9 HFT is a process whereby the UK EPR reactor is tested under high temperature and pressure prior to the loading of nuclear fuel into the reactor. The HFT phase of commissioning begins following the successful completion of the cleaning/flushing and cold performance tests and when the required equipment and functional units are deemed to be available.

4.5.10 The chemical substances discharged during the HFT phase of commissioning will be the same as those discharged during the normal operation of HPC. There will not be any radioactive effluents produced during non-active commissioning. However, HFT is an important step in passivating the primary circuit. This contributes to the minimisation of subsequent radioactive discharges over the lifetime of the facility.

4.5.11 Once HFT has been completed the primary circuit must be fully drained prior to refuelling with borated water. The steam generators are then either drained and placed in dry lay-up or wet lay-up (depending on the duration of preservation required). This is the only part of HFT that will be outside the normal operating envelope. During this period, operational discharge limits as defined by the appropriate Environmental Permit, will be respected and adhered to. This will involve careful planning to ensure that the effluent drained from the primary circuit is directed to appropriate storage tanks; sampled and subjected to appropriate analysis; and then discharged to the cooling water system. If analysis shows that discharge of this effluent would cause operational discharge limits to be breached, appropriate treatment would be applied to bring the effluent within specified limits. Failing this, disposal through an appropriately permitted off-site method would be arranged.

4.5.12 It is important to note that during the HFT phase, the cooling water system would be operational and therefore available to receive effluents and apply adequate dilution.

b) Active Commissioning Discharges

4.5.13 Discharges of chemical (non-radioactive) effluents during the active commissioning phase will be bounded by the limits described in the water discharge activity Environmental Permit. Discharges of radioactive liquid effluents will be bounded by the limits in the RSR Environmental Permit.

c) Sanitary Effluent Treatment During Commissioning

4.5.14 During the commissioning phase, HPC would continue to produce routine sewage effluent, which would be treated and discharged with sewage effluent associated with the construction works. Once the permanent Sewage Treatment Plant and cooling water infrastructure is available, then the sewage effluent associated with HPC would be rerouted and discharged via the cooling water outfall tunnel.

4.6 Operational Gaseous Emissions

4.6.1 The potential operational emissions to air arising from the operation of HPC would primarily include:

- Formaldehyde (H_2CO), that may in turn produce carbon monoxide (CO), emitted by the thermal decomposition of insulation material during reactor return to operation following maintenance outages.
- Ammonia (NH_3) discharged as the temperature rises in the steam generators during start-up following a maintenance outage.
- Sulphur dioxide and nitrogen oxides (SO_2 and NO_x), carbon monoxide (CO) and particulate matter (PM_{10} and $PM_{2.5}$) in the exhaust gases from engines of back-up diesel generators during periodic testing.
- SO_2, NO_x, CO, PM_{10} and $PM_{2.5}$ from plant including; fire fighting and hydrant diesel pumps, domestic heating boilers, and small diesel engines associated with the Interim Spent Fuel Store (ISFS).
- Discharge of radioactive gaseous effluents arising from the degassing of primary coolant and maintenance and operations in building areas containing radioactivity.

a) Start-up of the Reactor Plant

4.6.2 During the return to operation following a maintenance outage (approximately every 18 months), thermal decomposition of plant piping insulation material will result in the release of steam containing formaldehyde (H_2CO) that may in turn produce carbon monoxide (CO). It is estimated that during return to operation following maintenance, the operating time required to evacuate these emissions would be eight hours at normal flow and 42 hours at low flow. These gases would be captured by the ventilation extraction system and discharged to atmosphere via the main stack, which would be approximately 70m in height and have a flow rate of approximately 224 to 290 m^3/h. Two installation restarts are assumed per year during routine operation.

4.6.3 Start-up following a maintenance outage may also result in the production and emission of ammonia (NH_3). Depending on the type of maintenance planned during an outage, the steam generators may need to be filled with demineralised water and corrosion inhibitors to prevent their fabric corroding and also provide a biological barrier (a water shield). Once the outage is over, the rise in temperature in the steam generators generates gaseous ammonia partly from this wet lay-up solution, and partly from the steam generators emergency feedwater system. These emissions would be discharged via four steam relief valves associated with each unit. For the purpose of this ES, it has been assumed that the NH_3 emissions from one steam generator would be released during a period of 83 hours per restart. Two installation restarts are assumed per year.

b) Periodic Testing of the Back-up Diesel Generators

4.6.4 In order to ensure power is always available to the site (even in the event of loss of connection/supply to the National Grid), there would be a number of back-up diesel generators.

4.6.5 For each unit there are four main backup Essential Diesel Generators (EDGs) each with a thermal input of 18.5MW_{th}, and electrical output of around 7.9MWe. There would also be two emergency back-up generator per unit, referred to as Station Black Outs (SBOs) each with a thermal input of 7.0MW_{th}, and electrical output rated at around 2.9MWe.

4.6.6 These back-up generators would routinely operate during periodic tests, which represent an estimated 60 hours per year for each of the EDGs and SBO generators. This is a conservative assumption and in reality it is expected that running hours would be much lower.

4.6.7 These emissions would be discharged via exhaust stacks (one per generator), approximately 30m above ground level and have a flow rate of approximately 27.5 m^3/s (EDGs) and 7.9 m^3/s (SBOs), located on the roof of the diesel generator buildings. Each diesel generator building would house two EDGs and one SBO; thus there would be two diesel generator buildings per unit.

c) Other Gaseous Emissions

4.6.8 Domestic heating boilers would be routinely used around the site (particularly during periods of cold weather). Fire fighting diesel pumps located around the site would only be used for short periods in the event of an emergency or during periodic tests. Small diesel engines would also be used to provide backup power supply to the

ISFS. Emissions from these sources would be discharged to air via their own flue gas vents and likely to comprise SO_2, NO_x, CO, PM_{10} and $PM_{2.5}$.

4.6.9 Stack parameters and emission rates for EDGs, SBOs and non-diesel generator emissions to air are presented in **Appendix 4B.**

d) Radioactive Gaseous Emissions

4.6.10 Operation of the reactors and other radioactive facilities on site (such as the ISFS) produce radioactive gaseous effluent from the degassing of the primary cooling circuit and ventilation of potentially contaminated areas. Gaseous radioactive emissions are filtered and treated and only very small quantities are permitted to be discharged. These discharges into the environment will use the discharge stack and other authorised outlets, in accordance with the RSR Environmental Permit. The discharges are continuously sampled and monitored.

4.7 Gaseous Emissions associated with Commissioning

4.7.1 During commissioning there will be a number of emissions to air, including:

- Formaldehyde (H_2CO), that may in turn produce carbon monoxide (CO), emitted by the thermal decomposition of insulation material during reactor plant start-up (commissioning);
- Ammonia (NH_3) discharged as the temperature rises in the steam generators during start-up (commissioning):
- Sulphur dioxide and nitrogen oxides (SO_2 and NO_x), carbon monoxide (CO) and particulate matter (PM_{10} and $PM_{2.5}$) in the exhaust gases from engines of back-up diesel generators during periodic testing.

a) Start-up of the Reactor Plant

4.7.2 During start-up (commissioning) of the reactor building or return to operation following an outage (approximately every 18 to 22 months), thermal decomposition of plant piping insulation material results in the release of steam containing formaldehyde (H_2CO), that may in turn produce carbon monoxide (CO). Assuming the worst-case with respect to emissions (i.e. the shortest period over which the emissions may occur) It is estimated that during commissioning it would take 10 hours to evacuate these gases at normal flow rates, and 52 hours at low flow rates. As with operational discharges, these gases would be captured by the ventilation extraction system and discharged to atmosphere via the main stack.

b) Commissioning of Back-up Diesel Generators

4.7.3 During commissioning it is not anticipated that more than one EDG or SBO would be in operation at any one time. Each EDG and SBO will be operated for approximately 245 hours during its testing period. It should be noted that some of the hours needed for commissioning the SBOs will involve tests that can be carried out before the engines are brought to site. The commissioning hours presented therefore represent a conservative estimate of the time for which plant may be run on-site during this phase.

4.7.4 As for the operational testing of the diesel generators, these emissions would be discharged via exhaust stacks located on the roof of the diesel generator buildings.

4.8 Workforce and Visitors

4.8.1 The operational workforce would gradually build up during the commissioning phase and it is anticipated that the operational workforce of approximately 700 permanent staff would be employed on-site during normal operations. Approximately 180 staff would be employed in professional and managerial positions, 60 would be in clerical/administrative positions and 460 would be in industrial positions. There would also be up to an additional 200 contract staff.

4.8.2 It is anticipated that the majority of the operational staff would travel from the three local districts of Sedgemoor, West Somerset and Taunton Deane.

4.8.3 During the maintenance and refuelling outages, it is anticipated that a further 600-1000 staff would be required, with the number depending upon the extent of the maintenance planned for the outage, and that a large number would be located in the Operational Service Centre.

a) Working Hours

4.8.4 A number of operational staff will work shift patterns. Up to 100 operational staff will work shifts to cover the 24 hour day operational requirements. The remaining 800 staff would be likely to work day shifts (08:00 – 16:30).

4.8.5 The outage workforce would work day and night shifts with approx 60% of the workforce working a day shift and 40% a night shift. During an outage, the south car park will be made available to the additional staff.

b) Visitors

4.8.6 Business visitors will be limited in number and it is assumed for the EIA that in numerical terms they would replace members of the workforce who are working away from site at the time.

4.8.7 Visitors to the Public Information Centre (PIC) would reach a maximum of 1,360 in a single day. There are expected to be a maximum of four groups of visitors to the PIC during a day with a maximum of 340 people in a group to ensure that the maximum occupancy of the building is not exceeded. It is anticipated that there would be around seven staff working at the PIC.

c) Transport and Parking Arrangements

4.8.8 It is anticipated that the majority of the 700 permanent staff and 200 contract staff on-site will travel from the three local districts of Sedgemoor, West Somerset and Taunton Deane.

4.8.9 As described in **Chapter 2** of this volume, on-site car parking that would be available during the operational phase would comprise:

- 505 spaces in the south-east car park;
- 180 spaces in the east car park. Disabled parking will be included within the car parking provision; and
- 508 parking spaces in the south car park for additional workers who will be required during the planned ‘outages’ (i.e. maintenance periods), and car and coach parking for visitors to the PIC.

4.8.10 Of these car parking spaces approximately 430 would be available in the south-east car park for operational staff; equating to a ratio of one space per 1.9 workers present. It is assumed that these spaces would be occupied by workers’ cars using a car share ratio of 1.6. A Framework Travel Plan has been produced as part of the Transport Assessment which sets out the approach which will be adopted to travel planning during construction and operation of HPC.

CHAPTER 5: DECOMMISSIONING

CONTENTS

TABLES

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5. DECOMMISSIONING

5.1 Introduction

5.1.1 Following the 60 year operational phase, Hinkley Point C (HPC) will be decommissioned. This chapter outlines EDF Energy's overall approach to the decommissioning of the proposed UK EPR reactor units and the associated buildings and infrastructure based upon experience gained from decommissioning of other nuclear power stations and taking into account the UK EPR design and the site-specific conditions which apply at HPC.

5.1.2 The chapter also provides a summary of the relevant legislation and describes the required funding arrangements for decommissioning. An outline of the environmental effects that may be associated with the decommissioning process is presented.

5.1.3 Before decommissioning can take place, there is a requirement for the operator to obtain consent from the Office for Nuclear Regulation (ONR) under the Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 (EIADR 99) (Ref. 5.1). This requires the submission of an (ES) following an Environmental Impact Assessment (EIA) and a period of public consultation. For the HPC UK EPR reactor units the preparation and submission of the (EIA) will take place in the years leading up to End of Generation (EoG). The EIA performed at that time would take full account of the environmental impacts of decommissioning.

5.1.4 At this time, it is difficult to predict the specific characteristics of the environmental baseline conditions that will apply at the end of the operational life of HPC. New infrastructure may be built; local communities may change in size and character; a national geological disposal facility (GDF) for radioactive waste should exist but the location is not currently known; new technologies for waste treatment may be developed; and appropriate site reuse options would need to be considered. These issues represent substantial uncertainties with respect to the outcome of the assessment of impacts that can be undertaken at present. These uncertainties necessitate that the EIA for decommissioning will need to be completed nearer to the time when work will commence.

5.2 Legislation, Policy and Guidance

5.2.1 This section presents an outline of the regulatory framework specific to the decommissioning of nuclear sites.

5.2.2 In 1995, the Government produced a Review of Radioactive Waste Management Policy (White Paper CM2919) (Ref. 5.2). This set out the policy for decommissioning of nuclear sites and was updated following public consultation (Ref. 5.3). A further update was published in September 2004 "The Decommissioning of the UK Nuclear Industry's Facilities" (Ref. 5.4) and the 2008 White Paper "Meeting the Energy Challenge" (Ref. 5.5). Key aspects of the policy now in place include:

- each operator is expected to produce and maintain a decommissioning strategy and plans for its site(s);

- decommissioning operations should be carried out as soon as reasonably practicable, taking all relevant factors into account as provided for in the relevant operator's strategy and plan;
- sites of decommissioned nuclear facilities may represent a potentially valuable resource. The future use of the site, once decommissioning operations have been safely completed, could therefore be a significant factor in determining decommissioning operations;
- the use of Best Available Techniques (BAT) to minimise the volumes of radioactive wastes which are created, particularly the volume of Intermediate Level Waste (ILW). Wherever possible wastes should not be created during decommissioning until an appropriate management solution is, or would shortly be, available for use; and
- any new facility covered by this policy should be designed and built so as to minimise decommissioning and associated waste management operations and costs.

5.2.3 Regulation of the decommissioning of a nuclear facility is carried out under essentially the same arrangements as apply to construction and operation. Under the Nuclear Installations Act 1965, the ONR grants a licence for the purpose of installing, operating and subsequently decommissioning any commercial nuclear power station. Attached to the licence are conditions which require the operator to make and implement adequate arrangements relevant to safety. Site Licence Condition 35 specifically applies to decommissioning and requires that when a nuclear facility reaches the end of its operational life it is decommissioned in a safe and controlled manner and not left to pose a hazard for current and future generations. The purpose of the Licence Condition is therefore to require the licensee to have adequate arrangements for the safe decommissioning of its facilities. These arrangements include the preparation of a decommissioning plan and schedule for the site.

5.2.4 The precursor of the ONR, the Nuclear Installations Inspectorate, published its Safety Assessment Principles which apply to decommissioning and which the operator's site licence arrangements are required to meet (Ref. 5.6).

5.2.5 Disposal of radioactive wastes from decommissioning will be regulated by environmental permitting regulations where the application of BAT is expected to remain a key principle.

5.3 Funding of Decommissioning

5.3.1 The costs of decommissioning, waste and spent fuel management (post EoG) and disposal of all higher activity waste would be funded through a Funded Decommissioning Programme (FDP), approved by the Secretary of State, which the current draft guidance (Ref. 5.7) requires to have been approved before 'construction work on buildings with nuclear safety significance' commences. Under these arrangements, EDF Energy will ensure that it sets aside funds over the operating life of the power station to cover these costs in full.

5.3.2 A legal framework that implements this policy has been established through the Energy Act 2008 (Ref. 5.8) and the Nuclear Decommissioning and Waste Handling (Finance and Fees) Regulations 2011 (Ref. 5.9). Government has also published two consultations on draft FDP guidance, one in February 2008 (Ref. 5.7) and a second in December 2010 (Ref. 5.10), providing further detail on what an FDP should contain. In March 2010, Government published a further consultation on the arrangements for taking title and liability to waste and spent fuel, and the mechanism for setting a fixed price for waste disposal (Ref. 5.11) with an updated consultation document issued in December 2010 (Ref. 5.12).

5.3.3 The UK Government has created the independent Nuclear Liabilities Financing Assurance Board (NLFAB) to provide impartial scrutiny and advice on the suitability of the FDP submitted by operators of new nuclear power stations. NLFAB would advise the Secretary of State on the financial arrangements that operators submit for approval, and on the regular review and on-going scrutiny of funding.

5.3.4 Final guidance on the FDP and Waste Transfer Contract is now awaited from Government.

5.4 Design for Decommissioning

5.4.1 The UK EPR has been designed with maintenance and decommissioning in mind, enabling radiation doses to workers and radioactive waste quantities to be minimised when decommissioning takes place. The design incorporates a number of features to achieve this objective including:

- **choice of construction materials** – where practicable materials will be selected, to minimise the activation of certain elements which give rise to high levels of radiation, including cobalt, silver, and antimony;
- **optimisation of neutron shielding** – neutron shielding is utilised between the core and reactor vessel. This will reduce the depth of irradiation of the concrete of the reactor compartment;
- **optimisation of access routes to nuclear areas** – the layout of the primary circuit plant takes account of the handling and access routes for decommissioning;
- **reactor systems design** – systems are designed to minimise activation products and circuit contamination;
- **removal of major process components** – major components can be removed as a single item for size reduction in purpose built facilities;
- **submerged disassembly of reactor pressure vessel** – the design of the reactor compartment facilitates the flooding of the compartment for underwater dismantling of the reactor vessel;
- **modular thermal insulation** – the design facilitates easy removal minimising worker dose;
- **fuel cladding integrity** – improved fuel clad reduces contamination of the circuit with fission products;
- **primary circuit** – careful control of primary circuit chemistry should minimise level of activity in the primary circuit;

- **plant design** – design facilitates decontamination during decommissioning;
- **prevention of contamination spread** – containment, ventilation and segregation are utilised to prevent contamination spread; and
- **minimisation of hazardous materials** – the use of materials which would result in the creation of hazardous waste during decommissioning is minimised as far as possible.

5.4.2 In summary, the design of the UK EPR includes measures which would:

- minimise the activity level of irradiated components;
- reduce worker dose during decommissioning;
- permit decontamination;
- minimise the spread of contamination;
- facilitate the access of personnel and machines for decommissioning and the removal of waste from the reactor building;
- minimise the volume of radioactive waste;
- reduce the operator intervention time; and
- minimise the chemical toxicity of the waste.

5.5 Decommissioning Strategy

5.5.1 The decommissioning strategy to be employed for HPC is early site clearance. This strategy means that decommissioning would commence as soon as practicable after EoG and would proceed without significant delay to complete the process of decommissioning of the site. The decommissioning plan for HPC estimates that the decommissioning of the site, with the exception of the Interim Spent Fuel Store (ISFS), could be achieved approximately 20yrs after the EoG.

5.5.2 The process of decommissioning would be divided into a number of activities leading to the complete decommissioning of the site. For the UK EPR these are as follows:

- Activity 0: Pre-Closure Preparatory Work.
- Activity 1: Spent Fuel Management.
- Activity 2: Site Operation and Plant Preparation.
- Activity 3: Management of Operational Wastes.
- Activity 4: Plant Decommissioning.
- Activity 5: Site Clearance and Release for Re-use.

5.5.3 In many cases the activities overlap significantly in time, and are not necessarily sequential. The following sections outline each of the activities.

5.5.4 It is important to note that it is currently assumed that for this two UK EPR reactor unit site at HPC, Unit 2 would cease generation approximately 18 months after Unit 1.

5.6 Decommissioning Activities

a) Activity 0: Pre-closure Preparatory Work

5.6.1 Several years before the planned closure date for a reactor unit, a programme of preparatory work would be initiated to ensure that there is no delay to commencement of decommissioning following EoG and to ensure that the site is decommissioned as efficiently and economically as possible. This phase is anticipated to include the following:

- introduction of a final fuel cycle to maximise the utilisation of the nuclear fuel;
- preparation of a detailed decommissioning plan;
- preparation of an Article 37 submission (required to determine the acceptability of the radiological impact of decommissioning HPC on other EU member states);
- undertaking an EIA and preparation of an ES for commencement of decommissioning;
- preparation of further arrangements for compliance with Nuclear Site Licence Condition 35 to ensure safe and controlled decommissioning of the site;
- preparation of a decommissioning schedule;
- revisions to outage management;
- revisions to the requirements for maintenance, inspection and testing of systems and equipment;
- revisions to Radioactive Substances Regulation Environmental Permit for waste discharge and disposal; and
- revisions to site safety management arrangements.

5.6.2 Some of the activities listed above will require formal approval by regulatory bodies, therefore the preparation of these submissions will need to be commenced up to five years before the planned EoG.

b) Activity 1: Spent Fuel Management (Defuelling)

5.6.3 The first major activity following EoG would be the defuelling of the reactors. Defuelling would proceed as soon as practicable following reactor shutdown. The process would be undertaken using the existing fuel handling equipment, safety case and operational procedures.

5.6.4 Fuel would be removed from the reactor core within a few weeks of EoG. The fuel would be transferred to the reactor fuel pools and remain in storage in the reactor fuel storage pools for a period of cooling (approximately three years) before the spent fuel is transferred to the ISFS.

5.6.5 It has been determined that the final load of spent fuel would need to remain in storage within the ISFS for a period of approximately 50yrs after removal from the reactor (see **Chapter 7** of this volume for further details on spent fuel management). As a consequence there would be a need for periodic refurbishment and replacement of plant and equipment of the facility. In addition, during operation of the site a number of services are provided from the power station itself, (e.g. a secure electrical supply, waste treatment facilities and liquid effluent discharge). Each of these would need to be secured via an alternative arrangement to support the ISFS after decommissioning of the power station.

c) Activity 2: Site Operation and Plant Preparation

5.6.6 This section describes the "operation" of the site during decommissioning and management of the fuel and wastes. The scope of activities includes:

- safe operation of the plant after EoG, including resources for fuel and operational waste management;
- making plant and equipment safe for subsequent dismantling;
- Post Operational Clean Out including the removal of hazardous chemicals and clean up of radioactive materials;
- new liquid effluent discharge arrangements; and
- new alternative services (e.g. electrical supply).

5.6.7 As defuelling, operational waste management and other decommissioning work proceed, various systems are required to remain operational to maintain the safe operation of the plant. These systems would continue to be operated by experienced site staff employing the same or very similar procedures to those utilised during the operational life of the plant.

5.6.8 Following final shutdown of the reactor, plant systems, electrical equipment which are not required for safety reasons would become progressively redundant. Redundant electrical systems would be isolated and made safe. Redundant mechanical plant and systems would be taken out of service and isolated, drained and purged or flushed and vented to make them safe, and potentially hazardous materials would be removed from site as soon as is reasonably practicable.

5.6.9 To facilitate decommissioning, and the removal of some of the services, alternative services need to be installed. These include, for example, a new site electrical supply and distribution system and alternative liquid effluent discharge arrangements. These would enable the decommissioning of the existing high voltage electrical systems and of the cooling water system at the appropriate time.

d) Activity 3: Management of Operational Wastes

5.6.10 How radioactive waste is managed depends to a large extent on how radioactive it is. There are three main categories of radioactive waste defined in UK legislation; these are defined in **Table 5.1**.

5.6.11 Some waste which contains very little radioactivity is exempted from regulation by an Exemption Order currently issued under the Radioactive Substances Act 1993[1]. Exempt waste does not need require a specific permit for disposal.

Table 5.1: Radioactive Waste Categories

Waste Type	Description
Low Level Waste (LLW)	This comprises materials from routine operations and decommissioning with primarily low concentrations of beta/gamma contamination, but may include small amounts of alpha contaminated material. In the UK LLW may be treated and disposed of through a variety of routes including the national LLW Repository (the LLWR), via commercial incinerators, other treatment facilities, or in certain cases to specific approved landfill (see below). Some LLW which is not suitable for disposal within the LLWR would be stored until the national Geological Disposal Facility (GDF) is available. In the UK, LLW is defined as waste with a radioactive content exceeding 400kBq in any $0.1m^3$ and 40kBq per article (unless the activity is due to carbon-14 or tritium, in which case the limits are a factor of ten greater) but not exceeding 4GBq/te of alpha radioactivity or 12GBq/te of beta/gamma radioactivity.
Very Low Level Waste (VLLW)	A sub-set of LLW is categorised as VLLW which consists of the least radioactive component of the LLW category and may therefore be suitable for alternative disposal or treatment routes. VLLW from nuclear power stations would be classed as High-volume VLLW and could be disposed of to specified approved landfill sites. The waste would be subject to controls on its disposal which would be specified by the Environment Agency.
Intermediate Level Waste (ILW)	Waste containing higher concentrations of beta/gamma contamination and sometimes alpha emitters. There is little heat output from this category of waste. These wastes usually require remote handling. Such waste comes from routine power station maintenance operations, for example used ion exchange resin and filter cartridges. ILW generated during power station operations would be stored in purpose built facilities which may if necessary incorporate shielding to protect operators from radiation. Some ILW is treated as it arises to put it into a more inert, passively safe, form. This is known as conditioning. In the UK, ILW is defined as waste with a radioactive content exceeding that of LLW but which does not require heat dissipation to be taken into account in the design of storage or disposal facilities.
High Level Waste (HLW)	Waste containing high concentrations of alpha/beta/gamma emitting radionuclides. HLW only arises from nuclear fuel reprocessing operations and therefore would not be generated during operations at HPC. HLW generated during reprocessing of spent fuel requires remote handling (due to the radiation levels) and cooling (due to the heat produced) for many years. In the UK, HLW is defined as waste in which the temperature may rise significantly as energy is released by radioactive decay, so this factor has to be taken into account in designing storage or disposal facilities.

[1] The exemption orders are currently being revised and in the future will be implemented under the Environmental Permitting Regulations.

5.6.12 Operational wastes held in the operational vessels (e.g. ion exchange beds and filters utilised in effluent treatment), will need to be retrieved and processed after the EoG. Additionally there would be some operational type wastes that continue to be produced after the EoG as some essential systems would remain in service for a short period after EoG. These operational wastes would be retrieved and processed at the earliest practicable opportunity after EoG.

5.6.13 It is assumed that the GDF will be available to take these wastes at EoG, so the packaged waste arising from the ILW processing plants would be consigned directly to the GDF with no requirement to transfer packages to the on-site ILW Interim Storage Facility (ILWISF). Further it is also assumed that the packaged waste in storage can be retrieved from the ILWISF and despatched to the GDF for disposal at this time.

5.6.14 The Radioactive Waste Management Directorate (RWMD) of the Nuclear Decommissioning Authority (NDA) has indicated in its 2010 document "Geological Disposal – Steps towards implementation March 2010" (Ref. 5.13), that a UK GDF could be available to accept ILW for disposal by 2040. More recently in June 2011, Charles Hendry, the Energy Minister, has said that he would like to "*Set a goal of putting the first waste into a geological disposal facility by the end of 2029. I have tasked the Nuclear Decommissioning Authority to look at opportunities for accelerating progress to meet this aim.*" Given that these dates are for the disposal of existing legacy waste, it is considered that it is highly improbable that by the time EDF Energy would begin disposal of waste to the facility (some 40yrs after the proposed start of legacy ILW disposal) there will be no UK GDF available to accept the waste.

5.6.15 For the purposes of decommissioning planning it is assumed that the scheduling of transfer waste to the GDF can be optimised to allow transfer of packaged ILW during the main site decommissioning phase. However if optimisation requires a further period of interim storage the life of the on-site ILWISF may need to be extended until the GDF is available.

5.6.16 The strategy for the remaining operational low level waste (LLW) is identical to that for waste generated throughout electricity generation operations (i.e. it would be disposed of as soon as reasonably practicable following treatment to minimise volumes in line with the HPC Integrated Waste Strategy).

5.6.17 As with LLW, EDF Energy expect the ILW remaining in operational vessels at EoG would be processed in the same manner as ILW managed during the nuclear power plant operations subject to demonstrating this remains BAT. ILW would be retrieved and processed to ensure the waste is in a passively safe final form to be transferred from the site to the GDF.

5.6.18 Further detail on the management and disposal of operational radioactive waste is set out in the Radioactive Waste and Spent Fuel Management section of the ES (**Chapter 7** of this volume).

e) Activity 4: Plant Decommissioning

5.6.19 This activity covers the complete decommissioning of all plant, equipment, buildings and facilities at the power station site, and the management of the wastes arising from decommissioning activities. The activity includes the removal of all permanent buildings and facilities on the site with the exception of the ISFS and its supporting infrastructure.

5.6.20 The scope of this activity includes the decommissioning of the reactor and primary circuit and all other plant and equipment in the 'Nuclear Island', as described in **Chapter 2** of this volume, the processing of the wastes arising, and their packaging for disposal or recycling as appropriate.

5.6.21 The decommissioning of the 'Conventional Island' includes all power generation plant, ancillary plant and offices and welfare facilities. It is envisaged that the offshore structures would be demolished and removed to sea bed levels and on shore sections of the cooling water tunnels would be made safe.

5.6.22 All structures including roads, hard standings, cable and pipe trenches would be removed to 1m below ground. Basements would be adapted to permit free flow of groundwater, and would be backfilled with suitable infill material originated on-site from the demolition of buildings, supplemented, if necessary, with imported material.

f) Management of Decommissioning Wastes

5.6.23 Estimates of the volume and characteristics of radioactive waste generated during decommissioning have been developed as a basis for the development of the site decommissioning plan and the costs that will need to be covered by the FDP. The types of wastes expected to be generated during decommissioning are presented in **Table 5.2**.

5.6.24 During decommissioning, waste would be generated as a result of removing plant, equipment and structures, buildings and facilities at the power station site. The largest volume of this waste would be non-radioactive and suitable for reuse, recycling or disposal at suitably authorised sites. LLW generated during the decommissioning process would be disposed of to a suitably authorised site, this may include disposal of VLLW to an authorised landfill where this represents BAT.

5.6.25 The full range of waste minimisation methods will be used to reduce the amount of waste produced during decommissioning to as low a level as practicable, including decontamination, volume and size reduction and appropriate segregation of the waste to enable:

- the maximisation of materials recycling;
- minimal production of waste which is difficult to dispose of, particularly, long-lived, high activity waste and chemically hazardous wastes;
- minimal production of 'secondary' waste (equipment and materials used for the decommissioning); and
- maximum use of safe, radiologically exempt and chemically inert crushed and graded demolition material, such as brick and concrete, for backfilling voids, thus minimising the import of clean backfill material onto the site, subject to an appropriate waste disposal license.

g) Management of Radioactive Wastes during Decommissioning

Table 5.2: Types of Wastes Generated during Decommissioning

Waste Type	Description
Activated Waste	Activated products are created when stable chemical elements are bombarded by neutrons and turned into radioactive versions (isotopes) of the element. Typically these are produced from elements, such as cobalt, which are incorporated in the steel structure of nuclear reactors.
Contaminated Waste	Radioactive contamination is caused by radioactive material being deposited on the surface of, or within, objects. The radioactivity may be deposited from gaseous sources, from liquid sources, or from physical contact. Radioactive contamination is generally located on or near the surface of materials like metal or high-density concrete or painted walls. Radioactive contamination can usually be removed from surfaces by washing, scrubbing, spraying, or by removing the outer surface of the contaminated objects.
Primary Waste	Primary decommissioning waste refers to waste generated during dismantling activities. Primary waste will include plant system components; such as the pressure vessel and associated internal components, primary circuits, steam generators and the concrete shield that surround the vessels. Typically, primary waste consists of construction materials, such as steel and reinforced concrete.
Secondary Waste	Secondary waste refers to waste generated during various decontamination and dismantling activities (e.g. decontamination of metallic components or flushing of systems to reduce the amount of primary waste). Secondary waste consists of liquid waste, spent ion exchange resins, spent filters, and dry active waste.

5.6.26 ILW and LLW generated during decommissioning would consist of primary and secondary wastes. Primary waste varies widely in terms of type, activity, size and volume, and consists of both activated and contaminated components. Estimates of the quantities and characteristics of decommissioning ILW have been developed based on modelling of the neutron flux (a measure of the radiation field within the reactor capable of causing activation), the projected power history, and material composition data for the core of a UK EPR reactor unit. Activated components would have both short lived and long lived radionuclides resulting from the activation of the reactor material.

5.6.27 In addition to the activated waste, some surfaces, including building materials and process equipment and components would be contaminated by radioactive deposits. These deposits result from the transport of activated corrosion products, which occurs to a small extent in normal operation, and of fission products which may, in exceptional circumstances, be released from the fuel assemblies during reactor operation.

5.6.28 The strategy for the main components of the primary circuit, such as steam generators and pressurisers, is to remove them intact from their operational location, and to cut them up and package the wastes in a dedicated facility. This facility will also process, assay and package the other radioactive decommissioning wastes arising from the decommissioning of both reactor units. This facility is the Decommissioning Waste Management Facility (DWMF).

5.6.29 Following deplanting and backfilling of Unit 1 turbine hall, it would be converted into the DWMF for:

- processing of primary circuit and other large components requiring radiological precautions;
- receipt and buffer storage of raw LLW and ILW;
- further processing of LLW and ILW as necessary; and
- assay, packaging and buffer storage of packaged waste for disposal.

5.6.30 Other wastes would be generated during various decontamination and dismantling activities (e.g. decontamination of metallic components or flushing of systems to reduce the amount of primary waste). This waste would consist of liquid waste, spent ion exchange resins, spent filters, and dry active waste such as personal protective equipment, paper, and plastic. This waste will be managed and processed through the existing HPC waste management facilities or through the DWMF.

5.6.31 **Table 5.3** presents an estimate of the amount of waste produced by the two UK EPRs proposed at Hinkley Point C during decommissioning, based on an operational life of approximately 60yrs and a decommissioning strategy of early site clearance (Note these figures do not include waste arising from the decommissioning of the ISFS).

Table 5.3: Estimated HPC Decommissioning Waste Quantities (Based on two UK EPR Units)

	ILW (t)	LLW (t)	VLLW (t)
Primary Nuclear Island decommissioning waste	1,559	8,885	14,438
Clean-up waste (secondary waste from the decontamination, decommissioning and clean-up of the plant)	129	320	1,966
Process waste (filters and ion exchange resins arising from decommissioning activities)		642	
Induced waste (waste produced by equipment and material used in decommissioning)			1,642
Technological waste (waste plant and equipment used in decommissioning)		532	4,790
Total (t)	**1,688**	**10,379**	**22,836**

5.6.32 Surface treatment of contaminated materials can substantially reduce the amount of waste which has to be sentenced for final disposal as radioactive waste. In particular, the use of chemical cleaning or blasting of the surface and melting of metallic material can increase the amount of material suitable for unrestricted or restricted release. The use of these methods will be balanced against possible liquid and gaseous discharges arising from their use.

5.6.33 Appropriate segregation and decontamination procedures would be implemented to reduce, as far as is reasonably practicable, the volume of radioactive materials requiring treatment or disposal.

h) Disposal of ILW Generated During Decommissioning

5.6.34 As part of the ongoing Generic Design Assessment process, the views of the Nuclear Decommissioning Authority RWMD were sought on the likely acceptability for disposal in a GDF of packaged primary ILW generated during decommissioning of the UK EPRs. RWMD indicated that, in principle, any of the proposed waste packages would be acceptable for disposal. EDF Energy would continue to work with RWMD to ensure that packaged ILW from HPC would be acceptable for disposal in a GDF (Ref. 5.14).

5.6.35 ILW arising during decommissioning from decontamination and dismantling activities (i.e. secondary waste, would have similar characteristics to those wastes generated during the operation of HPC), therefore EDF Energy is confident that all wastes would be acceptable for disposal. EDF Energy is developing its decommissioning plans with due consideration of the potential disposability of any waste produced.

i) Management of Non-radioactive Waste During Decommissioning

5.6.36 Decommissioning activities would inevitably create large quantities of non-radioactive wastes during the deplanting and demolition of the non-radioactive and ancillary buildings and during final site clearance. It is anticipated that clean concrete and brick rubble from demolition of building structures would be crushed and retained on-site. It is planned to re-use as much of this material as possible on-site as infill for basement voids. This would minimise the environmental impact by reducing the amount of waste that has to be transported off-site for reuse, recycling or disposal to a landfill site.

5.6.37 Other non-radioactive wastes would be segregated and sent off-site for reuse or recycling (e.g. steelwork from building structures and redundant plant would be segregated and may be sold for recycling if a route is available). Materials unable to be reused or recycled would be disposed of to landfill.

5.6.38 Hazardous wastes would similarly be identified, segregated and securely stored on-site before transfer to permitted treatment or disposal facilities.

5.6.39 During the preparatory work stage, hydrocarbon fuels, refrigerants, oil and other chemical systems would be drained down and tanks emptied. Where possible these materials would be reused on-site, or sent off-site for re-use or recycling.

j) Final Decommissioning of Interim Spent Fuel Store (ISFS)

5.6.40 The ISFS would be utilised on the site to store the full operational lifetime arisings of spent fuel from the reactors. The current assumptions regarding availability of a GDF for spent fuel, and the length of cooling time before the fuel is suitable for disposal mean that a period of storage on the site would be required after the decommissioning of the reactors and other facilities.

5.6.41 It has been assumed that the date for start of transfer of spent fuel from the HPC site to a GDF is 2128. The process of transfer from the site could be completed in about 8.5yrs therefore all fuel could be removed from the site by 2136. Further detail on the management and disposal of spent fuel is set out in the Radioactive Waste and Spent Fuel Management section of this document (**Chapter 7** of this volume). On completion of transfer of the spent fuel from site for disposal, the ISFS would be decommissioned.

5.6.42 The decommissioning of the ISFS would be a relatively simple project. The techniques for decommissioning of wet spent fuel storage facilities, including pool clean up, are well developed internationally. The decommissioning process is anticipated to include:

- drainage and decontamination of the fuel storage pool;
- dismantling of the fuel storage racks and other pool furniture;
- dismantling of the fuel handling facilities;
- decontamination, drainage and dismantling of the pool water treatment plant;
- dismantling of the ventilation systems;
- decontamination and radiological clearance monitoring of the storage facility; and
- demolition of the storage facility and remediation of the site.

5.6.43 Appropriate radiological precautions would be employed throughout the process to minimise the spread of contamination and the quantities of radioactive waste, so as to ensure the safety of the public and workforce. All radiological and hazardous wastes would be packaged and disposed of appropriately, with clean non-radioactive waste reused or recycled wherever possible. Clean demolition rubble from decommissioning of the ISFS would be utilised to backfill ISFS basement areas.

k) Activity 5: Site Clearance and Release for Re-use

5.6.44 The current assumption for completion of the decommissioning process is the complete radiological clearance and de-licensing of the site.

5.6.45 Site clearance monitoring, remediation, landscaping and de-licensing would be undertaken in two phases. The first and largest phase would be undertaken following completion of the decommissioning of the power station plant and ILWISF. At this stage the ISFS would still be operational. The second phase would be undertaken on completion of emptying and decommissioning of the ISFS.

5.6.46 It is assumed that the original site licence and licensed area would be reduced to that required for the ISFS during the first phase of decommissioning. For the area to be cleared and de-licensed in the first phase a radiological and chemical survey would be undertaken and any necessary remediation carried out. On completion of this the site would be clearance monitored to check that all radioactive materials of regulatory concern have been removed from the site. Subject to the ONR being satisfied that there is no danger from any radioactivity on site, it would then be de-licensed. Upon completion of spent fuel transfer and decommissioning of the ISFS a further radiological and chemical survey would be undertaken and any necessary remediation carried out followed by de-licensing of the ISFS land.

5.6.47 The final stage of decommissioning would be the removal of the nuclear licensing requirements from the site. The ONR has published a policy statement setting out its criteria for de-licensing (Ref. 5.15). A licensee's period of responsibility does not end until there is no longer any danger from radioactivity on the site. Therefore, in seeking to end the licensee's period of responsibility, a safety submission would need to be made for the ONR's agreement. To de-license the site the ONR would establish that the site represents no danger to future site users from:

- licensee's evidence;
- ONR's own independent assessment; and
- evidence provided by the Environment Agency.

5.6.48 Once the criteria for "no danger" set by the ONR is met, the ONR would be able to de-license all or part of the site, thus ending the licensee's period of responsibility.

5.6.49 An important factor in site clearance would be the demonstration that the site has been cleared of all man-made sources of radioactivity originating from the operation of the reactors on the site to below an appropriate risk level.

5.6.50 The decommissioning EIA process would require significant consultation with statutory and non statutory bodies and their views would need to be considered before reinstatement proposals can be finalised.

5.6.51 For planning purposes it is assumed that the site is reused for industrial purposes but it is also assumed that landscaping of the site and return to grassland will be an interim measure.

5.7 Environmental Assessment of Decommissioning

5.7.1 As stated previously, in order to decommission a nuclear reactor it is necessary to obtain consent from the ONR under the Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 (EIADR99) (Ref. 5.1). This would require the submission of an ES and a period of public consultation prior to gaining approval for the commencement of decommissioning. A full EIA would be carried out as part of the process of obtaining consent to decommission HPC at the EoG, indicatively 60yrs after the start of operations.

5.7.2 The EIA would determine and describe the baseline conditions for the decommissioning works as they exist at the relevant time. This would be informed by any specialist surveys that may be necessary. The EIA would identify changes to the baseline conditions that would occur as a result of the decommissioning works and determine the scope, duration, magnitude and significance of the resultant impacts. The EIA would consider the relevant legislation in place at that time.

5.7.3 There are substantial uncertainties with respect to the characteristics of the future baseline conditions. In addition the technology which may be available to assist with the decommissioning works may change relative to current knowledge and capability. The location of the GDF is also not known at present and thus off-site impacts relating to the transportation of waste materials that may be disposed at the GDF cannot be fully assessed. Despite these uncertainties the types of environmental impacts that may occur during decommissioning and their broad scope have been identified and summarised below. The summary is based on the assumption that the decommissioning activities would largely be confined within the boundaries of the HPC permanent development site.

5.7.4 At the end of the decommissioning phase there would be a significant reduction in the amount of land occupied by buildings and other structures. The end state of the land following decommissioning is not certain at present, but is currently assumed to be re-used for industrial purposes with return to grassland as an interim measure.

a) Socio-economics

5.7.5 There will be a run down in workforce numbers from the operational phase to decommissioning after EoG and this will be the main socio-economic impact. The manner in which the run down in workforce numbers will take place is not fully known at present.

5.7.6 There will, however, be an increase in direct employment for contractors completing decommissioning activities. The services of specialist technology providers will also be required and their input will contribute to the knowledge economy of the area.

5.7.7 There may be a demand for local accommodation for out of the area workers although the use of local workers will be encouraged. There will also be expenditures during the decommissioning activities for material, plant and equipment supplies and by the decommissioning workforce personnel.

5.7.8 The assessment would determine the social and economic impacts related to the works and the deployment of the workforce. Requirements for worker accommodation and the need for support services such as health care and education would be evaluated relative to the provisions available in the local area at the time.

b) Transport

5.7.9 With the change in the workforce profile there will be a change in the pattern of worker trips to and from the site. It is likely that the decommissioning workforce numbers will be substantially less than the construction workforce. There will also be a change in the pattern of worker journeys to and from the site relative to the operational phase.

5.7.10 There will be an increase in traffic movements relative to the operational phase associated with the delivery of materials, plant and equipment required to facilitate the decommissioning works and the export of certain waste arisings. Vehicle trip generation is likely be substantially less than for the construction phase.

5.7.11 The transport assessment would determine the scope, magnitude and significance of impacts on the highway network and users of the network by applying the additional traffic related to decommissioning to the baseline traffic flows that apply at the time the works are scheduled to be carried out.

c) Noise and Vibration

5.7.12 Noise levels may be temporarily increased at the nearest sensitive receptors during the decommissioning phase relative to the operational phase. Noise levels will vary according to the particular activities being undertaken at any given time. There may be short-term peaks in noise levels associated with certain activities such as demolition of above ground structures.

5.7.13 As stated in Paragraph 5.7.3, decommissioning activities will be largely confined to the northern part of the HPC development site. It is considered that the noise impacts to local residents from decommissioning are likely to be of lower magnitude than during construction due to the substantial separation distance between the activities and residential dwellings.

5.7.14 The assessment would predict noise levels at sensitive receptors (principally residential dwellings) resulting from the decommissioning works on-site using appropriate predictive techniques. It is likely that noise modelling would be undertaken. In addition assessment would be undertaken of noise related to traffic associated with the works.

d) Air Quality

5.7.15 Air emissions during decommissioning will primarily comprise emissions from vehicles on the highway network and dust from demolition and site clearance activities.

5.7.16 Dust emissions will be controlled through the implementation of best construction practices. Since decommissioning activities will be focussed on the power station buildings and infrastructure it is not anticipated that dust generation will be a significant issue to off-site receptors (particularly residential receptors to the south of the HPC development site).

5.7.17 The assessment will provide predictions of air pollutant concentrations at sensitive receptor locations and will determine the scope, magnitude and significance of impacts on this basis. It is likely that air quality modelling would be undertaken.

e) Soils and Land Use

5.7.18 Soils and land use impacts will be limited to any areas of the HPC development site that may be temporarily required for decommissioning activities. The spatial extent of potential impacts would be much reduced compared to that related to the construction phase of HPC. Areas which are subject to impact during the works would be subject to appropriate restoration to enable use after completion of decommissioning. No significant adverse impacts on soils and land use are anticipated.

f) Geology, Land Contamination and Groundwater

5.7.19 Decommissioning may require some excavations to be undertaken adjacent to the below ground structures but these excavations will not result in significant impacts upon geological resources. Uncontaminated debris generated from demolition and clearance of above ground structures may be used to infill excavations. Material required for the backfilling of voids will be generated on-site as far as is practical.

5.7.20 The topography of the HPC site will have been modified during construction and landscape restoration post construction. The decommissioned site will be contoured after completion of works in accordance with requirements for the identified future use. It is likely that limited only regrading would be undertaken irrespective of future use.

5.7.21 It is not anticipated that contaminated soils will be present on site or that contaminated groundwater will be encountered during decommissioning works Monitoring of soil and groundwater contaminations status will continue during the operational phase of HPC and this information would be used to establish the baseline conditions prior to the commencement of decommissioning. In the unlikely event that contamination is identified it will be subject to appropriate management prior to commencement or during the execution of the works.

5.7.22 It is unlikely that groundwater dewatering will be required during decommissioning therefore no significant impact on groundwater behaviour is anticipated. Following completion of the works, the operational phase groundwater level control system is likely to become redundant. This will allow groundwater levels to equilibrate to a more natural state.

g) Surface Water

5.7.23 When the operational site's cooling water outfall and associated infrastructure are no longer available during decommissioning, the surface water runoff that flows into the outfall would need to be managed as necessary in the interim period during the works by diverting flows to suitable discharge locations which may include surface watercourses and/or to the intertidal zone.

5.7.24 Best practices will be implemented during the works to avoid the discharge of sediment laden water off-site into surface watercourses. Due to the distance of the decommissioning area from the site boundary, there would sufficient land area to allow effective management of runoff to ensure that sediment release does not occur.

5.7.25 No significant impacts on surface water receptors are anticipated as a result of the decommissioning works.

h) Terrestrial and Marine Ecology

5.7.26 During decommissioning the need for cooling water discharge from the reactors to the marine environment will cease and hence no impacts related to thermal discharges will occur. The generation of operational effluents will end thus the discharge of chemical and radiological substances will reduce over time. The cessation of cooling water intake will result in positive impacts with respect to a reduction of the entrainment of fish and other marine organisms.

5.7.27 It is not proposed to remove the HPC sea wall and thus there should be no requirement for significant decommissioning works in the intertidal area and hence no significant adverse impact on ecological receptors in this area or in the offshore areas is anticipated.

5.7.28 It is proposed to remove the intake and outfall structures but these works will be very limited in spatial scale and of limited duration. No significant impacts upon marine ecology receptors are anticipated as a result of these works.

5.7.29 Nevertheless, care will be taken through the design and execution of the works to avoid adverse effects on protected habitats such as Sites of Special Scientific Interest (SSI), National Nature Reserves (NNR), Special Protection Areas (SPA), Special Areas of Conservation (SAC) and County Wildlife Sites (CWS). The nearby protected habitats which are currently afforded protection are described in detail in **Volume 2**, **Chapters 19** and **20** of this ES.

i) Landscape and Visual

5.7.30 There will be some visual impacts due to the presence of construction plant and equipment during the decommissioning phase. However, the impacts will be temporary and after the decommissioning is complete all above ground structures will be removed. The landscape setting will differ from both the present baseline and the baseline at the EoG when both HPA and HPB are likely to have completed decommissioning. It is expected that there would be an interim period while the ISFS is still present in the north-east of the HPC development site before the site is totally cleared.

j) Amenity and Recreation

5.7.31 Dependant on the chosen end state of the site, there is the potential for the provision of new Public Rights of Way or other amenity uses.

5.8 Conclusions

5.8.1 This chapter has set out the anticipated approach to decommissioning for HPC and has outlined how it would meet Government policy and regulatory requirements.

5.8.2 Decommissioning plans for HPC estimate that the decommissioning of the site would be achieved approximately 20yrs after the EoG. At the end of this stage all buildings on the site will have been removed with the exception of the ISFS which will continue to operate until a GDF is available and the spent fuel is able to be disposed. Final decommissioning of the ISFS is planned to be completed by approximately 2140.

5.8.3 The types of environmental impacts anticipated to occur during decommissioning have been identified as far as can be determined at this point in time, however the decommissioning would be subject to an EIA under the decommissioning EIA regulations. Other regulatory requirements including the need to renew, and where necessary amend Environmental Permits will also be addressed.

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CHAPTER 6: ALTERNATIVES

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TABLES

FIGURES

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6. ALTERNATIVES

6.1 Introduction

6.1.1 This chapter presents the principal alternatives that have been addressed in the context of the design of the Hinkley Point C (HPC) development. The scope of the alternatives which have been considered during the evolving design process range from localised siting arrangements for the HPC power station and related infrastructure, to specific aspects of the power station design and proposals for the landscape restoration of the HPC Development Site upon completion of construction works. The alternatives which are described in this chapter have been included as they concern issues of relevance to the environmental impacts for the HPC Development Site and surrounding area.

6.2 Local Site Selection for HPC

6.2.1 One of the principal determining factors in the selection of the most appropriate site for HPC has been the presence of the existing Hinkley Point Power Station Complex. It is preferable to site a new nuclear power station as near to an existing power station as possible to minimise the landscape and visual impacts as the physical characteristics of HPC will be similar to the existing adjacent development. This would not be the case for an equivalent development within a greenfield setting. Co-locating alongside existing facilities provides other benefits including the ability to use existing infrastructure, for example access roads and power transmission lines.

6.2.2 Given the requirement for large volumes of cooling water for the operation of HPC and the prohibitive cost and significant energy consumption requirements associated with pumping water inland, HPC needs to be sited near to the coast. In terms of land use in relation to the existing nuclear complex and in view of the need to take advantage of existing infrastructure a location either directly east or west of the existing plant would be the best option.

6.2.3 The proposed siting of HPC was subject to consideration at the pre-application Stage 1 consultation in 2009. The areas which were considered at that time are shown in **Figure 6.1**. Following an evaluation of the land available, the area to the west of the Hinkley Point A station (the Hinkley Point C development site) was considered to be the most suitable for new nuclear development. The principal issues considered during the site selection process are outlined in **Table 6.1**.

Table 6.1: Hinkley Point Nuclear Power Station Location Assessment

Local Siting Criteria	East of the Existing Power Station Complex	West of the Existing Power Station Complex
Environmental Designations – International and National	The site is located within the Severn Estuary Special Protection Area (SPA), Severn Estuary Ramsar Site and Sites of Special Scientific Interest within Bridgwater Bay. The site lies adjacent to a number of designated sites of ecological importance including: Severn Estuary Special Area of Conservation (SAC) and Bridgwater Bay National Nature Reserve (NNR).	The majority of the site is undesignated. However, construction works will be necessary along the foreshore and these works lie within the Severn Estuary SPA; Severn Estuary Ramsar Site; Severn Estuary SAC; Sites of Special Scientific Interest within Bridgwater Bay and Bridgwater Bay NNR.
Flood Risk	The site lies within Environment Agency Flood Zone 3. The area would require substantial raising of existing ground levels to accommodate a new nuclear power station.	The site is suitable for development as a development platform can be readily created above the flood risk zone at 14m Above Ordnance Datum (AOD).
Landscape and Visual Impact	Ground raising is likely to have a significant impact on landscape character.	The existing topography of the land particularly the presence of the ridge line occupied by Green Lane will help assimilate the built development structures which will be to the north of ridge line into the surrounding landscape.
Access	Access is required to the site around the existing Hinkley Point Power Station Complex which would have landscape and ecology impacts.	The existing access road (Wick Moor Drove) lies adjacent to the eastern boundary of the site. This will help to limit the requirement for new primary access routes and reduce the impact of constructing new access roads into the site.
Existing Land Use	Low lying pasture land undisturbed by development.	Primarily agriculture with isolated derelict farm buildings. The north-eastern part of the site is used for car parking and training by the existing Hinkley Point Power Station Complex.
Cultural Heritage	The site has no Scheduled Monuments or Listed Buildings. Archaeological detail is not known. However, the area has not been disturbed by major development.	Site is near to Pixie's Mound Scheduled Monument.

6.3 Land Use

6.3.1 Public and statutory consultee responses to the Stage 1 consultation did not indicate concerns with respect to the suitability of the proposed site for HPC. Furthermore, the overall positioning and layout of the permanent power station buildings and infrastructure within the HPC development site have not been subject to significant debate. **Figure 2.1** within **Volume 2**, **Chapter 2** of the ES illustrates the location of the main power station structures including the reactor buildings, turbine halls and pump houses. These development elements remain largely unchanged from the locations shown in the Stage 1 consultation submission.

6.3.2 The principal focus of attention since Stage 1 has been on the use of land for construction purposes, particularly in the southern areas of the site which are closest to residential properties. Land use allocation within the site during the construction phase has predominantly been driven by the requirement for the creation of development and construction platforms to provide the necessary areas for construction activities and permanent buildings and infrastructure. The proposed extent of site levelling and terracing has evolved as a result of the need to minimise the volumes of material to be excavated whilst providing the necessary construction working areas and permanent development platforms. The excavation and terracing will require the management of approximately four million cubic metres of material in total, including topsoil, subsoil, material suitable for re-use in the power station construction (engineering fill principally comprising excavated rock) and material which is required to create the final restoration landform. To avoid road vehicle journeys, it is intended that the excavated material will be retained on site and therefore significant areas are required for interim materials stockpiling and storage prior to re-use. EDF Energy has addressed the requirements and available options for the siting of the following land uses during the site preparation works and subsequent construction phases:

- stockpiling of excavated rock for re-use as engineering backfill;
- subsoil and topsoil storage;
- contractors' working areas; and
- construction workers' accommodation campus.

6.3.3 In addition to assessing responses to Stage 1 consultation, EDF Energy has held specific discussions with the residents of Shurton and other surrounding villages in April and June 2010 on the proposed land uses within the HPC development site and the extent of the areas of land required for specific construction activities within the site. As a result of these discussions, EDF Energy reached an agreement with local residents that the main construction site fence would extend only as far south as Ordnance Survey Gridline 144750mN throughout construction of the power station thus limiting the main construction activities to the north of this line. This provision allows for an increased distance buffer between the southern extent of the principal construction activities and the closest residential properties as the 144750nM boundary lies to the north of the construction site boundary proposed at Stage 1. Some construction work will, however, need to be undertaken to the south of the main construction fence. These works include the construction of an emergency access road with an associated bridge crossing over Bum Brook, a water management zone(s) relating to surface water drainage and early landscaping, which will provide additional screening to occupiers of residential properties located to the south of the site from the main construction activities.

6.3.4 The proposed land uses within the HPC development site throughout the site preparation works and subsequent construction works are summarised in **Chapter 3**, **Volume 2** and illustrated further in the Construction Method Statement. See **Annex 5.3**.

6.4 Landscaping

6.4.1 Design of the landscape restoration of the HPC development site following completion of construction works commenced in 2009. At this time options for restoration were informed by the following requirements:

- retention of all excavated material within the site to avoid the need for removal, by road vehicles, of material which is not required for engineering purposes;
- retention of most of Green Lane due to its ecological, landscape and heritage value;
- final landform and interim materials stockpiling not to exceed the height of Green Lane;
- restoration of Holford Stream within the final landscape scheme in order to address the Environment Agency's policy which requires that culverting of watercourses should be avoided where possible; and
- provision of a mosaic of land uses including agricultural land and new wildlife habitat.

6.4.2 At this early stage, the design included proposals for the restoration of Holford Stream following completion of construction works for HPC. However, the volumes of excavated material which needed to be retained on-site post construction increased as engineering studies relating to earthworks progressed. The increased volume of material to be retained on-site resulted in the requirement to accommodate material permanently within the Holford Stream Valley. Therefore, the restoration of the valley profile to its baseline condition was not a viable option and the retention of Holford Stream in a permanent culvert became an essential engineering requirement. The requirement to retain the culvert was discussed and agreed with the Environment Agency and the Internal Drainage Board with decision making being informed through the provision of a culvert justification report by EDF Energy (Ref. 6.1).

6.4.3 Following the decision to retain the Holford Stream in culvert, the landscape restoration design progressed through a number of further iterations which focussed primarily on:

- the selection of the most appropriate profile for the restored landform to achieve compatibility with the character of the landscape in the locality of the HPC development site;
- treatment of boundaries around the perimeter of the site to provide screening of the construction works and the permanent built development through landforming and planting;
- creation of internal field boundaries in the restored landscape to reflect the typical pattern of field boundaries in the locality of the site; and
- provision of the appropriate proportions of different land uses in the restored landscape.

6.4.4 These design iterations were influenced by both formal consultation and dialogue with the following stakeholders:

- English Heritage;
- Natural England;
- Environment Agency;
- Somerset County Council;
- West Somerset Council;
- Sedgemoor District Council;
- Fairfield Estate;
- Commission for Architecture and the Built Environment; and
- Somerset Wildlife Trust.

6.4.5 The decision to increase the separation distance between the main construction works and the residential properties to the south of the HPC development site through the establishment of a buffer zone to the south of Ordnance Survey Gridline 144750mN provided opportunities for early planting and landforming to enable additional screening of the construction works and the permanent development to be achieved.

6.4.6 With the support of local residents, planting of a screening belt of vegetation including native tree species and shrubs has already been undertaken (March 2011) in order for this to have the longest possible time to mature prior to the commencement of construction of HPC. Additional planting of a hedgerow around Doggetts Farm is proposed in the winter planting season (2011).

6.4.7 Further to this, EDF Energy has considered alternative design options with respect to additional screening of the construction works and permanent development from the south. The Stage 2 Update consultation proposed early landscaping and ecological habitat creation to the south of main construction fence line. The design of this early landscaping has considered alternatives with respect to the most appropriate landform, plant species selection and planting layout to ensure the maximum screening benefit whilst meeting the objective of providing landscaping in keeping with the existing landscape character of the locality. The landform will result in the building up of the levels of the existing slope in the southern part of the HPC development site to provide visual screening whilst achieving smooth transitions in slopes from the adjacent land. The planting includes 3-6m high feathered trees to provide a high level of screening from the start of the construction phase. The early landscaping proposals were discussed with local residents and other consultees and include provisions for circular routes for walking together with bridleways for horse riding.

6.4.8 Extensive consultation has also taken place with the Fairfield Estate and other consultees to agree the screening landform and planting along the north-western boundary of the site and a range of alternative designs have been prepared for discussion and agreement with stakeholders in this context.

6.4.9 The final landscape scheme following construction of HPC has also been subject to design iteration and again alternative designs with respect to landform, planting and habitat creation have been prepared and discussed with stakeholders in order to ensure that the landscape design principles and objectives are met. From the outset, site landscape design was informed by the requirement to provide significant biodiversity gain relative to the existing baseline situation through the creation of extensive areas of new wildlife habitat. The principles with respect to the creation of new habitats were established at a very early stage. Specific features such as woodland and ponds have been included in the restoration design in response to consultee suggestions.

6.4.10 In response to consultee comments, habitat protection and creation proposals have been extended during the construction phase during the design process. Additional areas for habitat retention during the site preparation works phase have been identified and off-site planting of woodland and hedgerow on Fairfield Estate and , as part of site preparation wildflower meadow creation on nearby off-site agricultural land have been included in addition to the early landscaping of land south of the main construction fence line at latitude 144750nM.

6.5 Alternative Designs for Power Station Elements

a) Introduction

6.5.1 The design of the reactor and main elements of the Nuclear Islands are largely determined by generic EPR design requirements. However, for the HPC, elements of the associated power station infrastructure have undergone an iterative design process which has taken into account site-specific conditions and environmental, health and safety, and nuclear safety considerations. This section outlines where alternative designs have been considered for associated infrastructure that has significance with respect to potential environmental impacts and explains why the final design choices were made. Key alternative designs for the associated infrastructure are outlined below.

b) Alternatives for Cooling

i. Selection of Cooling Option

6.5.2 A number of potential alternative means of cooling the water used to condense steam after it has passed through power station turbines exist for new nuclear power stations in the UK. These alternatives have been reviewed by the Environment Agency (Ref. 6.2). An understanding of the alternatives and their respective benefits and drawbacks was fundamental to informing the EDF Energy and British Energy (BE) submissions to the Strategic Siting Assessment and EDF Energy's decision to proceed with an application for nuclear new build development at Hinkley Point.

6.5.3 There are three principal cooling options:

- air cooling (closed circuit) utilises an extensive array of radiators across which air is forced at high volume to effect heat loss directly to the atmosphere;
- tower cooling (again closed circuit) involves the dispersion and cooling of water in direct contact with incoming air, within a large tower (or towers), involving some evaporative heat loss from the cooling water circuit and the need to make-up for this loss; and

- direct cooling (open circuit) involves the transfer of heat directly from the condensers to a large volume of water which is typically abstracted from the sea or a major river by passing the water once through the condensers before returning it to the environment.

6.5.4 The development of the cooling infrastructure (heat sink) design for HPC has taken account of site-specific considerations and the substantial experience directly available to EDF Energy from the following sources:

- EDF SA's design for the heat sink for the Flamanville 3 EPR (FA3);
- EDF SA's operation of the heat sink plant for a fleet of 58 pressurised water reactors (PWRs) at 19 sites within France including four coastal locations (Gravelines, Paluel, Penly and Flamanville) and at an estuarine location (Blayais);
- BE's operation of the heat sink plant at the Hinkley Point B (HPB) site and at six other advanced gas cooled reactor (AGR) stations around the UK coast; and
- BE's operation of the heat sink plant at the Sizewell B PWR.

6.5.5 The experience of other nuclear plant operators (UK and worldwide) has also been considered, including that of Magnox who manage the adjoining Hinkley Point A (HPA) site and several other sites around the UK coast.

6.5.6 In addition to the local data already available from the operation of HPA and HPB, the following issues were considered to inform the development of the HPC heat sink design:

- bathymetry (i.e. sea water depth);
- sedimentology;
- geology;
- air temperature and humidity data;
- water temperature data;
- sea water composition (including turbidity and salinity);
- high and low water levels including astronomical tides, surge and wave heights;
- ship collision; and
- clogging potential from marine organisms, ice and other water-borne debris.

6.5.7 Feasibility studies were undertaken in 2008 to assess the key heat sink design options and in particular to compare the relative merits of open and closed circuit systems (and combinations of these). EDF SA's considerable experience in the use of closed circuit heat sink designs at inland sites was supplemented by meetings with closed circuit technology companies in order to assess the implications of using the turbid, saline water available from the Bristol Channel for use at HPC as make-up water for a closed circuit cooling system. The feasibility of each option was assessed for:

- nuclear safety, including:
  - protection against hazards (integrity, redundancy, segregation and diversity);
  - reliability and availability;

- environmental impact, including visual impact, noise and effects on flora and fauna;
- technical feasibility and proven performance;
- operability;
- inspection and maintenance requirements; and
- cost (capital and operating).

6.5.8 EDF Energy then undertook a major technical review of the heat sink option studies in December 2008 from which it was decided that the optimum design for the HPC heat sink would be an open circuit system drawing water through long offshore intake tunnels into one onshore forebay for each UK EPR reactor unit. The main factors which led to this decision were:

- A closed circuit design with cooling towers would be likely to have a significant visual and noise impact.
- A closed circuit design with sea water make-up would require a large-scale onshore water treatment facility to reduce sediment load and to undertake desalination because of the turbid, saline water available from the Bristol Channel for cooling at HPC. The disposal of large quantities of water treatment residue would pose operational and environmental challenges.
- A closed circuit design with sea water make-up would require on-site trials covering a full range of weather conditions to prove the operability and availability of the cooling towers, particularly if more basic water treatment options were considered.
- The site footprint of cooling towers and the associated water treatment facility and reserve basins would be large and necssitate a larger land area to be used for the power station.
- The availability of a closed circuit system with cooling towers would tend to be more vulnerable to extreme weather events than an open circuit system.
- At coastal sites, there is a far more operating experience using open circuits than closed circuits. All of the coastal nuclear power stations in the UK and France have open circuit heat sink designs.

6.5.9 The following issues related to open circuit design were recognised as requiring resolution, but operating experience and the design provisions developed for FA3 indicated that these were surmountable and not as substantive as the challenges presented by closed circuit designs:

- increased vulnerability of offshore cooling water infrastructure to marine hazards including clogging and ship collision;
- fish capture with cooling water intake;
- the discharge of cooling water at elevated temperature into the marine environment (thermal plume); and
- possible chemical dosing requirements to control marine biofouling.

6.5.10 During 2009, the concept design of the open circuit water intake and discharge progressed in conjunction with several supporting studies including initial assessment of the seismic integrity of the intake structures and the concept design of the intake heads (see on the next page).

ii. Length and Location of Cooling Water Intake and Outfall Tunnels

6.5.11 Aside from engineering practicability there are two primary considerations for the appropriate positioning of cooling water intake and outfall structures – the need for safe and efficient operation including the requirement to incorporate redundancy against hazards into the design, and the consideration of environmental sensitivities. To serve both requirements a detailed understanding of the physical conditions of the local marine environment is required, together with that of the dynamic processes that would govern the behaviour of the resultant cooling water plume.

6.5.12 The business and environmental risk associated with cooling water intake and outfall selection is high as, once built, subsequent alterations to infrastructure and specific items of plant would be exceedingly costly. As a result considerable care has been taken to obtain sufficient high quality data on the local marine environment in the vicinity of Hinkley Point and to develop the appropriate predictive tools to assess a series of potential alternative solutions.

6.5.13 Different levels of uncertainty exist within an assessment process of this kind and each is dealt with in turn by application of best practice. To describe the physical environment involved a sufficiency of data is required, both current and historical, and this is combined with an understanding of both likely forward trends of environmental change and a consideration of the range of possible future scenarios that might result, whether driven by deliberate management policy and associated infrastructure development or otherwise. For example, for HPC there has been a consideration of both the advice of UK government advisers on the likely effects of climate change, including the impact on sea level rise, and the use of expert groups of advisers in order to develop an understanding of a series of plausible alternative scenarios of coastal process change that could lead to changes in coastal geomorphology, sedimentation and bathymetry.

6.5.14 A key tool within this process is the use of predictive numerical hydrodynamic models. The models allow an understanding of the dispersion of a cooling water plume in the marine environment and its spatial extent relative to the locations of sensitive environmental receptors. In addition the models enable the interaction between cooling water intake and outfall locations to be determined both with respect to the proposed HPC infrastructure and the existing HPB infrastructure. Avoidance of recirculation of discharged cooling water is a fundamental requirement to ensure that the efficiency of the cooling water circuits for the existing HPB and proposed HPC power stations is maintained. Such models can be developed with a very high level of sophistication, based on the physical data acquired locally, and can be both validated with and calibrated against elements of that same data set. They nonetheless provide outputs which are only estimates, and when called upon to extrapolate a prediction for a situation for which there is little or no current data – such as a future coastal change scenario or indeed a new discharge location – there is, again, a degree of uncertainty involved. Best practice in this situation, if the cost is justified by the level of business and environmental risk, is to use a suite of differently designed numerical models independently constructed but subject to uniform standards of data quality input and peer review – this is termed 'ensemble' modelling. The secondary advantage of this approach is that, whilst allowing a cross-check between outputs and thus a reduction in uncertainty, such different models also provide a greater range of predictive and descriptive capability.

6.5.15 For HPC, two models have been used and some detail of this is provided in the Chapters on Coastal Hydrodynamics and Geomorphology, Marine Water and Sediment Quality and Marine Ecology (**Volume 2, Chapters 17**, **18** and **19**). These models were first used to test a series of alternative intake and outfall configurations for HPC in support of the heat sink design process and then to refine understandings of detail based upon a preferred option, in discussion with the regulatory authorities concerned.

iii. Cooling Water Intake Structure

6.5.16 On the basis of the numerical modelling work described above, and due to the extensive coastal modifications that would have been needed to secure a cross-shore intake given the extreme tidal range, an offshore intake position has been selected as the preferred option.

6.5.17 The requirements of such a structure are several: it must be sufficiently robust to function for the longer-term (60 years of power station operation) in the harsh physical environment concerned, with very limited opportunity for maintenance; it must abstract at a sufficient depth so as not to draw in air during extreme tidal conditions or in wave troughs; it must avoid interactions with bed sediment transport in order to avoid entraining solids that might accumulate within and block the cooling water system; and it must seek to limit the number of fish that could potentially be entrained (caught) with the water intake.

6.5.18 The engineering design solution that most recently evolved to meet the needs of nuclear site development in the UK was the ‘velocity capped’ intake design currently deployed at the Sizewell B power station. This intake stands proud of the seabed and abstracts water from within the lower water column from below an upper horizontal cap, designed to prevent water (or air) being drawn downwards from the sea surface. Through commissioning trials this intake structure and its relative offshore location was shown to reduce the rate of fish catch per unit water intake volume when compared to the catches of the adjacent Sizewell A power station.

6.5.19 With respect to the design of HPC the opportunity has been taken to revisit the velocity cap design, whose primary disadvantage in fish protection terms is that the intake port velocity varies with tidal condition. A conceptual design that had arisen through historic Central Electricity Generating Board (CEGB) research has been developed with the aim of achieving low intake port velocities throughout all tidal conditions, despite the very high tidal velocities concerned off Hinkley Point. Expert advice on the behavioural basis for fish exclusion at such structures has been employed in the development of this approach, which accords with the Environment Agency guidance (Ref. 6.2). The proposed intake head design enables a water intake velocity of not greater than 0.3m/s to be achieved which will minimise the entrainment of fish.

iv. Fish Deterrence, Recovery and Return

6.5.20 In addition to the limitation of water intake velocity at the intake heads, additional measures to limit the magnitude of fish entrainment have been considered following extensive consultation with the relevant regulatory bodies. In order to comply with BAT and in response to consultation, an Acoustic Fish Deterrence (AFD) system is proposed to further limit entrainment.

6.5.21 The recovery of fish that become entrained with the cooling water has also been considered and the decision making with respect to the most practical and efficient means of recovering entrained fish has been subject to engineering and environmental appraisal. The recovery of fish was deemed to be optimised at the point where the fish are caught (impinged) by the cooling water filtration systems. Several configurations of filtration recovery were considered along with the methods of collection and transfer of fish back to the marine environment. In particular, a range of methods was considered for the raising of fish from the filtration infrastructure to a sufficient height to allow gravity discharge back to the marine environment.

6.5.22 Various options have been considered for the return of fish and other marine organisms back into the marine environment. The main design requirement which applies in this context is the need to ensure that fish are returned into a sufficient depth of water at all tidal states. It is also necessary to ensure that returned fish are not entrained into the HPB cooling water intake.

6.5.23 Open and enclosed channels cut into the rock of the foreshore were considered. An open channel was rejected on the grounds of health and safety and the potential for the channel to be attractive to predators and for recreational angling. Although a closed rock cut channel would avoid these issues, it would lead to the requirement for significant construction works on the foreshore and thus the increased potential for environmental impact on sensitive ecological receptors in the intertidal zone.

6.5.24 A tunnel option was selected as it avoids the need for construction on the foreshore and provides a means of returning fish continually to the sea at all stages of the tide.

6.5.25 Four alignment options for the fish return tunnel (**Figure 6.2**) were assessed with respect to the following factors:

- potential for fish to be entrained in the intake water for HPB;
- tunnel length (abrasion and pressure issues which might affect fish survival prior to discharge);
- predation from sea birds;
- predation from fish and sea mammals;
- the requirement for the tunnel outfall to remain unblocked by sediment;
- sustainability of the outfall location given projected trends in relative sea level; and
- avoidance of the HPB thermal plume.

6.5.26 All four options have discharge locations that are below -6mODN which means that they would be covered by water during all tidal states. However, Options A and B would discharge into water depths of less than 1m at low tide and as a result returned fish are likely to suffer from significant predation by birds. Options C and D would discharge into a greater water depths (approximately 2m and 3m at low tide, respectively) which renders returned fish more likely to fall prey to other fish and sea mammals, however these forms of predation are considered less significant than predation by birds.

6.5.27 A predictive modelling study found Option C to be the most favourable in terms of minimisation of entrainment of returned fish in the intake water of HPB, as well as being the least likely to be affected by the thermal plume from HPB.

6.5.28 Option C would be the longest tunnel, but tunnel length was not considered to be important in terms of fish survival.

6.5.29 When the physical and topographical conditions at location of the outfalls were assessed, in particular with regard to the possibility of sedimentation and subsequent blocking of the fish return tunnel, Option D was found to be the best option because it is located within a relatively extensive area of scoured rock.

6.5.30 When all aspects are considered together, Option D is considered the most favourable option as it combines most of the favourable characteristics of Option C in terms of fish survival, with having the most favourable discharge location in terms of reduced sedimentation.

6.5.31 Option D is, therefore, the chosen alignment option for the fish return tunnel (**Figure 6.2**). This option would have an outfall that would discharge at 1m below the Lowest Astronomical Tide (LAT) mark and the tunnel would have a length of approximately 500m north of the shore.

v. Surface Water Drainage

6.5.32 In parrallel with the design of the earthworks and excavations required for the construction of HPC, considerable thought was given to requirements with respect to the management of surface water drainage during the construction phase, The existing topogarphy and proposed construction and development platforms to the north of Green Lane necessitate that surface water runoff within this area is discharged to Bridgwater Bay.

6.5.33 The rock platform within the intertidal area immediately to the north of the HPC Development Site contains open channels which support *Corallina sp* (a red algal species). EDF Energy recognised that discharge of surface water across the intertidal area under low tide conditions could impact the *Corallina* habitat and that engineering design should therefore consider options with respect to the location of the discharge in order to minimise such impact.

6.5.34 The evolving drainage design for the area of the HPC Development Site to the north of Green Lane resulted in proposals to collect surface water runoff into a series of three north/south orientated “spine drains”. In engineering terms the simplest arranagement would be to allow discharge of water from each of these spine drains directly to the intertidal area. However, this would result in surface water runoff being directed over *Corallina* habitat, the extent of which has been accurately mapped during detailed ecological surveys undertaken for EDF Energy.

6.5.35 As a result of the environmental sensitivity related to *Corallina,* options were explored to determine the most appropriate arrangement for the discharge to minimise the impact on Corallina habitat. Three discharge arrangements were considered as follows:

- **Option 1 –** Three Discharge Outfall options. This option would comprise three spine drains discharging directly to the shore through separate outfall structures at an elevation of 9m AOD at the cliff face.
- **Option 2 –** Single Outfall - for this option the spine drains would be in the same positions as Option 1 but they would be connected to the landward side of the cliff by a collector drain running parrallel to the cliff line. The collector drain would then discharge to the shore at an elevation of 7.5m AOD at the location of the former dry dock (graving dock) which was used during the construction of the existing Hinkley Point Power Station Complex.
- **Option 3 –** Single Outfall - this option would be similar to Option 2 but with the single outfall located at an elevation of 7.5m AOD in the vicinity of the Hinkley Point C Drainage Ditch discharge onto the shore. The location of the three options are shown in **Figure 6.3**.

6.5.36 These were assessed with the aid of a predictive hydraulic model which was used to identify the spatial extent and depth of the discharged water within the intertidal area. The 1 in 30 and 1 in 2.33 year flood events (3.33% and 43% Annual Exceedence Probability (AEP) events respectively) were modelled with respect to surface water runoff.

6.5.37 The modelling demonstrated that Option 2 with a single discharge point at Location A (former graving dock for HPA and HPB) was the most suitable. This is due to the fact that water discharged at this outfall point would be confined across the intertidal shore and would not migrate to a significnt extent laterally. Most importantly significant spillage of discharged water into the natural longshore drainage routes (channels) associated with *Corallina* would not occur.

6.5.38 Further consideration of the impacts upon the ecology of the intertidal environment associated with discharges to the shore is given in **Volume 2**, **Chapter 19:** Marine Ecology.

vi. Interim Storage of Spent Fuel

6.5.39 EDF Energy has reviewed the alternatives that are available for on-site interim storage of spent fuel at the HPC site prior to its disposal within a Geological Disposal Facility (GDF) (Ref 6.3). The length of time for which storage will be required is dependent upon the availability of the GDF which is yet to be constructed and the length of time required for the fuel to cool sufficiently before it meets the required conditions for disposal.

6.5.40 The alternative technological solutions that were subject to consideration by EDF Energy included those identified by the ONR under the GDA process together with the outcome of the work initiated by British Energy (prior to acquisition by EDF) which had already examined options for providing additional spent fuel storage at Sizewell B.

6.5.41 Assessment of the alternatives was conducted using a Multi-Attribute Decision Analysis (MADA) process, the findings of which were analysed using expert engineering judgement to determine the most appropriate solution for HPC.

6.5.42 The following spent fuel storage options were included within the MADA process:

- Pool storage (wet storage);
- Metal cask storage (dry storage);
- Vault storage (dry storage); and
- Canister storage (dry storage).

6.5.43 These options were considered as they have been used successfully internationally and all are judged to be capable of meeting the high safety and environmental standards which are required to permit their use in the UK. Each of the technologies was assessed with respect to attributes applicable to four evaluation categories:

- health and safety;
- technical performance, safety and practicability;
- environmental; and
- economic.

6.5.44 The MADA process involved the scoring of the different options against each of the attributes and also weighting the importance of each attribute. EDF Energy's review placed a high level of importance on safety and environmental performance. However, because all options studied were assessed as being capable of meeting stringent UK criteria, the selection of the preferred option was linked to other performance issues where the different attributes of each technology proved to be more discriminating. The key areas were:

- protecting long term flexibility with respect to possible development in fuel technology;
- ease of inspection of spent fuel thus enabling review of fuel condition against GDF waste acceptance criteria;
- reducing financial risks; and
- maximising the benefits from retaining consistency in design with other EDF EPRs.

6.5.45 In reaching its proposed spent fuel storage decision, EDF Energy has considered the possible future developments and determined that, for the site-specific circumstances at HPC, interim storage within an engineered pool (wet storage) is the chosen approach. The proposed spent fuel management strategy for HPC is detailed within **Volume 2**, **Chapter 7**. EDF Energy has concluded that, whilst its preferred option will deliver a safe and secure solution, there may be alternative options available in the long-term that mean spent fuel does not need to be stored for long periods on UK EPR reactor power station sites. The pool (wet storage) option proposed for HPC is one that is flexible enough to be adapted to such future changes, should they occur.

6.6 Delivery of Bulk Materials and Design of the Temporary Jetty

6.6.1 The construction of HPC will require a total of approximately two million tonnes of bulk construction materials (including aggregates, sand and cement) for concrete production. Concrete could be imported directly to the site (e.g. as pre-cast concrete units and/or ready mix concrete) or as raw materials for on-site concrete batching and on-site pre-casting. In order to avoid significant risk to the construction programme that would result from a lack of materials available for production due to, for example, adverse weather conditions EDF Energy determined that bulk materials should be stockpiled in sufficient quantities on-site to allow continuous concrete production to occur.

6.6.2 Three main alternatives have been considered for the delivery of the bulk materials required for concrete production to site including; sea, road and rail transportation routes.

6.6.3 EDF Energy has evaluated the option for a direct rail link to the HPC site. However, the nearest point of connectivity to the existing rail network lies some 10km from HPC and construction of the link would be a major civil engineering undertaking with substantive environmental impacts. A rail link has been discounted on economic and environmental grounds.

6.6.4 The estimated HGV movements would place a significant burden on the capacity of the road network and account for a very high proportion of HPC development related traffic during the construction phase. Importation by road would also lead to adverse environmental impacts, with noise and air quality being of particular significance in this context.

6.6.5 With respect to transportation by sea, the following five options were identified for the delivery of bulk construction materials and Abnormal Indivisible Loads (AILs):

- new temporary jetty facility at Hinkley Point;
- new temporary foreshore facility at Hinkley Point;
- new permanent foreshore facility at Hinkley Point;
- refurbishment of the existing facility at Combwich Wharf; and
- redevelopment of the existing facility at Combwich Wharf.

6.6.6 The options were assessed for the separate delivery of both AILs and bulk construction materials with the exception of the temporary jetty which was only considered for bulk construction materials. The assessment included consideration of transport options including some consideration of potential environmental impacts associated with the available options based upon the knowledge available at that time.

6.6.7 EDF Energy identified a temporary jetty as the preferred option for the importation of bulk materials to Hinkley Point because it would have the least effect on local communities and would not require the transfer of materials from Combwich Wharf to the HPC site by road. Upgrading of the wharf facility was the preferred option for the delivery of AILs.

6.6.8 A range of design options and locations was considered for the temporary jetty. Cross-shore facilities were considered including solid concrete wharf designs on the shore, with and without a shore access channel cut into the rock pavement, but an open-piered jetty design was eventually selected. The potential sensitivity of the intertidal environment in terms of its conservation interest was a consideration as was the need to ensure navigational access across a wide range of tidal conditions. An open-piered structure also has the advantage of being largely transparent to meteorological, tidal and wave forces; lending itself both to greater engineering efficiency and an avoidance of potential environmental impacts. Lastly, the design selected permitted a modular approach to construction and decommissioning.

6.6.9 Once on open-piered jetty structure had been selected, two options were considered for the location of the jetty, one at the east and one at the west of the HPC site. The options are similar with the exception that the eastern option extends further (by approximately 70m) offshore in order to reach a water depth of -2mCD which is the minimum depth necessary for navigational access for the vessels which will use the jetty.

6.6.10 The two options were then subject to a comparative assessment which included considerations with respect to navigational safety, the disposition of land based reception facilities for the bulk materials and environmental sensitivities in the intertidal and subtidal areas. Environmental survey (as described in **Chapter 19** of the ES on Marine Ecology) found the near subtidal area to be clear of particular ecological sensitivities for both options. The preferred option (western location) was selected principally because it is shorter and thus would be less costly and require less time to construct. The western jetty routing acknowledges the presence of certain ecological interests on the shore and that a high level of care will be required in protecting these interests during both construction and decommissioning.

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6.3 The Choice of Interim Spent Fuel Management Storage Technology for the Hinkley Point C UK EPRs. EDF Energy.

CHAPTER 7: SPENT FUEL AND RADIOACTIVE WASTE MANAGEMENT

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7. SPENT FUEL AND RADIOACTIVE WASTE MANAGEMENT

7.1 Introduction

7.1.1 This chapter considers the management of spent fuel and radioactive waste which will arise throughout the operation and decommissioning of Hinkley Point C (HPC).

7.1.2 Radioactive waste is designated as any waste material contaminated with or incorporating radioactivity above certain thresholds defined in legislation, and for which no further use is envisaged.

7.1.3 Spent fuel from nuclear power stations is not categorised as waste because it still contains uranium and plutonium which could potentially be separated out through reprocessing and used to make new fuel.

7.1.4 The management of spent fuel and radioactive waste would be carried out in accordance with relevant legislation, policy and guidance as detailed in **Appendix 7A**.

7.2 Spent Fuel and Radioactive Waste Management Strategy

a) HPC Integrated Waste Strategy

7.2.1 Strategic planning of waste management is a regulatory requirement and would be implemented at HPC through the development and production of an Integrated Waste Strategy (IWS) which will be reviewed and updated throughout the lifecycle of the HPC development. The IWS would set out the logic behind the development of individual waste strategies and how their integration results in the effective management of all the wastes generated by HPC.

7.2.2 The principal objective of the IWS is to ensure that waste management throughout the lifecycle of HPC is robust, consistent with UK policy and protects people and the environment. The IWS provides a framework to be utilised when taking decisions on waste management issues. The IWS will also be used to enable the site to demonstrate compliance with environmental protection principles for all waste types, including materials such as spent fuel that may become waste in the future. The IWS recognises that the design of the power station can have an impact on waste management strategy and is therefore taken into account in the design. The IWS aims to ensure that, during the construction, operation and decommissioning of the installation, workers, the public and the environment are protected and that radiation doses are as low as reasonably practicable (ALARP). These objectives are achieved by minimising discharges of radioactivity to the environment through the application of the waste hierarchy and best available techniques (BAT). Definitions of ALARP and BAT are set out in **Table 7.1** on the following page.

Table 7.1: Minimisation of Dose, Discharges and Radioactive Waste

Technique	Definition
ALARP	As Low As Reasonably Practicable is an expression used in risk reduction to define a standard or point at which the implementation of additional risk reduction measures would be grossly disproportionate to the benefits achieved.
BAT	Best Available Techniques describe the most effective economically and technically viable technology and methods designed to prevent, and where this is not practicable to reduce, emissions and their impacts on the environment as a whole.
Waste hierarchy	This concept proposes that minimisation of the creation of waste is the best way to reduce waste, re-use the second best option, followed by recovery (e.g. recycling) and as a last resort disposal.

7.2.3 The key factors in demonstrating the minimisation of the production of radioactive waste are:

- **Design of fuel, including containment** – the fuel is designed and handled to retain as much of the actinides and fission products as possible. This ensures that the radioactivity is removed with the fuel and does not enter the primary circuit or cooling pond water. The fuel cladding material has been chosen due to its resistance to corrosion, its impermeability to fission and activation products and the lower degree of activation. The manufacturing process minimises the presence of trace uranium on the outer surface which can release fission products into the primary circuit;
- **Efficiency of fuel use** – maximising the efficiency of fuel use, when coupled with fuel design and manufacture, will ensure that the minimum amount of spent fuel is created per unit of electricity generated. A combination of the UK EPR core design and the enrichment selected for the fuel is expected to deliver higher burn-up of the fuel which means that less fuel will be required. This will also reduce the secondary waste arisings from spent fuel management;
- **Detection and management of failed fuel** – the reactor is operated in such a way as to minimise the risk of fuel failure and the subsequent transfer of actinides and fission products to the primary circuit. EDF Energy continuously reviews operational experience and is engaged in exhaustive research and development programmes in this field. The condition of the fuel is assessed by monitoring the primary coolant activity levels. This allows any failures to be detected and managed;
- **Materials of construction for the reactor and cooling circuits** – the specification of any structural materials will include a requirement to replace or reduce those substances that are particularly susceptible to activation. This specification will also apply to materials that are susceptible to erosion, wear and corrosion to limit the potential for activation of any particulate matter that will pass through the reactor core with the primary coolant. Materials for the primary and secondary circuits will be specified to prevent leaks, to minimise the potential for corrosion and thus prevent the spread of radioactivity to lower contamination areas;
- **Primary coolant chemistry** – managing the primary coolant chemistry contributes to maintaining the integrity of the fuel cladding and the primary circuit by reducing corrosion. This, in turn, reduces the presence of activated corrosion

products in the cooling circuit and therefore minimises secondary waste from cooling water treatment. Chemistry management also includes the control of primary coolant gases and helps to minimise the production of tritium. The coolant management system allows the chemistry to be modified to reflect specific requirements at different phases of reactor operation; and

- **Commissioning, start-up and shutdown procedures** – a number of approaches have been developed to reduce the risk of generating corrosion products, which could subsequently become activated, during these key stages of reactor operation. Commissioning includes the creation of a tight and protective oxide layer on surfaces in the primary circuit. The primary circuit is degassed and purified during start-up to remove impurities that encourage corrosion. Cold shutdown procedures include a controlled release of corrosion products accumulated on surfaces. This allows them to be collected without the risk of activation in the neutron flux.

7.2.4 The features set out above will minimise the generation of radioactive waste and will, therefore, make a significant contribution to minimising the activity of the waste that will be discharged or disposed of.

b) Management and Storage of Wastes from Other Nuclear Sites

7.2.5 EDF Energy has no plans to receive, process or store spent fuel or radioactive waste from other nuclear sites. EDF Energy has no plans to reprocess spent fuel at the HPC site and has set out a baseline strategy that assumes interim storage followed by disposal. The facilities provided at HPC have been designed and sized to manage and store the spent fuel and waste from the HPC site only.

c) High-level Strategy for HPC Radioactive Wastes

7.2.6 This section provides a description of EDF Energy's preferred options for management of radioactive waste from HPC. Any implemented options will ultimately depend on regulatory agreement, and may therefore differ in some ways from those described within the following sections.

i. Solid Radioactive Waste and Spent Fuel Management Strategy

7.2.7 The strategy for solid radioactive wastes is these are to be disposed of as soon as reasonably practicable where a viable disposal route is available. ILW and spent fuel for which there are as yet no available disposal routes would be accumulated and safely stored on-site in compliance with the requirements of the NSL and HPC Radioactive Substances Regulation (RSR) Environmental Permit until a suitable disposal route or an alternative management route becomes available.

7.2.8 The design of the UK EPR incorporates a number of measures aimed at minimising the amount of solid wastes by facilitating the segregation and volume reduction of solid wastes, taking account of the review of the performance and operating experience of existing reactors.

ii. Liquid Radioactive Discharge Strategy

7.2.9 The overall strategy for the management of liquid radioactive discharges from the two UK EPR reactor units planned for HPC is based on the Reference Case presented in the Generic Design Assessment (GDA) for the UK EPR (Ref. 7.1) and the information presented within the RSR Permit Submission for HPC (Ref. 7.2) is:

- minimising the production of liquid effluents at source;
- partitioning of radionuclides where appropriate to minimise the environmental risks and impacts;
- optimum use of segregation and effluent treatment systems to afford greatest flexibility in their management;
- abatement to capture, concentrate and contain radionuclides, where appropriate, through the use of demineralisation, evaporation and filtration. The treatment of liquid effluent will exclude where reasonably practicable entrained solids, gases and non-aqueous liquids from the discharges;
- optimum use of suitable storage systems for the site, taking advantage of any delay and radioactive decay that may arise;
- assessment and sentencing of liquid effluents prior to discharge to confirm that these are in line with permitted levels;
- where radioactive effluent is discharged into the environment, optimising the manner and timing of any release to minimise the impacts on the environment and members of the public; and
- carrying out routine surveys of the environment to establish that the impact is acceptable.

7.2.10 The management strategy to limit radioactive liquid discharges from the operating activities of the UK EPR is based on the design of the plant and the operational practices to be implemented.

7.2.11 The design features use BAT to minimise liquid discharges at source and to minimise the impacts of discharges by means of abatement and discharge plant. EDF Energy will balance worker doses, costs and the accumulation on-site of additional solid waste incurred as a result of treatment in the plant with any potential reduction in public doses from discharges. Systems and plant are managed and used in a manner so as to minimise, so far as reasonably practicable, the environmental impacts of discharges and to ensure that all discharges are monitored and recorded to demonstrate that they fall within the permitted limits.

iii. Gaseous Radioactive Discharge Strategy

7.2.12 The overall strategy for the management of gaseous radioactive discharges from the two planned UK EPR reactor units at HPC is based on the Reference Case presented in the GDA (Ref. 7.1) and the information presented within the HPC RSR Permit Submission for Hinkley Point C (Ref. 7.2) is:

- minimising the production of gaseous effluents at source;
- partitioning of radionuclides where appropriate to minimise the environmental risks and impacts;
- abatement of gaseous discharge streams through the use of carbon delay beds to capture noble gases and carbon traps to capture isotopes of iodine and HEPA filters to trap particulate activity;

- monitoring of gaseous effluent prior to discharge;
- where radioactivity is discharged into the environment ensuring the design of the stacks is optimised such that they minimise the impacts on the environment and members of the public; and
- carrying out an agreed environmental survey programme to confirm that off-site impacts are acceptably small.

7.2.13 As with liquid discharges, the management strategy to limit radioactive gaseous discharges from the operating activities of the UK EPR is based on the design of the plant and the operational practices to be implemented. The design features use BAT to minimise gaseous discharges at source and to minimise the impacts of discharges by means of abatement and discharge plant, and also balance worker doses and costs together with the accumulation on-site of additional solid waste incurred as a result of treatment in the plant with any potential reduction of public doses from discharges. Systems and plant are managed and used in a manner so as to minimise so far as reasonably practicable the environmental impacts of discharges, and to ensure all discharges are monitored and recorded to demonstrate that they fall within the permitted limits.

7.3 Low-Level Wastes (LLW)

a) Management of LLW Generated During the Operation of the HPC UK EPR

7.3.1 The precise volume of solid LLW produced by HPC is dependent on the future management of the various systems associated with the operation of the nuclear power station. **Table 7.2** provides the annual estimated production of raw (untreated) LLW for two UK EPR reactor units based on the information presented in the UK EPR GDA submission (Ref. 7.1) and the HPC RSR Permit Submission for Hinkley Point C (Ref. 7.2). The volume and activity of LLW requiring disposal from HPC would be minimised by the use of the waste hierarchy and the application of BAT.

7.3.2 **Table 7.3** provides a description of the LLW that would be generated from the operation of the HPC reactors and auxiliary facilities. These can be grouped in two broad categories:

- LLW generated through operation of systems and processes used to ensure safe operation of the power station or to minimise discharges of radioactivity to the environment; and
- LLW generated during maintenance and refuelling operations.

Table 7.2: LLW Generation and Proposed Management Strategy for the HPC UK EPRs (Two EPR Units)

Waste Type		Estimated Raw Waste Volume Annual from Two UK EPRs (m^3)	Preferred Waste Arrangement[1]	Alternative Waste Arrangement
Steam Generator Blowdown System APG (SGBS) ion-exchange resins		15	Package as required to meet CfA and transfer for disposal as VLLW	Transfer for incineration Direct disposal to LLWR
Wet sludge (from sumps, tanks)		1	Condition/package as required to meet CfA and transfer for disposal to LLWR	
LLW cartridge filters from auxiliary circuit treatment		0.10	Condition/package as required to meet CfA and transfer for disposal to LLWR	
Evaporator concentrates		6	Condition/package as required to meet CfA and transfer for disposal to LLWR	
Air and water filters		8	Transfer for Incineration (water filters) Transfer for high force compaction (air filters) and onward disposal to LLWR	Direct disposal to LLWR
Dry active wastes (excluding metals)	Non-combustible	25	Transfer for high force compaction and onward disposal to LLWR	Direct disposal to LLWR
	Combustible	75	Package and transfer for off-site incineration	Direct disposal to LLWR
Waste oils and solvents		4	Package and transfer for off-site incineration	
Metal scraps and metallic waste		12	Package and transfer for metals treatment	Direct disposal to LLWR

[1] Note these disposal routes represent the preferred option for LLW management and disposal based on the anticipated waste characteristics. Alternative routes may be utilised in the future if they can be demonstrated to represent BAT or if the above disposal routes are found to be unavailable.

Table 7.3: Categories of LLW that would be Generated at HPC

Waste Type	Waste Description
Steam generator blowdown system (SGBS) ion-exchange resins	Ion-exchange beds are utilised in the SGBS to trap activation and fission products from the primary coolant circuit. In recycling the SGBS blowdown water from the UK EPR secondary circuit, the blowdown water is purified by the use of two parallel filters for the removal of suspended solids and two parallel demineralisation lines which use ion-exchange resins to perform the demineralisation.
LLW wet sludge	During the operation of the HPC UK EPR reactor units, particulates would settle as sludges in various buffer and storage tanks associated with the auxiliary water circuits (e.g. liquid waste processing system). These are likely to be contaminated with small quantities of fission and activated corrosion products. This sludge is periodically cleaned out and removed for treatment prior to disposal as LLW.
LLW cartridge filters from auxiliary circuit treatment	Filters are used to capture particulate material in the UK EPR water auxiliary circuits. Spent filter cartridges arise from the treatment lines of the following water auxiliary circuits: Chemical and volumetric control system, boron recycle system, liquid waste treatment system, and the spent fuel storage compartment treatment system. Water filters are withdrawn from operation on the basis of clogging and/or dose rate and then treated as waste. The physical form of this waste stream consists of filter cartridges that are composed principally of stainless steel supports with glass fibre filter media and some organic materials. The amount of particulate radioactive material (principally metallic oxides) trapped on each filter can vary. The majority of waste within this category is anticipated to be ILW at the point of generation but some LLW is expected.
Evaporator concentrates	The UK EPR proposes to make use of evaporation for the minimisation of non-recyclable radioactive liquid effluents arising from the liquid waste treatment system. Evaporation would be used to minimise the discharge of active aqueous effluents to the environment. Evaporation of effluents results in the production of a sludge-like concentrate that would contain the bulk of the radioactivity initially present in aqueous effluent streams as activated metal oxides.
Air filters	All radiation controlled areas of the nuclear auxiliary building, fuel building, safeguards buildings, reactor building, operational production centre, access building and effluent treatment building are served by dedicated ventilation systems. The extract from these systems is subject to a number of airborne activity abatement techniques, including the use of high efficiency particulate air (HEPA) filtration, before discharge to the environment. The HEPA filters remove particulate material to ensure doses to workers are ALARP and discharges to the environment are minimised. This also ensures that the doses to members of the public from airborne discharges are minimised. The abatement systems would produce a number of spent LLW HEPA filters over the course of reactor operations.
Water filters	Water filters may arise from filtering of the low active effluent (from the gaseous waste processing system, liquid waste treatment system, steam generator blowdown system). The physical form of this waste stream consists of filter cartridges that are composed principally of stainless steel supports with glass fibre filter media and some organic materials. The amount of particulate radioactive material (principally metallic oxides) trapped on each filter can vary.
Dry active wastes (DAW)	DAW comprise the combustible and non-combustible LLW generated through routine and maintenance operations in the UK EPR Nuclear Island and consist of contaminated personal protection equipment, monitoring swabs, plastic, clothing, contaminated tools, segregated pieces of metal, glassware and other process consumables. These wastes mainly arise during outages.

Waste Type	Waste Description
Oils and solvents	Oils are used in the lubrication of various components such as circulators and process pumps and have the potential to become radiologically contaminated during normal service. Contaminated liquids such as chemical cleaning solutions and solvents used as decontamination agents also arise and would be included within this waste stream.
Metal scraps and other metallic wastes (Dose rate < 2 mSv/h)	Metal wastes arise during maintenance operations from the replacement of engineering components. The redundant metal components or equipment used during the maintenance operations in the nuclear island may become contaminated and require disposal as radioactive waste.

b) Arrangements for Site LLW Management

7.3.3 Detailed arrangements for radioactive waste management would be covered in the EDF Energy operating procedures required to demonstrate compliance with NSL and RSR requirements. For LLW, these instructions are anticipated to cover minimisation, segregation, characterisation/assessment, packaging, labelling, record keeping and consignment for transfer/disposal.

7.3.4 The design of the UK EPR incorporates a number of measures aimed at minimising the amount of solid wastes by facilitating segregation and volume reduction of solid wastes, taking account of the performance and operating experience of existing reactors. Examples include:

- The composition of the primary circuit component materials has a direct impact on the radioactive inventory in the primary coolant, especially on the activation of corrosion products. Therefore, chemistry and radiochemistry are optimised in the UK EPR design to reduce the primary circuit radioactive inventory and lower the dose rate levels, which in turn would minimise the activity of corrosion products which contribute to solid waste arisings.
- Improved efficiency of recycling (e.g. coolant) and effluent processing systems to reduce solid waste volumes associated with the treatment of coolant and effluents.
- Zoning of rooms and controlled areas to maximise the segregation of radioactive and non-radioactive wastes and thus minimise radioactive waste arisings.

c) Facilities to be Provided for Site LLW Management

7.3.5 LLW generated during the operational period from both the reactors and the associated auxiliary plant would be transferred to the effluent treatment building (ETB) of UK EPR reactor Unit 1 (Unit 1). This facility is designed to manage waste through segregation and application of suitable treatments in preparation for disposal. LLW would be processed and packaged as required to meet the conditions for acceptance (CfA) of the appropriate off-site disposal facility.

7.3.6 LLW would be safely transferred from different locations in the radiation controlled area to the ETB. Waste would be collected and stored according to waste activity categorisation at dedicated locations in the ETB and placed into a temporary buffer store prior to treatment. The waste would then be separated on the basis of the treatment method and would be stored in these areas until sufficient quantities have accumulated for a treatment campaign to start or for shipment off-site.

7.3.7 The treatment route for solid waste would be determined (once it has been monitored and assayed) by categorisation of the waste and by considering its physical and chemical characteristics.

7.3.8 Once categorised the waste would be packaged (and conditioned if necessary) and transferred off-site to the most appropriate facility for its treatment (e.g. such as super-compaction, metal treatment or incineration) or disposal.

i. Segregation

7.3.9 Solid wastes would, as far as practicable, be segregated and sorted at source to minimise secondary handling. Where waste streams generate mixed wastes these would be sorted in a dedicated unit within the ETB to optimise their subsequent management and disposal. If no further benefit can be obtained from further segregation then the waste would be transferred to the next stage. The benefits associated with the segregation of waste need to be balanced with the detriments associated with increased operator exposure.

7.3.10 The segregation of the waste into different waste groups would be carried out on the basis of different physical and chemical properties (e.g. combustible, non-combustible and compactable waste, and non-compactable waste).

ii. Shredding

7.3.11 Bulky solid combustible and compactable waste may be size reduced by shredding in the ETB prior to further treatment. The waste is size reduced by the use of a rotating blade assembly. The shredded material then falls through a duct into a compactable drum located directly below the shredder. Once full, the drum would be returned to the storage area and temporarily stored until a sufficient volume of waste for treatment or disposal is collected.

iii. Low Force Compaction

7.3.12 A low force compactor in the ETB could be used on-site to assist in the volume reduction of appropriate wastes prior to transfer off-site for disposal.

iv. Conditioning of LLW for Disposal

7.3.13 Some LLW (e.g. sludges and resin), may require processing within the ETB through a combination of dewatering, drying, and encapsulation in a mortar matrix within the waste disposal package prior to transfer from the site in order to meet the CfA for the proposed disposal site.

v. Handling and Transfer of Final Packages

7.3.14 Following treatment, the waste would be placed in an appropriate container for transport or disposal. After being sealed, the containers would be checked for the presence of external contamination prior to transfer out of the ETB. Waste containers awaiting transfer off-site would be placed in buffer stores and transferred into transportation containers prior to loading onto the transportation vehicle.

d) LLW Volume Estimates

7.3.15 The LLW volume estimate is based on a review of the waste arisings from existing French nuclear reactors of similar power rating to the UK EPR, performed as part of the GDA process (Ref. 7.1). It is assumed at present that HPC, with two UK EPR reactor units, would produce double the arisings predicted for one unit in the GDA, even though some facilities would be shared. The sharing of facilities, such as the waste treatment facilities, may result in some reduction of operational arisings. However, at this stage it is not possible to make precise predictions of reductions so the figures set out in **Table 7.1** are considered to present a best estimate of solid LLW arisings.

e) LLW Disposal Strategy

7.3.16 A key consideration of the choice of preferred disposal route has been the commitment to demonstrate best use of existing UK LLW management facilities. Therefore direct disposal to LLWR, in Cumbria, is seen as the least desirable option and where a reasonably practicable alternative disposal route exists (e.g. incineration or metal recycling, this has been chosen as the preferred option). This approach is consistent with the national strategy for LLW and EDF Energy will aim to utilise alternative disposal routes to the LLWR as available. This will contribute to the minimisation of the disposal of wastes to the LLWR and maximise its remaining operational lifetime.

7.3.17 The strategy for LLW is that waste generated throughout nuclear power plant operations and decommissioning would be disposed of as soon as reasonably practicable, following treatment to minimise volume and perform appropriate conditioning or packaging. The ultimate disposal of the wastes is expected to be via one of the following main routes depending on the radioactivity level of the waste produced, its physical characteristics and its chemical properties:

- off-site treatment of metals, ultimately for recycling, via commercially available routes subject to meeting the relevant CfA;
- off-site incineration of combustible wastes using commercially available routes subject to meeting relevant CfA. There would be no on-site incineration of wastes;
- use of an appropriate authorised off-site disposal facility for exempt and VLLW disposal (notably for soil, rubble and aggregates) where no reuse or recycling options are viable, subject to meeting relevant CfA;

- transfer of suitable LLW for super-compaction prior to disposal at the LLWR to minimise disposal volume; and
- disposal of LLW directly to LLWR would be utilised only where the above alternatives are not practicable.

7.3.18 For all LLW, with the exception of oils and solvents, acceptance for disposal has been agreed in principle with LLWR during the GDA process. This has now been updated for HPC's LLW/VLLW and disposability in principle has been confirmed by LLWR for the volume and activity levels presented within this document.

7.3.19 In order to demonstrate the acceptability of the potential non-LLWR disposal routes for HPC's LLW, disposability in principle for the appropriate waste streams was obtained for incineration, VLLW landfill, and the ancillary segregated waste services provided by the LLWR Ltd. (e.g. metal treatment and super compaction). The segregated waste services are provided by LLWR Ltd. to improve the availability of alternative waste management options and reduce the volume of waste disposed of to LLWR.

7.3.20 EDF Energy has reviewed the potential treatment and disposal options for LLW from HPC. The preferred options for management of LLW generated at HPC are set out diagrammatically in **Plate 7.1.** Conditions and limits would be set, by the Environment Agency, for the transfer of LLW in the HPC RSR Environmental Permit issued under the Environmental Permitting (England and Wales) Regulations 2010 (Ref. 7.2).

7.3.21 EDF Energy is aware that the LLWR has a current estimated lifetime shorter than the operation of Hinkley Point C. It is assumed that, as stated in Government policy and enshrined in Environmental Permitting Regulations 2010, (Ref. 7.2) that new disposal facilities (either at LLWR or elsewhere) will ultimately be provided by the NDA after the current LLWR has ceased to receive waste. However EDF Energy will apply the waste hierarchy and waste segregation to demonstrate best use of existing UK LLW management assets.

i. Off-site Metal Recycling Facility Operations

7.3.22 Where the metallic waste generated by operational maintenance work cannot be adequately decontaminated on-site, the waste would be transferred to an off-site commercial Metal Recycling Facility (MRF) (e.g. Studsvik Metal Recycling Facility at Lillyhall, Cumbria). The volume of metallic waste requiring disposal could be reduced by up to 95% using metal recycling techniques.

7.3.23 Once transferred to the MRF, a range of industrial cutting and cleaning techniques would be applied. The metallic waste is decontaminated and cleaned using methods such as dry grit blasting. The resulting materials can either be recycled in the UK or potentially sent to a facility for further cleaning by melting.

ii. Off-site Incineration Operations

7.3.24 LLW would be segregated within the ETB to separate combustible waste from non-combustible. Combustible waste suitable for incineration would be transferred to an off-site commercial incinerator and incinerated in a specially engineered kiln up to around 1000^{o}C. Any gases produced during incineration are treated and filtered prior to discharge into the atmosphere and would conform to international standards and national emissions regulations.

7.3.25 Incineration of combustible wastes is used as a treatment for both radioactive and conventional wastes in the UK. In the case of radioactive waste, incineration has been used for the treatment of LLW from nuclear power plants, fuel production facilities, research centres (such as biomedical research), the medical sector and other waste treatment facilities.

7.3.26 Modern incineration systems are well engineered and designed to burn the waste efficiently whilst producing minimum emissions. Ash remaining following incineration would be disposed of as appropriate.

iii. Off-site Super Compaction Facility Operations

7.3.27 Suitable LLW would be transferred off-site to a super compaction facility to minimise its volume. In this process drums or boxes of waste are compacted under high pressure of up to 2,000 tonnes per square metre. Following super compaction the drums would be transferred onward to LLWR, near Drigg, in Cumbria for disposal.

iv. LLWR Operations

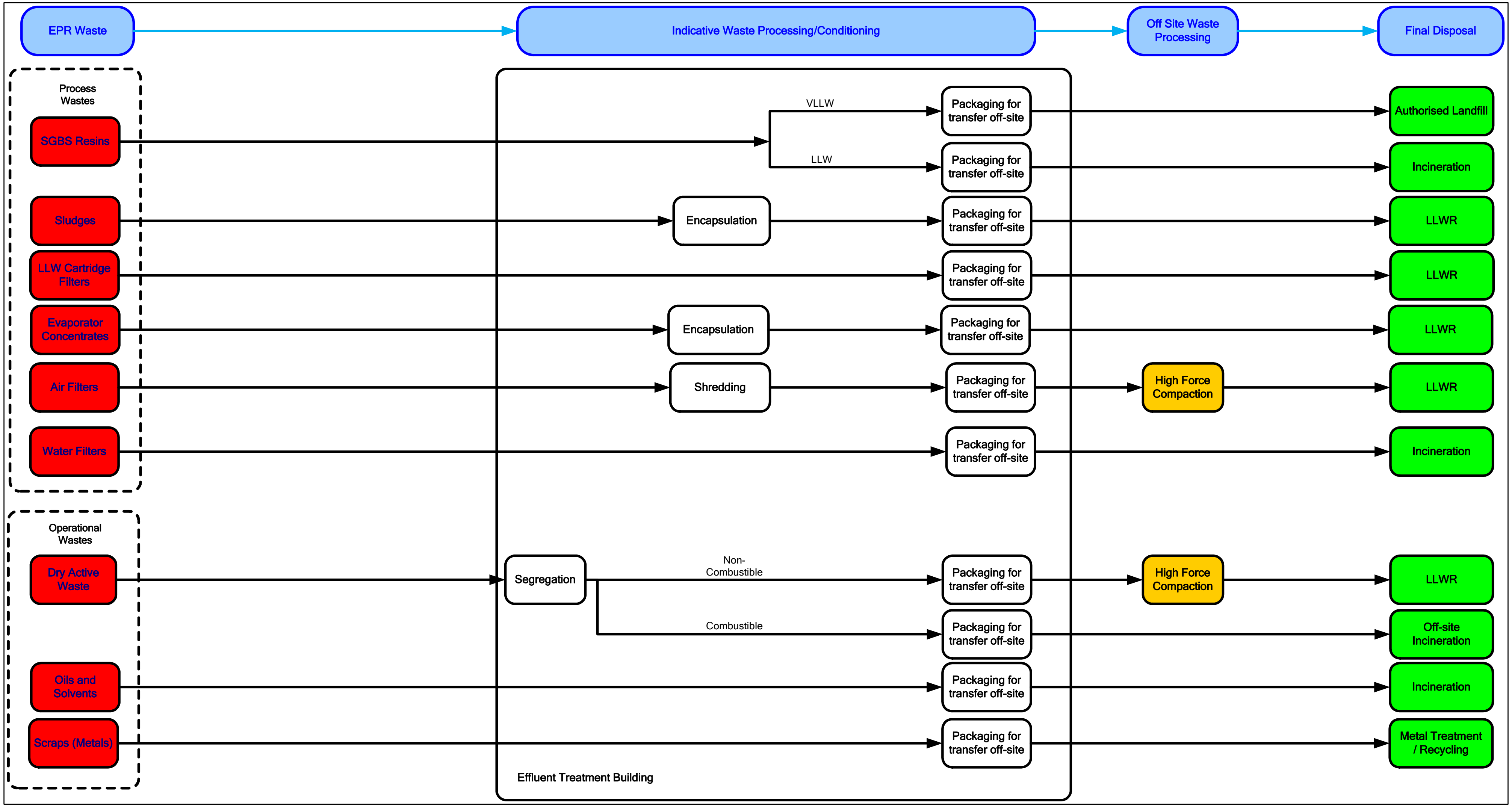
7.3.28 LLW unsuitable for disposal via the above disposal routes, but which meets the CfA for LLWR (Ref. 7.3), would be packaged on-site and transferred directly for disposal to LLWR in approved transport packages (e.g. Half Height ISO Containers (HHISO)).

v. VLLW Operations

7.3.29 High-volume VLLW could be disposed of to specified approved landfill sites. The waste would be subject to controls on its disposal which would be specified by the Environment Agency.

7.3.30 Wastes from HPC will be transferred to LLW disposal sites only if they have been demonstrated to represent BAT for the disposal of the waste and have been authorised by the UK regulatory bodies to accept the waste for disposal.

Plate 7.1: Indicative LLW Processing and Disposal Strategy



Note these disposal routes represent the preferred option for LLW management and disposal based on the anticipated waste characteristics. Alternative routes may be utilised in the future if they can be demonstrated to represent BAT or if the above disposal routes are found to be unavailable.

f) Transport Arrangements for LLW

7.3.31 All radioactive waste transferred from the site would need to comply with applicable UK and international legislation at the time of despatch, including the relevant requirements of the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (Ref. 7.3). Each consignment would undergo the required contamination checks and external radiation measurements before leaving the site.

7.3.32 Radioactive waste is transported in specially designed and approved packages. The packages provide protection to operators and members of the public and are required to be sufficiently robust to withstand a wide range of credible accident scenarios.

g) Timing of the Decommissioning of LLW Facilities

7.3.33 The LLW processing facilities would be utilised for the management of wastes throughout the operation of both of the HPC UK EPR reactor units. It is anticipated that the LLW processing facilities would be decommissioned in the final stages of the main decommissioning phase as set out in **Chapter 5** of this volume.

7.4 Intermediate Level Waste (ILW)

a) Management of ILW Generated during Operation of the HPC UK EPR

7.4.1 Routine operation of the HPC reactor units and their associated auxiliary systems would generate ILW. The majority of ILW would arise from the treatment of liquids and gases in order to reduce worker doses and discharges of radioactivity to the environment (e.g. ion exchange resins).

7.4.2 In addition to the process wastes, operational wastes may be generated as a result of maintenance work carried out during reactor operation and work performed during reactor outages.

7.4.3 The ILW streams that are anticipated to arise from normal operation and maintenance of the two UK EPR reactor units at HPC are set out in **Table 7.4** below.

Table 7.4: Categories of ILW that would be Generated at HPC

Waste Type	Waste Description
ILW ion exchange resins	Ion exchange beds are used to capture and minimise soluble radioactive material. This material results from corrosion in the primary circuit (mainly in the steam generators and activation of chemicals in the primary circuit) and in the following UK EPR water auxiliary circuits: • Chemical and volumetric control system; • Coolant purification system; and • Spent fuel storage compartment treatment system. The ion exchange resins in the beds are periodically changed to optimise their performance. Additional volumes of ILW ion exchange resins may arise from the maintenance of water quality and the abatement of liquid discharges from the Interim Spent Fuel Store (ISFS).
ILW cartridge filters	This waste consists of filters used in the clean-up of primary circuit water and water from the liquid waste and spent fuel pool treatment systems. There are several designs of filters depending on the abatement required. A proportion of the filters generated would fall into the ILW category.
ILW sludges	During the operation of the HPC UK EPR reactor units, particulates would settle as sludges in storage tanks associated with the auxiliary water circuits (e.g. liquid waste treatment system). These are variously contaminated with a range of fission and activated corrosion products. This sludge would be periodically cleaned out and removed for treatment prior to disposal. The waste is a sludge consisting of settled particulate. A proportion of the sludge generated would fall into the ILW category.
Operational wastes >2mSv/hr	This comprises a range of materials including contaminated metal, plastics, cloth, glassware, and rubble arising from operations during planned shutdown periods. Activated components with higher dose rates generated during maintenance operations may be temporarily placed into the reactor fuel pools to allow for a period of radioactive decay in order to minimise dose to workers.

b) ILW Management Strategy for HPC

7.4.4 The strategy is for ILW to be retrieved, conditioned and packaged on-site on a campaign basis throughout the operational phase. Waste processing would result in a passively safe package ready for interim storage. The passively safe packages would be stored in the ILW Interim Storage Facility (ILWISF) for the duration of operations. The stored ILW packages would be removed from the ILW store when a GDF is available to accept new build waste for final disposal. The assumed timescales for store emptying are discussed later in this chapter.

c) Decay Storage of Waste for Re-categorisation

7.4.5 The radioactivity of all radioactive waste diminishes with time (known as radioactive decay). All radionuclides have a characteristic half-life (the time it takes for any radionuclide to lose half of its radioactivity) and eventually all radioactive waste decays into non-radioactive elements. The process of waiting for a natural decline in the level of radioactivity to allow waste to be disposed of as a lower category of waste is known as decay storage.

7.4.6 The radioactivity of a proportion of the ILW that would be generated during operation of the HPC UK EPR reactor units would be dominated at the time of arising by relatively short lived radionuclides including cobalt-60 (half-life of 5.27yrs), caesium-137 (half-life of 30.2yrs) and iron-55 (half-life of 2.7yrs).

7.4.7 Waste identified as being suitable for decay storage will be packaged into suitably robust containers within the ETB and transferred into the ILWISF for a period of storage. Following the period of interim storage the radioactivity of the selected wastes would have reduced to such levels that the waste would no longer be classified as ILW. This waste would be removed from the ILWISF and managed as LLW.

d) Disposability of ILW from HPC

7.4.8 Before conditioning and packaging of ILW, regulatory guidance (Ref. 7.4) requires that sites produce an ILW conditioning proposal. This would include a demonstration that, following conditioning, the waste would be compatible with existing or future planned management and disposal options. This requires that a letter of compliance (LoC) is obtained for the packaging proposal. The LoC process is the mechanism that the NDA Radioactive Waste Management Directorate (RWMD) utilises to provide confidence that a waste package can be accepted at a future GDF.

7.4.9 The overall objective of the LoC assessment process is to give confidence to all stakeholders that the future management of waste packages has been taken into account as an integral part of their development and manufacture. This is achieved by the site operator working with RWMD to demonstrate that the waste packages produced by a proposed packaging process will be compliant with the generic waste package specification and compatible with plans for transportation and emplacement in the planned future geological repository.

7.4.10 In cases where the assessment has concluded that the waste package is compliant with the repository concept and underpinning assessments, RWMD is prepared to confirm this by the issue of the LoC.

7.4.11 As part of the GDA process, the opinion of the RWMD was sought on the likely acceptability for disposal in a GDF of packaged ILW generated by the UK EPR. RWMD was asked for its views on a number of different waste packages, including those that would be produced by implementing the GDA reference strategy for on-site ILW management. RWMD indicated that, in principle, any of the proposed waste packages would be acceptable for disposal. EDF Energy will continue to work with RWMD through the LoC process to ensure that packaged ILW from HPC would be acceptable for disposal in a GDF (Ref. 7.4).

e) HPC ILW Processing Strategy

7.4.12 The proposed strategy for ILW conditioning and packaging at HPC is termed the 'Reference Case'. It assumes that operational ILW would be conditioned and treated using the same procedures as applied during the operation of existing pressurised water reactors (PWR) in France with due consideration for UK specific requirements.

7.4.13 Under the Reference Case strategy, two types of cylindrical pre-cast concrete casks, designated C1 and C4, are the packages to be utilised for all operational ILW. Both of these casks can include internal mild steel shielding of varying thicknesses to provide shielding against different concentrations of gamma emitting radionuclides. The C1 cask is 1.4m in diameter, 1.3m high, and has a 0.15m thick concrete shield wall. The C4 cask has the same dimensions apart from the diameter which is 1.1m. In the Reference Case Scenario, the operational ILW would be immobilised within the casks using epoxy resin or cement grout prior to being placed into the on-site ILWISF.

f) Arrangements for Site ILW Management

7.4.14 Arrangements and requirements for radioactive waste management would cover minimisation, segregation, quantitative assessment, packaging, labelling, record keeping and consignment for transfer/disposal (Ref. 7.4).

7.4.15 Processes would be established and implemented for the packaging of radioactive wastes that encompass the whole lifetime of waste packages to ensure that packaged waste has the properties ascribed to it. These arrangements would be reviewed periodically and adequate records maintained.

7.4.16 The management arrangements would apply to all activities, interactions and aspects that can affect the quality of the waste package product, including:

- waste characterisation;
- container design;
- container manufacture;
- wasteform development;
- process development;
- plant specification and design;
- LoC submissions and advice actions;
- plant commissioning and operation;
- raw materials storage;

- waste package interim storage and monitoring;
- control of non-conforming packages;
- change control and continual improvement of waste package design, processing plant and interim storage; and
- package records and their long-term retention.

g) Facilities for Site ILW Management

7.4.17 ILW generated on the HPC site would require conditioning and packaging into an acceptable (passively safe) form prior to interim storage. This process is described in the following sections.

7.4.18 Based on current UK radioactive waste policy and strategy, the intention is that the final disposal location of packaged ILW from HPC would be in a GDF.

i. ILW Processing and Packaging

7.4.19 ILW generated during the operation of UK EPR reactor units at HPC would be conditioned in the ETB. The ETB is the primary interface for the processing of all radioactive operational waste materials that would be generated by the operation of the UK EPR reactor units and includes functions for safe handling, treatment, conditioning, buffer storage, packaging and monitoring of wastes prior to transfer of packages to the ILWISF. It is anticipated that some waste generated within the ISFS will be packaged and processed within the ISFS rather than being transferred to the ETB.

7.4.20 The key waste management functions are:

- treatment of radioactive wastewater and effluent;
- treatment of solid waste; and
- conditioning of solid/liquid waste (including cementation and resin encapsulation).

7.4.21 The conditioning process for the treatment of the waste would ensure the waste is in a passively safe form to be transferred from the ETB to the ILWISF and the waste package itself would be compliant with the requirements of RWMD.

ii. ILW Cementation

7.4.22 Cementation through the use of specially formulated grouts provides a means to immobilise radioactive material that is either solid or in various forms of sludges. At HPC, it is anticipated that all ILW wastes, other than ion-exchange resins, would be conditioned utilising a cementation process.

7.4.23 In general the solid wastes would be placed into C1 or C4 containers. The grout is then added into this container and allowed to set. The container with the now monolithic block of concrete/waste is then suitable for storage and disposal.

7.4.24 Similarly in the case of sludges the current packaging assumption is that the waste would be placed in a C1 or C4 container and a grouting mix, in powder form, is added. The two are mixed inside the container and left to set leaving a similar type of product as in the case of solids, which can be disposed of in a similar way.

iii. ILW Epoxy Resin Encapsulation

7.4.25 Ion-exchange resins consist of small beads used to remove radioactivity from contaminated liquids. The radioactive ions in the liquid are absorbed onto the resin by the chemical process of ion exchange. The resins retain the activity and the cleaned liquids can then be safely disposed of. When the ability of the resins to absorb more radioactive ions is exhausted they become radioactive waste.

7.4.26 It is proposed that spent ion exchange resins would be processed by in-container solidification utilising a polymer solidification process. The process is already established as a technique for treating ILW ion exchange resins in the UK at the Magnox site at Trawsfynydd. At HPC, EDF Energy propose to utilise the same mobile processing units currently operating to manage the resin waste generated on the fleet of EDF Nuclear Power Plants in France.

h) Summary of ILW Strategy and Volumes

7.4.27 The baseline processing strategy for the HPC ILW streams is summarised in **Table 7.5**. The proposed baseline set out in the table is the Reference Case for ILW processing which has been used to demonstrate that a suitable strategy can be implemented to manage the waste streams.

7.4.28 The anticipated lifetime package numbers set out in the final column of **Table 7.5** provides an upper estimate which does not take into account ILW that would, following decay storage in the ILWISF, be suitable for re-categorisation as LLW. As the detailed proposals for decay storage of ILW at HPC are developed this figure is expected to be reduced as waste initially categorised as ILW is disposed of as LLW.

Table 7.5: Operational ILW Waste Generation and Proposed Management Strategy for the HPC UK EPR Reactor Units

ILW Stream	Waste Description	Anticipated Annual Raw Waste Volume from Two UK EPR Reactor Units (m^3)	Lifetime (60yr) Raw Waste Volume from Two UK EPR Reactor Units (m^3)	HPC Processing Strategy	Anticipated Lifetime (60yr) Package Numbers from Two UK EPR Reactor Units
ILW ion exchange resins	Organic resins that arise from the clean-up of primary circuit water, water from the effluent treatment systems and the reactor fuel pools.	6	360	Polymer immobilisation in Concrete C1 casks. Followed by interim storage on-site awaiting availability of a GDF.	900
ILW spent cartridge filters	Filters from the clean-up of primary circuit water and water from the Liquid Waste and Spent Fuel Treatment Systems. The filters consist of a stainless steel support, with a glass fibre or organic filter media.	5	300	Cement grouted in Concrete C1 casks. Followed by interim storage on-site awaiting availability of a GDF.	720
	Other designs of filters, typically with lower activity.	5	300	Cement grouted in Concrete C4 casks. Followed by interim storage on-site awaiting availability of a GDF.	1200
Operational wastes >2mSv/hr	A range of materials, including activated core components, contaminated metal, plastics, cloth, glassware and rubble arising from operations during planned shutdown periods.	2	120	Cement grouted in Concrete C1 casks. Followed by interim storage on-site awaiting availability of a GDF. Note: Activated core components with heat generation levels above the ILW categorisation would be transferred to the reactor fuel pools where they would be held for a period of delay storage before processing.	360

ILW Stream	Waste Description	Anticipated Annual Raw Waste Volume from Two UK EPR Reactor Units (m^3)	Lifetime (60yr) Raw Waste Volume from Two UK EPR Reactor Units (m^3)	HPC Processing Strategy	Anticipated Lifetime (60yr) Package Numbers from Two UK EPR Reactor Units
ILW wet sludge	Sludge arising from cleaning the bottoms of liquid waste treatment tanks and various sumps.	2	120	Cement grouted in Concrete C1 casks. Followed by interim storage on-site awaiting availability of a GDF.	480
Totals		**20m^3[(2)]**	**1200m^3**		**3660 Packages**

i) Interim On-site Storage of ILW

7.4.29 There is currently no ILW disposal facility in the UK. The GDF is not expected to be available for disposal of wastes for a number of years after start of HPC operations. The strategy for ILW management at HPC is, therefore, to process and store the waste on-site, according to the principles of passive safety (Ref. 7.5), pending availability of the GDF.

7.4.30 The key requirement of the ILWISF would be to provide protection for the waste packages from potential degradation which could have a long-term impact on the integrity of the package and eventual acceptance of the package at GDF. In terms of containment of radioactivity and prevention of releases which could impact upon the outside environment, a number of barriers and environmental controls are provided as listed below:

- the conditioned wasteform is the primary barrier (e.g. the cemented matrix);
- the waste container is the secondary barrier (e.g. the concrete package);
- control of the store environment is important in maintaining integrity of the waste container to ensure compliance with LoC requirements (e.g. humidity levels controlled by adequate ventilation); and
- the store structure is the final layer of weather protection for the waste package and also provides a role in the physical security of the waste.

[2] An additional volume of ILW may be generated during the operation of the ISFS. The design of the ISFS is ongoing and as such the abatement systems and waste volume generation has not yet been finalised. All waste resulting from the operation of the ISFS is expected to fall into the categories set out above, or the previously discussed LLW categories. The main solid waste streams are anticipated to be spent ion exchange resins and filters; these would be expected to be processed as above followed by interim storage on-site awaiting availability of a GDF.

7.4.31 The store would require appropriate maintenance and various levels of in-service refurbishment. As a condition of the NSL, the facilities on-site, including the ILWISF, would be subject to Periodic Review of the safety case throughout the operational life of the store, ensuring any necessary improvements would be made in a timely manner.

7.4.32 EDF Energy anticipate that the store would be emptied of waste and would be decommissioned within 20 years of EoG but its lifespan is considered to be capable of extension if necessary, through refurbishment or replacement of equipment and structures.

7.4.33 The facility is designed to receive and store packages of ILW waste arising from the planned 60 years of operation of the two UK EPR reactor units on the HPC site. The waste would be packaged into a passively safe state as described earlier, prior to being transferred to the ILWISF.

ii. Facility Design Description

7.4.34 The ILWISF would consist of areas performing the following functions:

- receipt and dispatch area;
- interim storage space for all operational ILW until a GDF becomes available;
- package inspection area; and
- facilities to manage ILW that would become LLW following a period of decay storage.

7.4.35 The facility would also require a number of auxiliary systems and plant, such as those providing electrical power, ventilation and maintenance facilities.

iii. Safety Aspects

7.4.36 The design and operation of the facility would be required to be compliant with the NSL with regard to the safety of workers and the public. The facility would be designed, constructed and operated to comply with the Ionising Radiation Regulations 1999. In order to minimise radiation doses to workers and the public, the facility would include the following safety functions:

- the facility would provide containment for radioactive material. In most instances the primary containment would be provided by the conditioning process and the waste packages and secondary containment by the facility structure;
- the facility would minimise the radiation exposure of workers and the public through the provision of shielding; and
- the facility would be maintained at a reduced pressure through the use of a filtered ventilation system to prevent any spread of contamination in the event of an incident at the facility.

7.4.37 Further measures would be implemented to prevent loss of containment by a waste package including:

- minimising waste package handling operations and when package movements cannot be avoided, minimising the lift height of packages where practicable;

- inspection and monitoring of the waste packages in the storage hall to allow early intervention if any package defect is identified; and
- the waste packages are designed to be robust against impact and or being dropped during movement.

7.5 Long-Term Management of ILW

a) Timing of Decommissioning of ILW Management Facilities

7.5.1 The ILW processing facilities would be utilised for the management of wastes throughout the operation of both of the HPC UK EPR reactor units. It is anticipated that the ILW processing facilities would be decommissioned in the final stages of the main decommissioning phase as set out in **Chapter 5** of this volume.

7.5.2 The ILWISF would be decommissioned following complete transfer of all waste from the store; the anticipated timing of transfer of ILW from the store is set out below.

b) Transport of ILW to GDF

7.5.3 At the end of the interim storage period it is the responsibility of the waste producers to ensure that the package is safe for export off-site and is compliant with transport regulations in force at that time. Assessments for the LoC process also address transportation, so that transport issues will necessarily have been addressed for packages that comply with a LoC.

7.5.4 All radioactive waste despatched from the site would need to comply with applicable UK and international legislation at the time of despatch, including the relevant requirements of the Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2009 (Ref. 7.3). Each consignment would undergo the required contamination monitoring and external radiation measurements before leaving the site.

7.5.5 Radioactive waste is transported in specially designed and approved packages. The packages provide protection to operators and members of the public and are required to be sufficiently robust to withstand a range of credible accident scenarios. The UK has more than 50 years of experience of transporting radioactive waste and other radioactive materials by road, rail and sea in accordance with international and national regulations that are designed to protect people, property and the environment. The transport of radioactive material and waste is a well established process that has a proven safety record.

c) Disposal of ILW to GDF

7.5.6 In planning the implementation of the national policy of geological disposal, the NDA has assessed that a UK facility could be operational for the disposal of legacy ILW by about 2040. Disposal of legacy waste is estimated to be completed by about 2130 and the Government's waste base case currently assumes that disposal of new build wastes would begin once disposal of legacy wastes is completed. This assumes that new build ILW is disposed of to the same facility as the UK legacy waste inventory which would require agreement with the host community through the MRWS process.

7.5.7 The proposed decommissioning strategy which would be employed at HPC is early site clearance. Fundamentally the strategy means that decommissioning would commence as soon as possible after EoG at the site, and would proceed without significant delay to complete the process of decommissioning of the reactors and auxiliary buildings. Therefore a reactor that begins generation in 2018, with a 60 year generating life, could have all ILW packaged and ready for transfer to GDF by approximately 2100 (i.e. significantly earlier than the current assumption regarding availability of the GDF).

7.5.8 The current scheduling for transfer of waste to the GDF has been devised by the NDA based on a design which has not been optimised for new build waste. Optimisation of the current scheduling programme for legacy ILW could allow disposal of new build ILW on earlier time scales than the 2130 date currently assumed. NDA is engaging with nuclear new build operators to determine whether it is feasible to establish an optimised baseline which would allow earlier disposal of ILW to the GDF.

7.5.9 For the purposes of decommissioning planning it is assumed that the GDF scheduling can be optimised to allow transfer of packaged ILW during the main site decommissioning phase. However if optimisation requires a further period of interim storage it is possible that the ILWISF may need refurbishment to extend its life until the GDF is available. Safety issues related to the design of the ILWISF and the extension of its life would be regulated outside of the planning regime, through nuclear site licensing.

7.5.10 The potential impact of the disposal of UK EPR operational and decommissioning ILW on the size of a GDF has been assessed by NDA RWMD. Although the impact depends to some extent on the type of package, it has been concluded that in all cases the volume increase is relatively small, corresponding to less than approximately 60m of disposal vault length for each UK EPR. This represents less than 1% of the area required for the UK legacy ILW, per reactor. This reflects the substantial reduction in waste arising per unit of electricity generated in the UK EPR compared with earlier designs.

7.6 Spent Fuel

a) The Quantity of Spent Fuel Generated During the Operation of HPC UK EPR

7.6.1 The UK EPR core contains the nuclear fuel in which the fission reaction occurs. The remainder of the core structure serves either to support the fuel, control the chain reaction or to channel the coolant.

7.6.2 The reactor core of a UK EPR consists of 241 fuel assemblies providing a controlled fission reaction and a heat source for electrical power production. Each fuel assembly is formed by a 17x17 array of Zircaloy M5 (or equivalent zirconium alloy) tubes, made up of 265 fuel rods and 24 guide thimbles. The fuel rods consist of uranium dioxide pellets stacked in a zirconium alloy cladding tube which is then plugged and seal welded.

7.6.3 It is currently assumed that a maximum of 90 spent fuel assemblies (SFA) would be removed every 18 months of operation from each UK EPR reactor unit. With time included for planned outages for maintenance over the anticipated 60yrs operation, a total of approximately 3,400 assemblies per UK EPR reactor unit are expected to be generated. Through the lifetime of HPC, which would have two UK EPR reactor units, a total of around 6,800 fuel assemblies would be generated.

7.6.4 The dimensions of one fuel assembly are 0.214m x 0.214m x 4.859m so the raw waste volume associated with the lifetime total of 6,800 fuel assemblies requiring interim on-site storage would be 1,513m^3. Each spent fuel assembly has a mass of 527.5kg of uranium; therefore a total inventory at EoG would be approximately 3,600 tonnes.

b) The Requirement for Interim On-site Storage of Spent Fuel

7.6.5 The Government has concluded that, in the absence of any proposals from industry for reprocessing, any new nuclear power stations that might be built in the UK should proceed on the basis that spent fuel would not be reprocessed and that plans for, and financing of, waste management should proceed on this basis.

7.6.6 Whilst there is a Government programme in place to develop a GDF, there is currently no disposal facility for spent fuel and the GDF will not be available until many years after the time when HPC would start generating spent fuel. The strategy for spent fuel management at HPC is, therefore, to store the spent fuel on-site pending availability of a GDF and this is consistent with the "base case" that Government has described in Section 4 of its 2008 Consultation on Funded Decommissioning Programme Guidance for New Nuclear Power Stations.

7.6.7 Although it is possible that over the life of the station alternative facilities could become available that might allow spent fuel to be transported off-site earlier, it is prudent to plan on the basis that sufficient capacity is provided on-site to store the lifetime arisings of spent fuel from the two UK EPR reactor units until it can be transported offsite for disposal in the GDF which is currently estimated as being around 2130.

c) Arrangements for Site Spent Fuel Management

7.6.8 The amount of heat generated from radioactive decay within spent fuel means that after it has been removed from a reactor it must be cooled for an initial period under water before its heat output reduces such that it can be placed into interim storage and eventually transported off-site for disposal. This initial cooling would take place in the reactor pool within the Fuel Buildings associated with each EPR unit. Fuel assemblies removed from the reactor would be cooled underwater in the on-site reactor fuel pool for up to 10 years. The reactor fuel pools are not designed for the full life-time arisings of spent fuel.

7.6.9 Following this initial storage period in the on-site reactor fuel pool, the spent fuel assemblies would be prepared for transfer to the separate on-site ISFS where they would be safely stored until the GDF is available and the spent fuel is in a condition suitable for final disposal.

7.6.10 This period of interim storage is assumed to last until around 2130 when on, current planning assumptions, the GDF will be available to receive spent fuel from new nuclear power stations and the spent fuel produced within the Hinkley Point EPRs will have cooled to a level compatible with its disposal.

7.6.11 The planning assumption is therefore that the ISFS would provide storage for spent fuel from the HPC UK EPR reactor units from around 10 years after the start up of Unit 1 until the spent fuel is transferred off-site for disposal at the GDF at around 2130. The ISFS would be designed for a life of at least 100 years and there would be a capability for this to be both achieved and extended, if necessary, through refurbishment or replacement. The ISFS will be designed so as to be capable of operating independently of other parts of the power station in recognition of the fact that it will have a lifetime that would, under current assumptions, extend beyond the decommissioning of the other facilities on the site.

7.6.12 The design of the ISFS must be capable of meeting the following requirements:

- ensuring safe operations (e.g. by preventing a fuel criticality, ensuring sufficient residual heat removal, and maintaining effective containment of radioactivity);
- providing radiological protection of the public, workers and the environment at all times in compliance with dose limits and ensuring that all doses are ALARP and that any discharges of radioactivity to the environment are demonstrated to be minimised in accordance with BAT;
- ensuring cooling and maintaining spent fuel in a condition appropriate for its eventual retrieval, transport and final disposal.

7.6.13 EDF Energy has reviewed the options available for on-site interim storage of spent fuel and determined that for the site specific circumstances at HPC, wet interim storage within an engineered pool is the best approach. The alternative technical options that have been considered and the factors leading to EDF Energy's choice are identified within **Chapter 6** of this volume.

7.6.14 Wet storage of spent fuel has been used widely in the UK and internationally (Ref. 7.6) and has been licensed previously. The use of wet interim storage of spent fuel is capable of providing HPC with a safe, secure and technically flexible solution until such time that the spent fuel is suitable for transfer and a UK GDF, or other off-site management facility, is available.

7.6.15 Although the ISFS is not required to be available until around 10 years after the first unit begins operation, it is the intention to build the facility as part of the main power station construction.

d) Key Safety and Operational Features Associated with the HPC ISFS

7.6.16 The ISFS design is under development and is currently at the conceptual stage. The proposed ISFS would have a range of safety features to maintain the safety of the facility and it would be required meet the requirements of the safety, security and environmental regulators.

7.6.17 A brief outline of some of the key safety and operational features of the proposed ISFS are summarised below:

- Even when containing its full loading of spent fuel, the volume of water within the pool will be large in comparison with the amount of heat generated within the stored spent fuel; this means that pool water temperature will only change slowly should there be an interruption to cooling systems;
- the spent fuel pool cooling systems will be designed such that they will be able to provide significant cooling even when operating in passive mode and this capability will be sufficient to ensure safety over very long periods even if all power supplies were lost. In addition, the design will be optimised to favour as much as possible passive operation of the facility;

- clean-up systems will be provided to maintain water quality and the water chemistry will be controlled to avoid corrosion of fuel assemblies;
- the facility will be designed to be resistant to a wide range of external events such as aircraft crashes or earthquakes;
- the spent fuel pool will be designed with high integrity and will have leak detection and collection systems;
- the water within the ISFS will not require to be dosed with a soluble neutron absorber to ensure protection from criticality; instead this will be achieved through structural materials surrounding the stored fuel assemblies;
- the design and operation of the ISFS will ensure that the amount of radioactivity discharged to air or to sea during operation of the facility will be extremely small.

e) Operations involved during the management of Spent Fuel on site

7.6.18 The operations involved in managing HPC spent fuel can be broken down into a number of steps:

- after an appropriate length of storage, spent fuel would be removed from the reactor fuel pool and packaged into a flask for transfer to the separate ISFS;
- on arrival at the ISFS, the flask would be submerged in the unloading pool;
- the flask lid would be opened and the flask prepared for unloading;
- the fuel assemblies would be unloaded one at a time and placed into mobile storage racks which would contain several assemblies;
- pool handling equipment would be used:
  - to place fuel within a storage rack (or remove it if necessary);
  - to move the racks from the loading position to the storage positions in the pool;
  - to move the racks during storage to optimise pool loading;
  - to move the racks from/to the stored position to permit fuel inspection; and
  - to move the racks from the stored positions to the unloading position (at the end of the interim storage period);
- throughout the operational life of the ISFS an inspection and monitoring regime would be implemented to ensure that fuel is stored safely
- When the time comes for the ISFS to be emptied, the spent fuel assemblies would be removed from the ISFS and loaded into transport flasks for transfer to an encapsulation (packaging) facility prior to transport to the GDF for disposal.

f) Management of Radioactive Waste and Discharges from the ISFS

7.6.19 Wet interim storage would result in the generation of small quantities of liquid, gaseous and solid radioactive wastes resulting from the requirement to maintain pool water quality, to ensure that doses to workers are ALARP, and to minimise discharges of radioactivity to the environment. These wastes would require management throughout the lifetime of the interim store.

7.6.20 The minimisation of wastes and discharges from ISFS operations, through the application of BAT, would need to be demonstrated in order for EDF Energy to fulfil the requirements of the RSR Environmental Permit.

7.6.21 While the UK EPR reactor units are operating it is anticipated that liquid discharges from the ISFS would be routed to the same discharge point as for other liquid discharges from both HPC UK EPR reactor units. The liquid discharges from the ISFS would be minor in comparison to the already small radioactive liquid discharges from the operation of both UK EPR reactor units. Following decommissioning of the EPR units at HPC an alternative liquid discharge arrangement would be required for the ISFS. It is anticipated that the gaseous releases of the ISFS would be discharged by a specific stack on the ISFS. Again, the gaseous discharges associated with spent fuel management would be much less than the already very small gaseous discharges associated with the UK EPR reactor units themselves.

7.6.22 During the period of reactor operations the treatment of radioactive waste generated from the ISFS would be carried out either within the ISFS itself or would be transferred to the ETB. Waste generated following the decommissioning of the reactors and auxiliary buildings, including the ETB, would require management within a new waste treatment facility within the ISFS. It is anticipated that these wastes would be transferred for disposal directly to GDF in the case of ILW, or to a suitable LLW disposal facility for LLW, without the need for interim storage on-site. In the event that disposal facilities are unavailable following decommissioning of the reactor site and auxiliary buildings an additional period of on-site interim storage for the ILW and LLW from spent fuel management may be required.

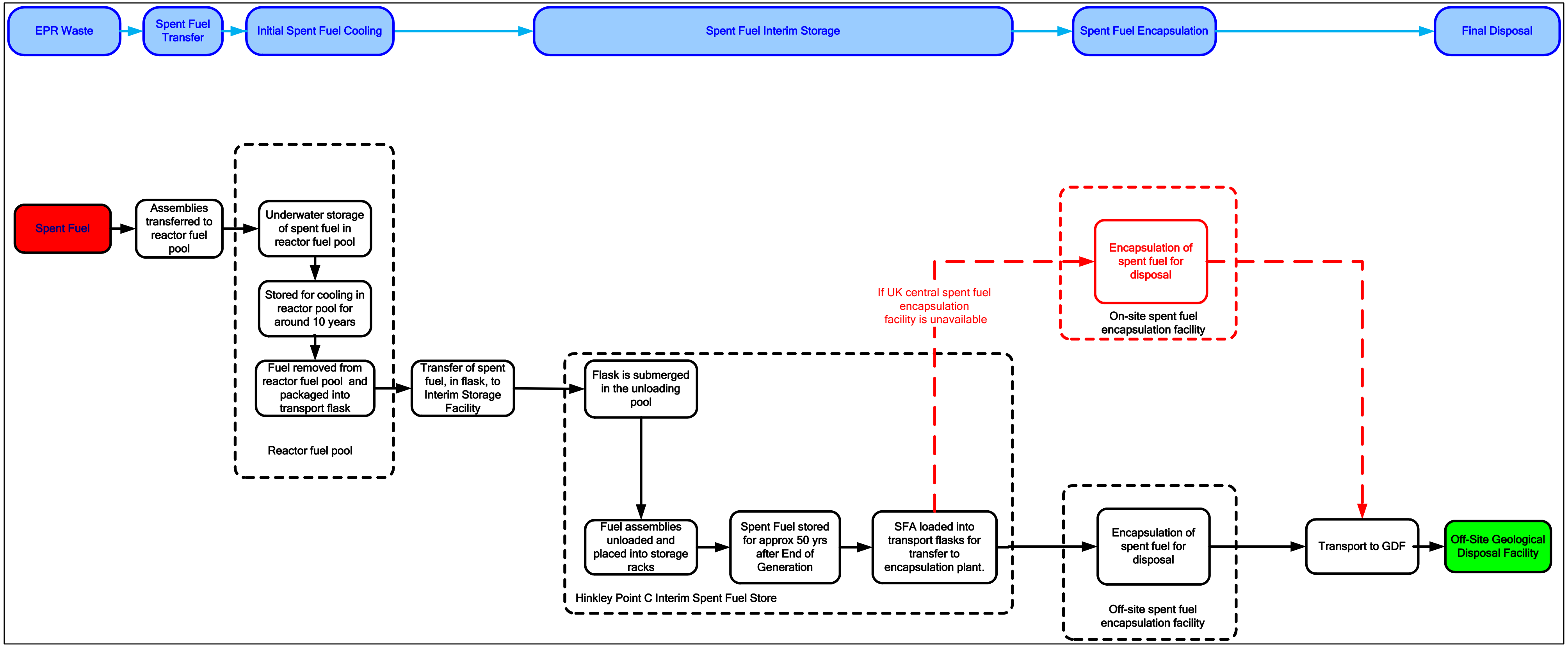
7.7 Long-Term Management of Spent Fuel

a) Spent Fuel Management Following Reactor Decommissioning

7.7.1 At the EoG (indicatively 2079 for Unit 1 and 2080 for Unit 2) all remaining spent fuel would be removed from the reactors and transferred to the ISFS, following the initial cooling period in the reactor storage pools. During the main site decommissioning phase the spent fuel would continue to be stored in the on-site ISFS and the store would be modified to allow it to be a stand alone facility after the rest of the site has been decommissioned.

7.7.2 Following the end of the main site decommissioning the spent fuel would remain within the ISFS. The facility would continue to be licensed as a nuclear site and a number of additional facilities would be provided to accommodate the requirements for a small workforce to operate the storage facility, ensure security of the site, and continue to maintain all safety and environmental obligations. The costs for these modifications and the continued operation of the facility would be funded through the EDF Energy FDP. The Spent Fuel Management Strategy (**Plate 7.2**) sets out the proposed spent fuel management baseline. Only when all the spent fuel has been removed from the ISFS, and decommissioning of the facility is completed, would this remaining part of the site be de-licensed and the land released for alternative use.

Plate 7.2: HPC Spent Fuel Management Strategy



b) Timing of Transfer of Spent Fuel to GDF

7.7.3 The time that would be required for the safe and secure on-site interim storage of spent fuel prior to disposal depends on a two key factors:

- the availability of a GDF; and
- the requirement that spent fuel characteristics are suitable to allow disposal to the GDF (i.e. the spent fuel has sufficiently cooled to allow disposal to GDF).

7.7.4 RWMD have published their plans and timescales for the expected implementation of the GDF (Ref. 7.7). This schedules the end of legacy spent fuel disposal to the GDF as approximately 2130.

7.7.5 NDA's disposability assessment for UK EPR spent fuel, performed during the GDA process, included the finding that if spent fuel is produced at the highest burn-up considered (65GWd/tU), spent fuel cooling (i.e. the time in interim storage) might be required for a period of up to 100 years before disposal to GDF (Ref. 7.7). It was acknowledged that this figure is conservative and the more recent work performed has resulted in a reduction of the expected storage time.

7.7.6 Recent work undertaken by RWMD on behalf of the NIA (Ref. 7.7) has concluded that the storage period to enable the spent fuel to cool sufficiently to allow disposal to the GDF could be around 50 years after the EoG.

7.7.7 It is therefore assumed that the date for start of transfer of spent fuel from the HPC site to a GDF, following encapsulation, is approximately 2128 (50 years after EoG). The process of transfer from the site could be completed in about 8.5 years (based on a transfer rate of 800 spent fuel assemblies per year) therefore all fuel could be removed from the site by 2136. On completion of transfer of the spent fuel from site for encapsulation and disposal, the ISFS would be decommissioned. The final stage of decommissioning would be to demonstrate that there is no longer any danger from radioactivity on the site, and that it can therefore be delicensed and the operator's period of responsibility brought to and end.

c) Alternative Scenarios for Long-term Interim Storage of Spent Fuel

7.7.8 There are a number of alternative scenarios which could result in spent fuel being transferred from the site significantly earlier, allowing earlier decommissioning of the ISFS and subsequent site de-licensing. For example:

- a change in spent fuel management strategy, for example the provision of a UK centralised spent fuel interim storage facility; or
- the optimisation of the GDF design to allow earlier disposal of new build spent fuel.

d) Packaging (Encapsulation) of Spent Fuel for Disposal

7.7.9 The RWMD is developing disposal concepts for HLW and spent fuel undertaking work on several related areas.

7.7.10 RWMD has developed a reference disposal concept based on the Swedish KBS-3V method. This concept is known as the UK Reference HLW and Spent Fuel

Repository Concept. The concept was developed in order to demonstrate the viability of geological disposal of HLW and spent fuel in the UK.

7.7.11 Under this concept, spent fuel would be over-packed before disposal into durable, corrosion resistant disposal canisters manufactured from suitable materials, which would provide long-term containment for the radionuclides contained within the spent fuel. This process is known as encapsulation.

7.7.12 Encapsulation of fuel under the UK reference strategy would require the construction of a complex and expensive facility. Whilst the Government's waste base case envisages on-site encapsulation of spent fuel, EDF Energy considers that a more realistic assumption would be for a single UK facility to be developed to encapsulate both legacy and new build spent fuel and HLW. Such a facility could be co-located with the eventual repository site.

7.7.13 In the event that a central facility for encapsulation of spent fuel is unavailable at the required time, an encapsulation facility to manage Hinkley Point spent fuel could be constructed on site. Such a facility would require planning consent and would be designed, constructed and operated in compliance with the NSL and RSR permit requirements with regard to safety and radioactive waste discharges.

e) Transport and Disposal of Spent Fuel to GDF

7.7.14 As part of the GDA of the UK EPR, RWMD has undertaken a Disposability Assessment for the spent fuel expected to arise from the operation of a UK EPR (Ref. 7.7). This assessed the implications of the disposal of the proposed spent fuel disposal packages against the waste package standards and specifications developed by RWMD and the supporting safety assessments for a GDF. The safety of transport operations, handling and emplacement at a GDF, and the longer term performance of the system have been considered, together with the implications for the size and design of a GDF.

7.7.15 On the basis of the GDA Disposability Assessment for the UK EPR, RWMD has concluded that, compared with existing spent fuel, no new issues arise that challenge the fundamental disposability of the spent fuel expected to arise from operation of such a reactor. This conclusion is supported by the similarity of the fuel to that expected to arise from the existing PWR at Sizewell B. Given a disposal site with suitable characteristics, the spent fuel from the UK EPR is expected to be disposable.

7.7.16 The assumed operating scenario for a single UK EPR reactor unit (60 years operation) gives rise to an estimated 900 disposal canisters. This has been calculated to require an area below ground of approximately 0.15km^2 for the associated disposal tunnels representing approximately 8% of the area required for legacy HLW and spent fuel. The spent fuel associated with the two HPC UK EPR reactor units would require an area of approximately 0.30km^2, excluding associated service facilities. This represents approximately 16% of the area required for legacy HLW and spent fuel.

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7.3 Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations. HMSO, 2009.

7.4 HSE and EA (2007),The management of higher activity radioactive wastes on nuclear licensed sites, Part I The regulatory process, Guidance from the Health and Safety Executive, the Environment Agency and the Scottish Environmental Protection Agency to nuclear licensees.

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7.6 IAEA. Selection of Away-From-Reactor Facilities for Spent Fuel Storage, Annex III, Global Status of AFR Storage of Spent Fuel. 2007

7.7 NDA. Geological Disposal – Steps towards implementation, NDA/RWMD/013, 2010.

CHAPTER 8: CONVENTIONAL WASTE MANAGEMENT

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TABLES

PLATES

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8. CONVENTIONAL WASTE MANAGEMENT

8.1 Introduction

8.1.1 This chapter provides an assessment of the potential impact of conventional waste arisings associated with the construction and operation of Hinkley Point C, including the construction, operation and as far as reasonably practicable, the post-operational phase of the associated developments.

8.1.2 Spent fuel and radioactive waste which arise during the operation of HPC are discussed within **Chapter 7** of this volume, and the waste arisings associated with the decommissioning of the HPC nuclear power station are considered in **Chapter 5.**

8.1.3 The key phases which will generate waste associated with HPC and the associated developments are:

- **earthworks/construction** such as demolition/remedial wastes of any pre-existing structures; old formwork, steel off-cuts;
- **operational wastes** such as maintenance of pipes, equipment and control rooms at the HPC nuclear power station, and general waste produced from the workers at their offices/accommodation; and
- **post-operational waste** such as demolition waste and spoil, where applicable.

8.1.4 HPC will be constructed over a period of approximately nine years, and throughout this period waste will be produced. It is proposed that Unit 1 and Unit 2 would become fully operational in 2019 and 2020 respectively, and will operate for a period of 60 years prior to decommissioning.

8.1.5 The off-site associated developments will take up to two years to construct, with an approximate seven year operational phase, unless required to support the operational phase of HPC, as described in **Chapter 5** of each of **Volumes 3** to **10** of this ES. The potential post-operational uses differ for each proposed development as explained in the above chapter.

- **Bridgwater A -** Some infrastructure would be removed and some retained following cessation of use of the site by EDF Energy. A Post-Operational Scheme would be submitted to the Infrastructure Planning Commission (IPC) at the relevant time to approve which components of the development would be retained or removed, to facilitate re-use of the site in the longer term.
- **Bridgwater C -** The infrastructure would be retained, with the exception of some minor structures, following cessation of use by EDF Energy and would be transferred to a third party for use in connection with Bridgwater College.
- **Cannington Bypass -** The bypass would be retained to support the operational phase of the HPC power station and would be adopted by the highways authority for use as public highway.

- **Cannington Park and Ride -** All of the infrastructure would be removed and the land would be restored to agriculture.
- **Combwich -** The wharf would be retained to support the operational phase of the HPC power station. In terms of the freight laydown facility, all of the infrastructure would be removed and the land returned to agriculture.
- **Junction 23 -** The proposed development could be removed and the land restored to its existing use (agriculture) following cessation of use by EDF Energy. Alternatively, the site could be retained in part to allow for future use by third parties.
- **Junction 24 -** Appropriate measures would be carried out to allow the site to be available for storage/distribution purposes following cessation of use by EDF Energy.
- **Williton -** Appropriate measures would be carried out to allow the site to be available for use as a lorry park depot and storage area following cessation of use by EDF Energy.

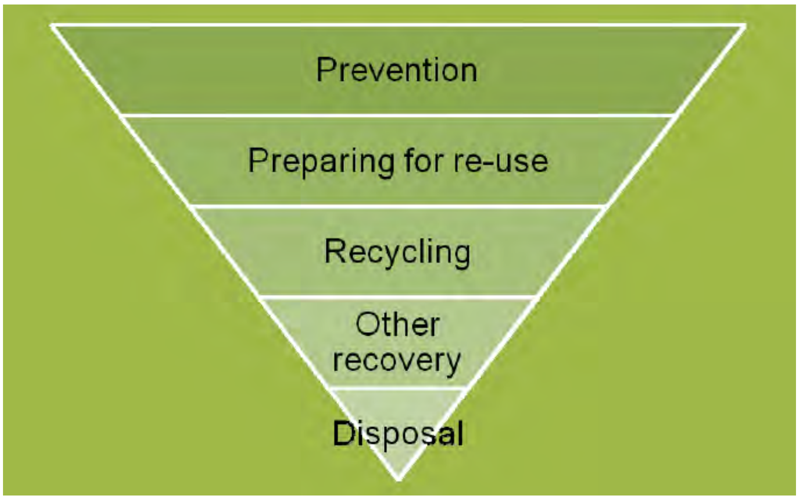
8.1.6 Further details of the mechanisms for the post-operational phase are described in the **Post-operational Strategy** appended to the **Environmental Statement.**

8.1.7 To facilitate the prevention and minimisation of waste in accordance with the waste hierarchy described below, EDF Energy has developed a Waste Management Implementation Strategy (WMIS) (see **Annex 5**) for waste generated during the construction and operation of the HPC Project, which includes the post-operational phases for each of the off-site associated developments.

8.1.8 The principal objective of sustainable waste management is to use material resources more efficiently, thereby reducing the amount of waste generated and minimising the quantity of residual waste requiring final disposal. Where there is residual waste, it would be managed in line with the principles of the waste hierarchy, applying the proximity principle to minimise environmental impacts and actively contribute to the social and economic goals of sustainable development.

8.1.9 The waste hierarchy requires prevention of waste generation in the first instance and reducing, as far as possible, the volume requiring disposal once the waste has been produced. The waste hierarchy gives an order of preference for waste management options to minimise the volume for disposal, as illustrated in **Plate 8.1**.

Plate 8.1: The Waste Hierarchy. Source: Defra.



8.1.10 Waste is defined as any substance or object which the holder discards, intends to discard or is required to discard, and has no specific proposed use at the time of its creation. Waste is generally subdivided into three broad categories, inert, non-hazardous and hazardous, as described below:

- **Inert waste** does not undergo any significant physical, chemical or biological transformations (e.g. brick, concrete and glass). Construction and demolition type waste will be the largest volume of inert waste produced from the project.
- **Non-hazardous waste** is reactive but not considered harmful to human health and/or the environment (e.g. organic matter in household waste).
- **Hazardous waste** has properties which are considered harmful to human health and/or the environment (e.g. some remedial waste, batteries and fluorescent tubes). Hazardous waste will comprise the smallest proportion of waste produced from the project.

8.2 Scope and Objectives of Assessment

a) Scope of Assessment

8.2.1 The scope of this chapter has been determined through the Stage 1 and 2 consultations, along with informal engagement with Somerset County Council (SCC), the Environment Agency (EA) and Somerset Waste Partnership (SWP).

8.2.2 This assessment aims to:

- identify the main waste streams and predicted volumes likely to arise from the construction, operation and post-operational phases of the HPC Project;
- identify any potential impacts upon existing waste infrastructure;
- identify measures that would be implemented to prevent and minimise waste generation; and
- ensure that a sustainable waste management option is adopted.

8.2.3 The assessment of conventional waste generation arising from the HPC development site and the off-site associated developments has been undertaken adopting the methodologies described in Section 8.4.

8.2.4 The existing baseline conditions, against which the likely waste impacts are assessed, are described in Section 8.5. The baseline conditions have been identified as the existing waste management facilities within Somerset, in terms of their type, capacity and availability. In addition, baseline conditions for the HPC development site and each of the off-site associated developments have been determined, in terms of their current waste production.

8.2.5 The predicted waste types, volumes and schedule of waste production are outlined in Section 8.6. In Section 8.7, the predicted waste volumes have been compared against the existing baseline conditions. Appropriate mitigation measures aimed at reducing the impact of the waste generation are presented in Section 8.8.

b) Objectives of the Assessment

8.2.6 With regards to earthworks, construction and demolition waste resulting from the HPC Project, EDF Energy has set a target of re-using, recycling or recovering at least 90% of the waste. This is in addition to a target of re-using, as far as practicable, 100% of excavated clean soils.

8.2.7 In order to meet the above targets, the following objectives have been developed for waste management:

- prevent and reduce the volumes of waste produced through the application of the waste hierarchy;
- maximise re-use and recycling within the wider development;
- maximise re-use and recycling outside of the HPC Project; and
- minimise the impact upon the existing waste management infrastructure.

8.2.8 The practical implementation of these objectives across the HPC Project is summarised below.

i. Prevention

- EDF Energy will ensure careful design of earthworks, for example:
  - storage of topsoil and subsoil during construction and incorporation into the final landscape scheme;
  - re-use of deeper subsoil and rock to construct the main platform;
  - the reuse of excavated natural bedrock (where appropriate); and
  - recovery of secondary aggregates from excavated Made Ground.
- Construction activities and the ordering of materials during the construction phase will be planned to minimise waste including packaging.
- Use of modular units to reduce construction waste generation on-site. For example, the majority of the accommodation campus buildings will be modular. Consequently, these materials would be delivered as abnormal indivisible loads (AILs) to site.
- Adoption of best practice construction methods and consultation with the Waste and Resources Action Programme (WRAP) would ensure that the waste minimisation and resource efficiency targets are met.

ii. Preparation for Re-use

- Efforts will be made to re-use materials during construction, operation and reinstatement of the main site, and the post-operational phase for the associated developments (as applicable).
- EDF Energy will encourage re-use of material through a waste inventory, for example, whole units, materials, fabrics and components could potentially be resold locally.

iii. Recycling

- General waste (e.g. plastic and glass) produced from the operational phases of the accommodation campuses will be segregated prior to being sent to an appropriate recycling facility.

iv. Disposal

- Where not connected an existing system/discharge, sewage at the off-site associated development sites would be collected and sent to a foul sewer. At the HPC development site during construction, sewage would be tertiary treated prior to being discharged *via* the construction outfall to the foreshore.
- Only in the last instance would material be sent to landfill.

8.2.9 EDF Energy will ensure that suppliers comply with sustainability objectives through contractual mechanisms and will develop systems for monitoring and checking performance, with an aim of annual improvement. Furthermore, all workers involved with the HPC Project will be actively encouraged to recycle and this will be monitored accordingly.

8.3 Legislation, Policy and Guidance

8.3.1 The key pieces of legislation and guidance considered in developing a compliant WMIS are discussed below. A more detailed review of legislation, policy and guidance relating to waste is provided in the WMIS report.

8.3.2 **The Waste Strategy for England 2007** (Ref. 8.1) – This national strategy for waste sets out the government's views on waste management in England. The strategy commits to setting new national targets for the reduction of household waste through recycling and composting by at least 40% by 2010, 45% by 2015 and 50% by 2020, in comparison to 2000 levels. In addition, new national targets are expected for the reduction of commercial/industrial waste going to landfill; including a 20% reduction in material going to landfill by 2010 compared to 2004. This project aims to achieve a rate of <10% of construction, demolition and earthworks waste going to landfill.

8.3.3 **The Environmental Protection Act 1990** (Ref. 8.2) addresses areas of significant environmental concern including waste disposal. Waste Management issues are considered under Part II of the EPA. Controlled waste includes commercial, industrial (including agricultural waste from 2006) and household waste. Under the act, the deposition of waste to land without a licence or breaching licence conditions is an offence. The Act is also designed to prevent environmental pollution or harm to human health by prohibiting treatment, storage and disposal of controlled wastes without a licence or in breach of a licence

8.3.4 **The Site Waste Management Plans Regulations 2011** (Ref. 8.3) aim to make the construction industry more sustainable by ensuring that those responsible for development projects are aware of the waste being produced, so that it can be reduced. These regulations make it an offence to fail to prepare and implement a site waste management plan (SWMP) for certain construction projects that have an estimated cost of more than £300,000 (excluding VAT). Additional requirements are described in the Schedule for projects over £500,000.

8.3.5 **Environmental Permitting (England and Wales) Regulations (2010)** (Ref. 8.4) – These regulations introduce a new streamlined system of environmental permitting in England and Wales for certain installations, waste operations and mobile plants. Activities under these regimes will be covered by a single form of environmental permit governed by one set of regulations. This provides a system for environmental permits and exemptions for industrial activities, mobile plant, waste operations, mining waste operations, water discharge activities, groundwater activities and radioactive substances. It also sets out the powers, functions and duties of the regulators. Notably, the requirements of the Landfill Directive and Waste Management Licensing are applied under these regulations.

8.3.6 **Planning Policy Statement 10 (PPS10): Planning for Sustainable Waste Management (2005)** (Ref. 8.5) – PPS10 forms part of the national waste management plan for the UK. The main aim of the policy is to protect human health and the environment by producing less waste and by using it as a resource wherever possible. PPS10 sets out the key planning objectives for waste planning authorities.

8.3.7 The development falls within the south-west region of England and therefore **The Regional Waste Strategy for the South West 'From Rubbish to Resource' (2004-2020)** (Ref. 8.6) applies. This is a non-statutory Regional Waste Strategy which aims to ensure that by the year 2020 over 45% of waste is recycled and reused and less than 20% of waste produced in the region will be landfilled. One of the key areas for action is to adopt the waste hierarchy to reduce the amount of waste being produced, before considering reuse, recycling, recovery or disposal. The strategy's policies and actions address local authorities, the waste industry, non-governmental organisations and community groups as they are key partners to deliver the strategy.

8.3.8 **The Somerset Waste Local Plan (2001-2011) (adopted in February 2005)** (Ref. 8.7) sets out the broad land use framework for future waste management in Somerset. It covers all forms of waste including household, commercial, industrial and construction waste. The plan states that the most significant implication is the amount of waste disposed to landfill, which will have to be reduced in order to meet government disposal targets. In addition, most waste sent to landfill will require pre-treatment. The plan has a number of policies which provide commitment to sustainable waste management, including the waste hierarchy and the proximity principle, whereby waste is managed close to its sources of generation.

8.3.9 **Waste and Resources Action Programme (WRAP)** (Ref. 8.8) assists the UK government to meet national and international commitments and to support resource efficiency in the UK. This is achieved by helping businesses and individuals within the UK to benefit from reducing waste, develop sustainable products and use resources in an efficient way.

8.3.10 **Contaminated Land Applications in Real Environments (CL:AIRE)** (Ref. 8.9) is an independent, non-profit organisation that aims to encourage the sustainable remediation of contaminated land and groundwater throughout the UK, for effective social and economic use. This is achieved by increasing awareness and confidence in practical, sustainable remedial solutions.

8.4 Methodology

8.4.1 The methodology for assessing likely impacts associated with the generation of conventional waste at the HPC development site and the off-site associated developments is based upon an assessment of the quantity and types of waste that are likely to be produced during their construction, operational and post-operational phases (where relevant), and their impact upon the existing waste infrastructure. In order to identify any resultant impacts, the baseline conditions were determined, as per the methods described below.

a) Study Area

8.4.2 The study area for this assessment comprises the HPC development site and the off-site associated developments.

b) Baseline Description

8.4.3 To establish the baseline conditions for the waste assessment, the current levels of conventional waste production in Somerset have been determined together with the type, capacity, and availability of existing waste management infrastructure within the county.

8.4.4 Data for the current level of waste production and available waste handling, treatment and disposal facilities have been derived from publicly available government sources and through direct consultation with the relevant regulatory bodies, including SCC, the Environment Agency and SWP. An assessment of operational Materials Recovery Facilities (MRF) and Waste Transfer Plants within Somerset has been undertaken, using information provided in SCC's Mineral and Waste Development Framework (Ref. 8.10). The assessment was based on the annual tonnage capacity of each facility (as per the Environment Agency Public Register) and the distance of the facility from the HPC development site. Discussions included the feasibility of utilising existing waste infrastructure within Somerset and the surrounding counties over the duration of the project.

c) Assessment Methodology for Waste Volumes

i. HPC Nuclear Power Station

8.4.5 In order to calculate the anticipated waste volumes for the construction of the HPC nuclear power station, reference has been made to the construction of the Flamanville 3 nuclear power station in France. This is considered to be an appropriate reference as it used similar construction techniques and is likely to produce comparable waste types and quantities. As HPC will have two UK EPR reactor units and Flamanville has only one, the waste volumes from the Flamanville project have been doubled. An additional 10% has been added to the total calculated volume as a contingency measure.

8.4.6 The operational waste volumes for HPC nuclear power station were based upon typical arisings from the two other operating reactor units at Flamanville during 2006.

ii. Associated Developments

8.4.7 The anticipated construction waste volumes arising from the associated development sites were calculated as approximately 1% of the estimated material volumes required for construction. The percentage was considered appropriate based upon experience from other similarly scaled projects, combined with professional judgement. Furthermore, as a conservative measure, a 20% contingency has been assigned to the total numbers calculated. Where volumes have been provided in cubic metres, these have been converted to tonnes assuming a density of 2.0 tonnes per m^3. This conversion has been based upon a typical density of sand and gravel being 1.8 tonnes per m^3, plus a conservative allowance for bulking of material.

8.4.8 Waste is anticipated to arise at Bridgwater A and Bridgwater C from remediation of the sites. However, the final details of this remediation are to be defined. Consequently, conservative estimates of the potential remediation volumes have been incorporated into the overall waste volumes based on similarly scaled projects and professional judgement. More specifically, the volumes of remedial waste calculated for Bridgwater A were partly based on the volume of contaminated arisings produced through the redevelopment of a site in North-East Bridgwater.

8.4.9 The operational waste volumes estimated for the accommodation campuses were based upon national performance indicators for Sedgemoor residents, as provided by SWP. Furthermore, consideration was taken of British Standard 5906 (Ref. 8.11), which provides estimates of operational waste generation for various developments. The operational waste volumes for the non-accommodation sites were derived from experience of similarly scaled projects and professional judgement.

8.4.10 The post-operational waste volume estimates for the associated developments were determined as the estimated volume required for construction, minus the waste produced during construction (1%) and any infrastructure to remain on-site for its legacy use. Where volumes have been provided in cubic metres, these have been converted to tonnes assuming a density of 2.0 tonnes per m^3. A 20% contingency has been assigned to the total numbers as a conservative measure. The types of waste to be produced from the post-operational phases were assumed to be similar to the construction phase.

d) Methodology for Impact Assessment

8.4.11 The predicted waste volumes to be produced for each phase of development (i.e. construction, operational and post-operational) have been compared against the current baseline conditions at the HPC development site and each of the off-site associated developments. Secondly, the total predicted waste volumes for each phase of development have been compared against the baseline conditions in terms of the types and total volumes of waste managed and/or produced in Somerset annually.

e) Assumptions

8.4.12 For the purpose of this document, it is assumed that the Development Consent Order (DCO) would be granted in 2012, and EDF Energy's target for the first nuclear reactor becoming operational in 2019.

8.4.13 There would be some highway improvements proposed as part of the HPC Project, however, these works are assumed to be produce only negligible waste volumes and therefore are not considered further.

8.4.14 The future re-use option for the proposed park and ride facility and freight management facility at Junction 23 is undetermined at this stage. There are three potential options but for the purpose of this assessment, the most conservative scenario, of restoring the site to greenfield status (in full or part) has been assumed.

8.4.15 In the event that it is not possible to re-use soils on the site of origin or on other HPC Project sites, then it is assumed that surplus soils could be re-used on other sites within Somerset. For example, the use of the National Industrial Symbiosis Programme (NISP) (Ref. 8.12) could assist in the identification of companies/sites that may require large quantities of construction and demolition wastes, such as large scale housing developments. In addition, Taunton is to undergo regeneration, therefore there may be opportunities for re-use of materials from those developments.

8.5 Baseline Assessment

8.5.1 Baseline conditions have been established in order to clarify the present circumstances within Somerset in terms of the waste types and volumes currently produced, including the capacity and availability of waste management facilities. Furthermore, baseline conditions have been determined for the HPC development site and the off-site associated developments in terms of the waste types and volumes currently produced (if any).

a) Somerset Waste Production

8.5.2 It is reported by SCC in their Document Waste Management Need to 2028 (March 2011) (Ref. 8.13), that a total of 393,603 tonnes of waste was received at licensed facilities within Somerset during 2008. Details are presented in **Table 8.1** below:

Table 8.1: Construction/Demolition Waste Received in Somerset – 2008

Construction/Demolition Waste	Total (tonnes)
Inert	104,857
Non-inert	249,336
Other	39,410
TOTAL	**393,603**

8.5.3 Following consultation with SCC, it is evident that facilities in Somerset are either small-scale or recycle predominantly household type wastes. They, therefore, have limited capacity to manage large volumes of construction and demolition waste. According to SCC's document Waste Management Need to 2028 (March 2011) (Ref. 8.13), it is assumed that approximately 33,865 tonnes of hazardous waste is produced in Somerset annually.

8.5.4 In terms of municipal solid waste, 279,117 tonnes arose within Somerset during 2009/2010 (Ref. 8.13). Of this, 45% was recycled, 0.7% was treated and 54% was sent to landfill. The national performance indicators show that Sedgemoor residents generate for collection approximately 400kg per head per annum of wastes.

b) Waste Management Facilities in Somerset

8.5.5 **Table 8.2** details the various waste management facilities in Somerset along with their location, distance from the HPC development site and capacity for managing waste.

Table 8.2: Waste Facility Search for Somerset

Recycling Facility	Distance (miles)	Capacity (tonnes p/a)	Operator	Post Code
Material Recycling Facilities and Waste Transfer Stations				
Old Station Yard Scrap Metal	26.4	49,999	J C Thomas & Sons Ltd.	BA6 9LU
Myrtle Garage Scrap Metal Yard	36.4	13,000	Pylle Motor Spares Ltd.	BA4 6TA
Green Ore Farm, Wells	32.7	74,999	Bruchen Down Ltd.	BA5
Park Farm Scrap Yard	26.4	5,000	Colin White	BA6 9NN
Hamp Yard Scrap Metal Recycling	10.3	5,000	Johm Metcalfe	TA6 7RR
Black – Ram Recycling Ltd.	19.2	74,999	Black – Ram Recycling Ltd.	TA9 4AG
Johnson Metals Ltd.	11.5	7,500	Johnson Metals Ltd.	TA6 5L7
Abbey Hill Trading Estate Scrap Metal Yard	43	5,000	L & W Metals (Yeovil) Ltd.	BA21 3AR
Penmill Trading Easte Scrap Metal Yard	45.7	5,000	Mountstar Metals Ltd.	BA21 5HA
Symonds Salvage – Henstridge	50.7	4,999	R Symonds	BA21 5HA
Springmead Works Scrapyard	33.1	25,000	Sheppard (Group) Ltd. George Cohen Chard Division	TA20 1BB
Scrap Metal Recycling Yard	27.6	5,000	Smith D V & R R	TA11 7JB
Blacknell Lane Scrap Metal Recycling Yard	42.4	25,000	Hallett Recycling Ltd.	TA18 7HE
W S Scrap Metals	49.2	5,000	Stoodley William	BA7 7NR
Martock Waste Paper (now Viridor)	25	50,000	Viridor	TA12 6HB
Old Railway Yard Scrap Metal Recycling Yard	30.1	5,000	Crossleys Motor Services Ltd.	TA11 7E7

Recycling Facility	Distance (miles)	Capacity (tonnes p/a)	Operator	Post Code
J C Thomas & Sons Ltd.	43	5,000	J C Thomas & Sons Ltd.	BA21 3AR
Tyre Renewals Ltd.	41.5	24,999	T R L Ltd.	BA7 7DT
Kedgeworth 2000 Ltd.	50.7	2,500	Kedgeworth 2000 Ltd.	BA8 0TN
Priory Way Scrap Metal Recycling Yard	21.9	25,000	Sims Group UK Ltd.	TA1 2BB
Priory Depot Waste transfer Stations	21.9	25,000	Deane D L O	TA1 2BB
The Old Brickworks Metal Recycling	28.7	5,000	A J Garrett	TA21 9HW
Wansbrough Mill	13.2	50,000	St. Regis Paper Co Ltd.	TA23 0AY
EB Janes Ltd.	19.6	2,500		TA24 5BJ
Evercreech Depot	38.3	74,999	May Gurney Plc.	BA4 6NA
Frome Waste Recycling Centre	46.5	7,500	Somerset County Council	BA11 4RN
Lime Kiln Hill Transfer Station	45.4	75,000	Western Skip Hire Ltd.	BA11 3PH
Southwood Waste Transfer Station	38	74,999	Commercial Recycling Ltd.	BA4 6LX
Bunns Lane Scrap Metal Recycling Yard Transfer Stations	48.9	24,999	Ransome J W & Son	BA11 3PH
Burcott House Farm Transfer Station	31.5	25,000	Lansdown, B W & E F	BA5 1NH
Colley Lane Depot	12	149,998	May Gurney Plc.	TA6 5LB
Spaxton Road Transfer Station	6.5	25,000	J Roberts & Sons	TA6 3BB
Burnham Waste Ltd.	19.2	74,999	Burnham Waste Ltd.	TA9 4AN
Brue Avenue Transfer Station	12.2	2,499	Hemmings Frederick	TA6 5LT
Dunwear Transfer Station	13.5	500	Towens Waste Management Ltd.	TA7 0AA
The Old Oil Works Transfer Station	18.9	25,000	Rickard Terence E	TA9 3AH
Silver Lining	16.6	4,999	Silver Lining Industries	TA7 0JS
Axe Road Transfer Station	12.1	25,000	Erwin Rhodes Contracting Ltd.	TA6 5LP
Dunwear Depot	13.5	25,000	R K Bell Ltd.	TA4 0AA
Perry's Material Recycling Facility	12.7	74,999	Perry's Recycling	TA6 6AJ
Castlefields Transfer Station		25,000	S Roberts & Son (Bridgwater Ltd.)	TA6 3BB
Whiscombe Hill Transfer Station	27.2	25,000	Westcombe Waste Ltd.	TA11 6HY

Recycling Facility	Distance (miles)	Capacity (tonnes p/a)	Operator	Post Code
Dimmer Hazardous Waste Transfer Station	42.2	5,000	Viridor Waste Management	BA7 7NR
Perry's MRF	38	74,999	Perry's Recycling Ltd.	BA22 8DL
Priorswood Taunton MRF	20.2	25,000	Viridor	TA2 8QY
Greenham Quarry Transfer Stations	33.3	25,000	Wasteology Ltd.	TA21 0JU
Wellington Waste Skips Transfer Station	28.7	25,000	Palfrey Mr A R & Ralfrey Mrs B J	TA21 9HW
Taunton Trading Estate Transfer Station	30.6	25,000	Riste Jnr Mr H	TA2 6RX
Bickenhall Lane Transfer Station	25.6	5,000	Somerset County Council	TA3 6TN
Silver Lining Industries Ltd.	24	16,499	Silver Lining Industries	TA1 2BB
Mart Road Industrial Estate Transfer Station	19.5	25,000	West Somerset Council	TA24 5BY
Dimmer Materials Recycling Facility (MRF)	42.2	25,000	Viridor	BA7 7NR
Composting Facilities				
Monksham Farm, Frome	46.7	1,469	Monksham Farm, Frome	BA11 5BR
Dimmer In Vessel Composting and rotary composting	42.2	35,000	Dimmer In Vessel Composting and Rotary Composting	BA7 7 NR
Dimmer Open Windrow	42.2	15,000	Dimmer Open Windrow	BA7 7NR
Walpole Composting and Wood Shredding Facility	15.4	74,999	Walpole Composting and Wood Shredding Facility	TA6 4TF
Smokey Farm Staplegrove	25	2,500	Smokey Farm Staplegrove	TA2 6SL
Landfills				
Whiteball Landfill Site	31.9	25,000	Whiteball Landfill Site	TA21 0LT
Lime Kiln Hill Quarry Landfill Site	45.4	52,000	Lime Kiln Hill Quarry Landfill Site	BA11 3PH
Walpole Landfill	15.4	446,350	Walpole Landfill	TA6 4TF
Dimmer Landfill	42.2	150,000	Dimmer Landfill	BA7 7NR
Whiscombe Hill Landfill	27.2	25,000	Whiscombe Hill Landfill	TA11 6HY
Anaerobic Digestion / Sewage Treatment Facilities				
Ham Sewage Treatment Works (AD Plan)	22.7	~3,000	Wessex Water	Taunton
Cannington Cold Stores	6.1	19,999	–	TA5 2NJ

Notes: With Planning Permission; WPS Pyrolysis Plan at Heybridge, Wells; Anaerobic Digestion Plant (Viridor), Walpole. To open by 2014; Priorswood MRF Extension (Viridor), Taunton.

8.5.6 Examples of small-scale facilities which can accept construction and demolition wastes in Somerset include Wellington Waste Skips in Taunton, which can accept approximately 11,000 tonnes of per annum and Southwood Waste Transfer Station in Shepton Mallet, which can accept up to 9,000 tonnes. However, the capacity of these facilities is relatively small in comparison to the anticipated waste generation for the HPC Project.

8.5.7 There is a MRF at Priorswood, Taunton operated by waste management contractor Viridor which has a capacity of up to 25,000 tonnes and can receive co-mingled wastes, as well as individual specific waste streams such as glass. Residual wastes that are non-recyclable would currently be sent to the Walpole Landfill.

8.5.8 In addition, Viridor operate several household waste recycling centres on behalf of SCC (Bridgwater, Chard, Highbridge, Taunton and Williton) with individual capacities of up to 25,000 tonnes per annum.

8.5.9 There is a composting and wood shredding facility at Walpole landfill close to Junction 23 of the M5 which has a capacity of up to 75,000 tonnes per annum. Furthermore, there is an in-vessel/rotary composting facility, along with an open windrow composting facility at Dimmer Landfill near Castle Cary. These facilities accept 35,000 tonnes and 15,000 tonnes per annum respectively but are scheduled to close by 2014.

8.5.10 There is an anaerobic digestion plant operating in Cannington which has an annual capacity of up to 20,000 tonnes. It may be possible for this facility to accept food waste from the HPC Project. There are also proposals for a Mechanical Biological Treatment (MBT) and anaerobic digestion facility to be constructed to the north-east of Walpole Landfill. If this is developed then the facility will be operational by 2014 and would provide treatment of segregated organic waste to recover energy and compost from waste that currently goes to landfill. Waste that could be accepted includes vegetation and food.

8.5.11 Walpole landfill, as mentioned above, accepts construction and demolition waste. This landfill is permitted to accept up to 446,350 tonnes per annum. In addition, there are four other landfills located within Somerset which would be able to accept construction and demolition type waste.

8.5.12 The only facilities which can accept hazardous waste are landfill sites. Walpole landfill, which has been mentioned previously, can accept asbestos waste. However, the closest landfill sites to the HPC Project which can accept other types of hazardous waste are located outside of Somerset. Examples are Kingweston Landfill in Bristol and Parkgate Farm Hazardous Waste Landfill in Wiltshire.

c) Baseline Conditions – HPC Development Site

8.5.13 The HPC development sites is currently greenfield status except for the Built Development Area East, where part of the area is subject to a series of works including remediation of a spoil mound as described in **Volume 1**, **Chapter 6**. It is assumed for the purposes of this application that these works would have been completed prior to commencement of the bulk earthworks.

8.5.14 The site preparation works as resolved to be approved by West Somerset Council (WSC) are anticipated to commence in the third quarter of 2011, with the earthworks commencing in 2012. However it is intended that all material arising would be retained on-site for re-use throughout the HPC Project. Consequently, there would only very limited volumes of waste, such as some general waste produced from the construction workers.

8.5.15 Certain off-site associated developments are currently greenfield status. Consequently, current baseline waste volumes produced at these sites are considered to be negligible. Any minor quantities of waste produced would be likely to be organic and therefore re-used by the farmer. The off-site associated developments which are currently greenfield status are listed as follows:

- Combwich Wharf freight laydown facility.
- Cannington park and ride facility.
- Cannington bypass.
- Junction 23 park and ride, freight management and courier consolidation facilities and induction centre.

8.5.16 The Bridgwater A accommodation campus site currently comprises a derelict factory, giving rise to reasonable quantities of demolition waste.

8.5.17 The Bridgwater C accommodation campus site forms part of a rugby club and therefore some general waste and some green waste (e.g. from pitch maintenance) would be likely to be produced at present but only in small quantities (less than 20 tonnes per annum).

8.5.18 Combwich Wharf is only used occasionally by EDF Energy for the delivery of AILs which cannot be delivered to Hinkley Point by road due to their size or weight. As such, current waste volumes are not likely to exceed 70 tonnes of operational waste per annum.

8.5.19 The Junction 24 site comprises a storage/distribution facility and Williton park and ride comprises an existing lorry park. Consequently, current waste volumes are likely to be in the region of 85 tonnes per annum at these sites and will likely comprise some general waste and a small volume of hazardous waste.

8.6 Project Waste Generation Assessment

8.6.1 The predicted waste volumes for the earthworks/construction, operational and post-operational phases are displayed below in **Tables 8.3**, **8.4** and **8.5** respectively.

Table 8.3: Earthworks/Construction Phase Waste Quantity Estimates

Earthworks/Construction Waste (tonnes)	Inert	Non-Hazardous	Hazardous	TOTAL	TOTAL (Contingency = 10% HPC Power Station, 20% AD's)
HPC Development Site					
HPC power station	150,000	68,000	2,000	220,000	242,000

Earthworks/Construction Waste (tonnes)	Inert	Non-Hazardous	Hazardous	TOTAL	TOTAL (Contingency = 10% HPC Power Station, 20% AD's)
HPC accommodation campus	1,767	471	118	2,356	2,828
Off-Site Associated Development Sites					
Combwich Wharf refurbishment and extension	23,972	6,392	1,589	31,953	38,344
Combwich Wharf freight laydown facility	2,103	560	140	2,803	3,364
Bridgwater A accommodation campus (including remediation waste)	28,775	8,800	12,062	49,637	59,564
Bridgwater C accommodation campus (including any remediation waste)	1,592	608	1,766	3,966	4,760
Cannington bypass	40,364	10,764	2,691	53,819	64,583
Cannington park and ride	2,099	560	140	2,799	3,359
Junction 23	4,295	1,145	286	5,726	6,872
Junction 24	2,577	687	172	3,436	4,123
Williton park and ride	2,273	606	152	3,031	3,636
TOTAL	**259,817**	**98,593**	**21,116**	**379,526**	**433,433**

Table 8.4: Operational Phase Waste Quantity Estimates

Operational Waste (tonnes)	TOTAL (tonnes per annum)	TOTAL (over lifetime of development)
HPC Development Site		
HPC power station (non-radioactive waste)	1,140	68,400 (60 years)
Temporary jetty	0	0
HPC accommodation campus	168	1,008
Off-Site Associated Developments		
Combwich Wharf refurbishment and extension	0	0
Combwich Wharf freight laydown facility	75	487
Bridgwater A accommodation campus	280	1,820
Bridgwater C accommodation campus	50	325
Cannington bypass	0	0
Cannington park and ride	86	688
Junction 23	86	600
Junction 24	86	744
Williton park and ride	86	600

Table 8.5: Post-Operational Associated Development and Temporary Jetty Waste Quantity Estimates

Post-Operational Phase Waste (tonnes)	Inert (79%)	Non-Hazardous (20%)	Hazardous (1%)	TOTAL	TOTAL (Contingency = 20%)
HPC Development Site					
Temporary jetty	37,707	9,546	477	47,730	57,276
HPC accommodation campus	29,709	7,521	376	37,606	45,128
Off-Site Associated Development Sites					
Combwich Wharf freight laydown facility	265,756	67,280	3,364	336,400	403,680
Bridgwater A accommodation campus	61,523	15,576	778	77,877	93,453
Cannington park and ride	14,096	3,569	178	17,843	21,412
Junction 23	76,343	19,327	966	96,636	115,964
Junction 24	2,462	623	31	3,116	3,739
Williton park and ride	815	206	10	1,031	1,238
TOTAL	**488,411**	**123,648**	**6,180**	**618,239**	**741,890**

8.6.2 A peak in waste production would occur during mid-2013. This is because the majority of the associated developments would be under construction at this same time, along with the site preparation works and temporary jetty construction at HPC development site. The waste volumes would decrease in early 2015, owing to the onset of the operational phases of the associated developments, although the HPC construction continues. The volumes would remain relatively constant until mid-2020, when they will begin to increase significantly as the associated development post-operational phases commence. A significant peak occurs around 2021, particularly associated with the removal of the following:

- Temporary jetty.
- HPC accommodation campus.
- Bridgwater A accommodation campus.
- Combwich Wharf freight laydown facility.
- Cannington park and ride facility.
- Junction 23 park and ride facility, freight management facility, consolidation facility for postal courier deliveries and induction centre.

8.7 Assessment of Impacts

i. HPC Construction

8.7.1 Approximately 242,000 tonnes of waste would be produced from the site earthworks/construction phase of HPC, of which the majority would be suitable for re-use, recycling or recovery. As such, there would be a significant increase in the volume of waste currently produced at this site. It is reported by SCC in their Mineral and Waste Development Framework (March 2011) (Ref. 8.10) that 393,603 tonnes of construction/demolition waste was received by licensed facilities within Somerset during 2008. Consequently, in view that the total waste to be generated from the construction of HPC will be spread over a period of approximately ten years, it is expected that the waste management infrastructure within Somerset will be capable of managing the waste.

ii. Associated Developments – Construction Phase

8.7.2 The volumes of waste to be produced during the earthworks/construction phases of the associated developments would exceed the baseline volumes of waste currently produced at these sites.

8.7.3 It is anticipated that the waste to be produced from the earthworks/construction phases will be suitable for re-use, recycling or recovery. However, a small quantity of waste would require disposal at landfill (e.g. remedial wastes from Bridgwater A and Bridgwater C sites).

8.7.4 It is not expected that the total waste to be produced from the construction of the associated developments will exceed the annual baseline capacity of 393,603 tonnes of construction/demolition waste, which can be managed in Somerset (Ref. 8.10). Furthermore, the waste production would be spread over approximately two years. However, in order to comply with the waste hierarchy and to avoid exerting undue burden on the existing waste management infrastructure in Somerset, material would need to be re-used in the first instance (e.g. selling direct to market or re-using surplus soils from the site preparation phases on other non HPC Project sites within Somerset). Remaining material would then be managed effectively through use of a network of smaller MRF's within Somerset which are considered to have sufficient capacity to manage the waste produced. If necessary, waste management infrastructure in the surrounding counties will be utilised.

iii. Associated Developments – Operational Phase

8.7.5 The operational phases of the associated developments would exceed the current negligible baseline values, with the exceptions of Bridgwater A (which would be likely to produce lower volumes) and the Junction 24 site and Williton park and ride (which are predicted to produce the same volumes). In total, approximately 915 tonnes of waste would be produced from the associated developments each year, over an average period of approximately seven years. The majority of this waste would comprise general wastes suitable for re-use, recycling or recovery.

8.7.6 As the predicted annual operational waste volumes described above are only a fraction of the baseline value of 279,117 tonnes of the municipal solid waste managed in Somerset during 2009/2010, there should not be any significant additional pressure on the existing waste management facilities from the operational phases.

8.7.7 Notably, the waste produced during the operational phases of the associated developments would be generated during the construction of the HPC nuclear power station. As such, there will be cumulative, project-wide waste generation during this period.

iv. Associated Developments – Post-operational Phase

8.7.8 The post-operational phases of the associated developments would produce significant waste volumes, as detailed in **Table 8.5**. These volumes are significantly greater than the current negligible baseline values. Consequently, a significant volume of predominantly inert demolition waste would require management over a relatively short period of time (mid 2020-2022). As the baseline volume of inert construction/demolition waste managed in Somerset each year is reported to be 393,603 tonnes, the post operational phases may result in some strain on the existing waste infrastructure within Somerset. Hence, it would be necessary to re use material by selling these direct to market or to waste brokers in the first instance, and then use a network of smaller MRF's within Somerset and the surrounding counties. However, given the time period to the post operational phase, there would likely be some market changes. It is difficult at this stage to predict the future availability of waste management facilities, therefore this will be reviewed at the time.

v. HPC Operational Phase Waste

8.7.9 The operational phase of the HPC nuclear power station is estimated to generate approximately 1,140 tonnes of non-radioactive waste annually over a 60 year period of which 200 tonnes would comprise hazardous waste. Again, this would exceed the current baseline volume of waste produced at the site. As this total is a small fraction of the 279,117 tonnes of municipal solid waste which was managed during Somerset during 2009/2010, the 393,603 tonnes of construction/demolition type waste managed during 2008 and the 33,865 tonnes of hazardous waste produced annually within the county (Ref. 8.10), this should not present any significant additional pressure on the existing waste management facilities.

8.8 Mitigation of Impacts

8.8.1 All waste arisings would be managed in a responsible manner throughout all phases of the development with a clear intention to prevent and reduce waste streams in accordance with the waste hierarchy (see **Plate 8.1**). Most importantly, waste production would be prevented through careful design and management of materials during the construction phase. The existing waste infrastructure within Somerset will be used to manage sustainably the waste that would be produced. Furthermore, the proximity principle would be applied, whereby waste facilities located closest to the point of waste production are given preference over facilities located further away, where economically feasible.

8.8.2 Calculations based upon figures provided by SCC indicate that between 2011 and 2021, a total of 14,965 tonnes of earthworks material sourced from the HPC Project could be utilised in Bridgwater for the development of residential and commercial properties (excluding HPC and the off-site associated developments), if this was deemed appropriate as a mitigation measure.

8.8.3 During the construction and post-operational phases of the associated developments, each site will be subject to a **Site Waste Management Plan** (SWMP) as required by the Site Waste Management Plans Regulations 2011 (Ref. 8.3), whereby co-ordinated planning between the various sites will be encouraged.

8.8.4 During the operational phases of the associated developments there may be opportunities to engage with local waste management authorities and the supply chain on how best to manage the post-operational phase waste.

8.8.5 Following the operational phases of the associated developments, and prior to the post-operational phases (where relevant) there would be a review stage, whereby the proposed waste management methods would be re-assessed. This would take into account any new management methods or facilities available.

8.9 Conclusions

8.9.1 Overall, this assessment has demonstrated that impacts from the production of waste across the HPC Project would be mitigated through its management in order of the waste hierarchy (e.g. prevention, preparation for re-use, recycling, other recovery and disposal), seconded by the implementation of the proximity principle, whereby waste would be managed close to the point of origin. Essentially, it is intended for the production of waste to be prevented/reduced at source where possible through careful design and procurement.

8.9.2 The greatest volumes of waste production are predicted to arise during the early construction works for HPC and associated developments and post-operational phases of the associated developments. In general, the current baseline waste volumes produced at the primarily undeveloped HPC main site and associated development sites would increase during all phases of their development (construction and operation).

8.9.3 Despite the increase to the current baseline volumes of the HPC Project sites, it is anticipated that this waste would be managed effectively. Materials will be reused when possible (e.g. selling direct to market or re-using surplus soils from the site preparation phases on other non HPC Project sites within Somerset). Additional materials would then be managed through use of a network of smaller MRF's and recovery facilities within Somerset with capacity to manage the waste produced. Although it is the intention for waste to be managed in order of the waste hierarchy, there would inevitably be some waste which would require disposal to landfill. Waste management infrastructure in the surrounding counties would be utilised.

8.9.4 Given the time period to the post-operational phase of the associated developments (approximately ten years time), there are expected to be some market changes. It is therefore difficult to predict the future availability of waste management facilities. However, during the operational phases of the associated developments there may be opportunities to engage with local waste management authorities and the supply chain on the best methods to manage the post-operational phase waste. Furthermore, there will be a review stage prior to the post-operational phases whereby the proposed waste management methods will be reassessed.

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8.8 Waste & Resources Action Programme (WRAP).

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CHAPTER 9: SOCIO-ECONOMICS

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9. SOCIO-ECONOMICS

9.1 Introduction

9.1.1 This Chapter covers the socio-economic effects of the Hinkley Point C (HPC) Project including the proposed HPC nuclear power station and associated developments. The assessment considers the potential employment, economic, population and demographic effects on the wider study area (defined in section 9.4).

9.1.2 The construction of the HPC Project would take approximately nine years before both units are operational, and both units would be permanent, operating for a period of approximately 60 years after which they will be decommissioned. The associated developments are proposed to facilitate the construction of HPC and to mitigate potential transport impacts and socio-economic impacts, associated with workforce accommodation and journeys to and from the HPC development site.

9.2 Scope and Objectives of Assessment

9.2.1 The scope of the assessment has been determined through a formal Environmental Impact Assessment (EIA) scoping process undertaken with the Infrastructure Planning Commission (IPC). It has also been informed by ongoing consultation with statutory consultees (including Sedgemoor District Council (SDC), West Somerset Council (WSC) and Somerset County Council (SCC), the local community and the general public). The socio-economic assessment of the proposals for HPC has been integrated into EDF Energy's wider process of project development, collaborative working, and consultation. The scoping and production of the assessment has therefore been an ongoing "adaptive" process emerging from the stages of project development, both formal consultation and through ongoing engagement with local authorities and statutory bodies.

9.2.2 EDF Energy's approach to project development has followed the Infrastructure Planning Commission's (IPC) guidance promoting collaborative working (Advice Note 2, Working Together on Nationally Significant Infrastructure Projects (Ref. 9.1)). This has included the use of a Planning Performance Agreement (PPA) between EDF Energy (the applicant) and local authorities: WSC; SDC; and SCC, which has enabled cross boundary working across the study area, and addresses, amongst other issues, the following priorities:

- defining and delivery of the proposed low carbon business cluster;
- ensuring a long term employment and skills legacy for local people;
- recognition of the contribution made by the natural environment and built heritage to the local economy; and
- contributing to the County's image for inward investment and tourism.

9.2.3 A socio-economic workstream was established bringing together EDF Energy's technical assessment and implementation teams with the local authorities, their advisers and representatives of other statutory and partner organisations. **Technical Notes** on key assessment issues have been produced and considered with the local authorities and form the basis of key elements of this assessment. EDF Energy has used these assessments as the basis for discussions with service providers, through working groups, to identify the key mitigation and enhancement measures.

9.2.4 Accommodation and transport workstreams have been run in parallel and their work has fed into this assessment, including the assessment of accommodation baseline and impacts and the underlying assumptions about the spatial spread of impacts.

9.2.5 In parallel with this collaborative approach EDF Energy has also undertaken the formal statutory process of scoping and consultation as required by the IPC.

9.2.6 The **Scoping Opinion** was issued by the IPC in April 2010. It welcomes EDF Energy's intention to take a broad approach to the assessment and identifies a number of areas which should be covered. These are the cumulative impacts with the de-commissioning of the existing stations at Hinkley Point, and the impacts on agriculture and rural communities, and on Bridgwater.

9.2.7 The formal consultation process has included:

- preliminary consultation prior to the Stage 1 proposals;
- the Stage 1 Consultation Document and Environmental Status Report;
- the Stage 2 Consultation Documentation including the Socio-Economic Chapter of the Environmental Appraisal; and
- an updated workforce profile published as part of the Stage 2 Update Consultation.

9.2.8 The **Consultation Report** sets out the formal response to these consultations which includes comments on the scope or nature of the Socio-Economic Assessment. As a result of this process, and reference to the scope of assessments set out in the National Policy Statements (NPS) for Energy Infrastructure (see Section 9.3b) the objectives underlying the socio-economic impact assessment were:

- identification of the workforce required to construct and operate HPC and associated developments including phasing, skills requirements and labour supply – this underpins the remainder of the assessment;
- identification of the likely origins of workers, including a Construction Daily Commuting Zone (CDCZ) to identify the locations from which workers already living within the area will travel to HPC and the likely proportion of the workforce who will come from within that zone (home-based workers);
- identification of activities and measures to support training and recruitment of residents of the study area and region to work in the construction and operational phases at HPC, and to help businesses benefit from supply chain opportunities;
- identification of the likely proportion of non-home-based workers – those who will temporarily move to the area to work on the construction of the power station;
- identification of likely age and demographic profiles of the workforce and the extent to which non-home-based workers will bring families to the area;
- assessment of current accommodation capacity, likely accommodation preferences of workers (in the context of EDF Energy's proposed accommodation

strategy) and impacts of this on local accommodation supply and demand and locations in which workers are likely to live;

- assessment of consequent impacts on public services of likely workforce accommodation preferences and spatial spread, including education, health, policing and emergency services, and leisure and recreation provision and any mitigation measures required;
- assessment of likely impacts on community cohesion and wellbeing in locations in which there may be clusters of workers;
- assessment of likely wider economic impacts including expenditure and induced effects and impacts on the tourism and hospitality sector; and
- assessments of impacts on key equalities target groups as identified in the Equalities Act 2010 (Ref. 9.2).

9.2.9 The spatial spread of effects will vary depending on the different topic area. Consultation with the local authorities and others identified some key generic areas for consideration which include the CDCZ, the South West region, the County, and the three most local Districts (West Somerset in which HPC is located, Sedgemoor in which a number of associated development sites are located, and Taunton Deane).

9.2.10 More fine grained assessments are based on those locations/areas which may see some localised impacts based on assumptions about workers' locational preferences. Section 9.4a considers these issues in more detail.

9.2.11 A number of comments on socio-economic impacts and assessment raised through the consultation process by both public bodies and individual consultees have taken the form of comments or speculative statements. The authors of this assessment have sought to find evidence in relation to the full range of these issues. However in line with NPS Guidance, the assessment of socio-economic impacts has been limited in this document to those areas where likely effects can be considered, based on evidence. The assessment also identifies the need for mitigation arising from the socio-economic effects, and outline enhancements and the scale of residual effects.

9.2.12 The DCO application is accompanied by other documents, outside the Environmental Statement, for example the **Health Impact Assessment**, which seeks to identify and assess some of the more qualitative "wellbeing" impacts.

9.2.13 Cumulative socio-economic impacts arising from the proposed development with external plans and projects are identified and assessed in **Volume 11** of this ES.

9.3 Legislation, Policy and Guidance

9.3.1 There is a very large amount of policy and guidance relating to socio-economic issues, particularly at the national level. This section summarises that which is regarded as being of direct relevance to the assessment of the impacts of the HPC Project. This includes "process" guidance as to what should be included in such an assessment, as well as specific policies on issues on which there may be significant impacts.

9.3.2 The UK coalition Government, elected in May 2010 inherited a substantial amount of policy guidance across the various Government departments. In priority areas it has made explicit where it has abolished or intends to replace previous policies. In the area of planning for example, it is in the process of the abolition of Regional Spatial Strategies and consolidating guidance into a National Planning Policy Framework, which has been published in draft for consultation. In relation to education, the Department for Education website states that “All statutory guidance and legislation linked to/from this site continues to reflect the current legal position unless indicated otherwise, but may not reflect Government policy.”

9.3.3 This policy review seeks to identify the current policy position and those areas where policy is being reviewed and the direction of Government policy based on public statements and business plans.

9.3.4 As stated in **Volume 1**, **Chapter 4**, the Overarching National Policy Statement (NPS) for Energy (NPS EN-1) when combined with the NPS for Nuclear Power Generation (NPS EN-6) provides the primary basis for decisions by the IPC on applications for nuclear power generation developments that fall within the scope of the NPSs.

9.3.5 Notwithstanding this, the IPC may consider other matters that are both important and relevant to its decision-making. This could include Planning Policy Statements (PPSs), Planning Policy Guidance Notes (PPGs), regional and local policy documents, although, if there is a conflict between these and the NPS, the NPS prevails for the purposes of IPC decision making.

9.3.6 Further, the Planning Act 2008 provides that the IPC must, in making its decision on an application, have regard to any Local Impact Report (LIR) prepared by relevant local authorities. It is anticipated that the LIRs will rely in part on PPSs, PPGs, regional and local policy to provide a context for their assessment. On this basis, regard has been given to these documents (where relevant to the technical assessment) since they are likely to inform the LIRs prepared by the relevant local authorities.

a) International

i. Inter-organisational Committee Guidelines and Principles for Social Impact Assessment (Ref. 9.3)

9.3.7 While there is no formal legislation or statutory guidance which sets out either scope or standards for socio-economic assessments there is a growing literature on appropriate standards and thresholds. Some international guidance is provided by the Inter-organisational Committee on Guidelines and Principles for Social Impact Assessment (ICGPS) (1994), with more recent academic updates by Vanclay (Ref. 9.4), Glasson (Ref. 9.5) and Chadwick (Ref. 9.6). The ICGPS defines social impacts as:

> *“the consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organise to meet their needs, and generally cope as members of society.’’*

ii. EU Directive 85/337/EEC (the EIA Directive) (Ref. 9.7)

9.3.8 The EU Directive 85/337/EEC (CEC 1985) (as amended by 97/11/EC (Ref. 9.8)) and 2003/35/EC (Ref. 9.9)) requires a description of possible impacts on human beings. The Lisbon Strategy (European Council, 2000) remains the EU's strategy for creating growth and jobs in a sustainable manner. This identifies the main dimensions of social sustainability as: education, employment policy (to create more and better jobs), modernising social protection, and the promotion of equality to counter poverty and social exclusion. It emphasises the continuing right of citizens to live and work anywhere in the EU.

b) National Policy

9.3.9 There is no UK legislation that specifies the detailed content required for socio-economic assessments or provides appropriate standards and thresholds for impact significance. However, there are a number of guidelines of relevance to socio-economic assessment.

i. Department of the Environment (DoE) (1989) Environmental Assessment: A Guide to the Procedures, London: HMSO (Ref. 9.10)

9.3.10 Early guidance from the UK Government suggested that ''*certain aspects of a project including numbers employed and where they will come from should be considered within an environmental statement*'' (DoE, 1989).

ii. Office of the Deputy Prime Minister (ODPM) (2004) Creating, Using and Updating a Neighbourhood Baseline, London: HMSO (Ref. 9.11); and

iii. Department for Communities and Local Government (DCLG) (2006) Environmental Impact Assessment: A Guide to Good Practice and Procedures, A Consultation Paper, London: DCLG (Ref. 9.12)

9.3.11 More recent guidance on the use of official statistics in baseline assessment work is provided in ODPM (2004) and on the approach to EIA in DCLG (2006).

9.3.12 The National Policy Statements (NPS) for Energy Infrastructure set out the Government's energy policy; the need for new infrastructure; and guidance to the Infrastructure Planning Commission (IPC) in determining an application for a Development Consent Order (DCO). The NPSs include specific criteria and issues which should be covered by applicants' assessments of the effects of their scheme, and how the IPC should consider these impacts. They include specific references to socio-economic effects and health and wellbeing.

9.3.13 On 23 June 2011, the Secretary of State laid a final set of the energy NPSs before Parliament for approval. The House of Commons voted to approve the NPSs on 18 July 2011 and the NPSs were then designated on 19 July 2011.

9.3.14 There are two energy NPSs of relevance to the Hinkley Point C Project, the Overarching NPS for Energy (NPS EN-1), and the NPS for Nuclear Power Generation (NPS EN-6). NPS EN-1, when combined with NPS EN-6, provides the primary basis for decisions by the IPC on applications for nuclear power generation developments that fall within the scope of the NPSs.

iv. Overarching National Policy Statement for Energy (NPS EN-1) (July 2011) (Ref. 9.13)

9.3.15 Paragraph 4.2.2 of NPS EN1 confirms that socio-economic issues should be considered as within the scope of the Environmental Statement submitted with any relevant application stating that:

> *"To consider the potential effects, including benefits, of a proposal for a project, the IPC will find it helpful if the applicant sets out information on the likely significant social and economic effects of the development, and shows how any likely significant negative effects would be avoided or mitigated. This information could include matters such as employment, equality, community cohesion and well-being."*

9.3.16 Cumulative effects should be provided for within the ES in relation to how the effects of the development proposals would combine and interact with the effects of other development (including projects for which consent has been sought or granted, as well as those already in existence). The accumulation of, and interrelationship between, effects should be considered on the environment, economy and community as a whole, even though they may be acceptable when considered on an individual basis with mitigation measures in place (Para 4.2.5 and 4.2.6).

9.3.17 Paragraph 4.13.2 confirms that this assessment should include impacts on health and measures to avoid, reduce or mitigate these effects.

9.3.18 Part 5 of NPS EN-1 sets out policies in relation to potential impacts which are common across the range of energy NSIPs ("Generic Impacts").Section 1.2 sets out the additional generic socio-economic effects which should be assessed. This states that any effects likely to have an impact at a local or regional level should be considered (paragraph 5.12.2). This could include impacts on jobs and training, public services, tourism, the impact of the workforce on local communities and community cohesion, and cumulative effects – specifically on construction labour demand at the regional level (paragraph 5.12.3). Para 5.12.4 states that the assessment needs to identify local baseline conditions and how impacts relate to local policies.

9.3.19 The criteria for IPC consideration of these impacts confirm that assessments need to be evidence based. Para 5.12.7 states that:

> *"The IPC may conclude that limited weight is to be given to assertions of socio-economic impacts that are not supported by evidence (particularly in view of the need for energy infrastructure as set out in this NPS)."*

9.3.20 The IPC should also consider any positive contributions made by the developer (paragraph 5.12.8) and consider whether mitigation measures are necessary to mitigate any adverse socio-economic impacts of the development (5.12.9). Para 4.1.8 confirms that that the IPC should only impose planning obligations in relation to a development consent that are:

> *"…relevant to planning, necessary to make the proposed development acceptable in planning terms, directly related to the proposed development, fairly and reasonably related in scale and kind to the proposed development, and reasonable in all other respects."*

v. The National Policy Statement for Nuclear Power Generation (NPS EN-6) (July 2011) (Ref. 9.14)

9.3.21 Part 3 of NPS EN-6 sets out additional policy in relation to certain “Nuclear Impacts” for when the IPC is considering an application for a new nuclear power station. “Socio-Economic” and “Human Health and Wellbeing” are two of the seven nuclear impacts identified in paragraph 3.4.3.

9.3.22 Paragraphs 3.11.3, 3.11.4 and 3.12.7 set out what the applicant’s assessment should cover:

> *“Through the EIA, and in accordance with Section 5.12 of EN-1, the applicant should identify at local and regional levels any socio-economic impacts associated with the construction, operation and decommissioning of the proposed new nuclear power station.*
>
> *“This assessment should demonstrate that the applicant has taken account of, amongst other things, potential pressures on local and regional resources, demographic change and economic benefits.”*
>
> *“The applicant should work with the local authority and the local primary care trust (in England) or the Health Board (in Wales) to identify any potentially significant health impacts and appropriate mitigation measures. Where such measures relate to better public information on the extent of risk in relation to radiological hazard, the applicant should consult the Health Protection Agency on the appropriate standards for radiological protection.”*

vi. Appraisal of Sustainability of the Nuclear NPS (October 2010) (Ref. 9.15)

9.3.23 The Appraisal of Sustainability (AoS) for NPS EN-6 sets out what the construction of new nationally significant energy infrastructure, in accordance with the requirements of the new policy regime, is expected to mean for the environment, society and the economy.

9.3.24 The AoS (Table S.4.1) has three objectives identified in relation to the theme “*Communities – population, employment, and viability*”. These are:

- to create employment opportunities;
- to encourage the development of sustainable communities; and
- to avoid adverse impacts on property and land values and avoid planning blight.

9.3.25 The AoS (paragraphs S.11.8 to S.11.10) identifies the potential for significant positive effects on employment and the economy at the local and regional level during the construction phase and also economic benefits in the operational phase. There are possible short term negative effects on local labour supply, and local communities and demand for public services from incoming workers although it is noted that these can be mitigated. It concludes that “*Overall the revised AoS found that there are likely to be significant beneficial effects on employment and viability for communities*” (paragraph S.10.10).

9.3.26 In relation to the potentially suitable site at Hinkley Point, the Appraisal of Sustainability (AoS) of NPS EN-6 concluded that the potential likely effects and key findings recommended as guidance for the IPC to consider include:

- Positive cumulative effects associated with long-term employment and enhanced prosperity in the region;
- The site is in a cluster of two nominated sites (Oldbury being the other) in the south west region. Potential regional cumulative effects both positive and adverse may apply if both sites in the region were to be developed; and
- Further significant adverse cumulative effects if both new power stations were to be developed alongside any Severn Tidal Power scheme.

vii. Draft National Planning Policy Framework: Consultation (Ref. 9.16)

9.3.27 On 25 July 2011 DCLG published a consultation draft of the National Planning Policy Framework (NPPF). The consultation period concludes on 17 October 2011 and it is expected that the final NPPF will be adopted in 2012. The NPPF aims to streamline existing Planning Policy Statements and some Circulars into a single consolidated document that sets out the Government's key economic, social and environmental objectives and the planning policies to deliver them. These policies will provide local communities with tools to enhance their local economies, meet housing needs, plan for a low-carbon future and protect environmental and cultural landscapes. The following key points are outlined in the Consultation draft NPPF:

- a presumption in favour of sustainable development (paragraphs 13 to 18);
- supporting planning reform and decentralisation through neighbourhood planning, the Localism Bill, the provision of affordable housing and economic viability (paragraphs 25 and 28 to 30); and
- support for renewable and low-carbon energy. The NPPF envisages that applications for low-carbon energy development should be approved if the impact is or can be made acceptable (paragraphs 148 to 153).

viii. Planning Policy Statement 1: Planning for Sustainable Development (PPS1) (2005) (Ref. 9.17)

9.3.28 PPS1 sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system.

9.3.29 Para 5 (The Government's Objectives for the Planning System) states that planning should facilitate and promote sustainable and inclusive patterns of urban and rural development by:

- making suitable land available for development in line with economic, social and environmental objectives to improve people's quality of life;
- contributing to sustainable economic development;
- protecting and enhancing the natural and historic environment, the quality and character of the countryside, and existing communities;
- ensuring high quality development through good and inclusive design, and the efficient use of resources; and

- ensuring that development supports existing communities and contributes to the creation of safe, sustainable, liveable and mixed communities with good access to jobs and key services for all members of the community.

9.3.30 Paragraph 23 (Sustainable Economic Development) sets out the Government's commitment to promoting a strong, stable and productive economy that aims to bring jobs and prosperity for all. In summary, planning authorities should:

- recognise that economic development can deliver environmental and social benefits;
- recognise the wider sub-regional, regional or national benefits of economic development and consider these alongside any adverse local impacts;
- be sensitive to changes in local economies and the implications for development and growth;
- promote and facilitate good quality development, which is sustainable and consistent with their plans; and
- ensure that infrastructure and services are provided to support new and existing economic development and housing.

9.3.31 Paragraph 27 (Delivering Sustainable Development) sets out the general approach to delivering sustainable development. The most relevant points to this chapter state that planning authorities should:

- provide a positive planning framework for sustainable economic growth to support efficient, competitive and innovative business, commercial and industrial sectors; and
- promote urban and rural regeneration.

ix. Planning Policy Statement 4: Planning for Sustainable Economic Growth (PPS4) (2009) (Ref. 9.18)

9.3.32 PPS 4 identifies that the Governments overarching objective is one of sustainable economic growth. In order to help achieve this overall ambition the Government sets out a series of objectives which seek to reduce the disparities between rural and urban locations, between different regions of the UK whilst regenerating failing town centres all of which will help to raise the quality of life for residents in communities across the UK.

9.3.33 Policies EC6 and EC7 set out policies for planning for the economy and tourism in rural areas. These highlight the need to protect the countryside but also to promote opportunities for sustainable economic development, tourism and leisure activities. Policy EC10 says that local authorities should take a positive approach to dealing with planning applications for economic development. Considerations which should be taken into account include whether the development limits carbon dioxide emissions and impacts on local employment.

x. Planning Policy Statement 7: Sustainable Development in Rural Areas (2004) (Ref. 9.19)

9.3.34 PPS7 sets out the Government's planning policies that apply to rural areas, including country towns and villages and the wider, largely undeveloped countryside up to the fringes of larger urban areas. It should be noted that the economic development sections of PPS7 have been replaced by PPS4.

9.3.35 PPS 7 outlines the Government's objectives for rural areas which can be summarised as follows:

- raise the quality of life and the environment in rural areas;
- promote more sustainable patterns of development;
- promote the development of English regions by improving their economic performance; and
- promote sustainable, diverse and adaptable agriculture sectors.

xi. Local Growth: Realising Everyone's Potential (CM 7961, 2010) (Ref. 9.20)

9.3.36 The Local Growth White Paper sets out the Government's approach to local growth "shifting power away from central Government to local communities, citizens and independent providers".

9.3.37 This builds on the Government's overall approach to supporting growth based on four strands:

- creating macroeconomic stability, so that interest rates stay low and businesses have the certainty they need to plan ahead;
- helping markets work more effectively, to encourage innovation and the efficient allocation of resources;
- ensuring that it is efficient and focused in its own activities, prioritising high-value spending and reducing tax and regulatory burdens; and
- ensuring that everyone in the UK has access to opportunities that enable them to fulfil their potential.

9.3.38 The Government seeks to spread growth across the UK by:

- shifting power to the right levels: abolishing Regional Development Agencies, and replacing them with new sub-national arrangements through which Local Authorities and Local Business come together through Local Enterprise Partnerships to plan for actions to support local growth;
- increasing confidence to invest: by introducing an presumption in favour of sustainable development in the planning system, simplifying the planning system, requiring local authorities to work together to plan for major infrastructure and providing financial incentives for local authorities to support growth through the New Homes Bonus and more freedom to retain other funding locally and invest in infrastructure; and

- focussed investment: through a Regional Growth Fund to support growth in areas with a string dependence on public sector employment or low private sector activity, and also direct capital investment in major infrastructure such as Crossrail, Broadband connections in rural areas, investment in low-carbon energy and climate change adaptation, including a Green Investment Bank and support manufacturing and business development, with a focus on supporting potential high growth companies and the commercialisation of technologies.

xii. HM Government (2011) 2011 Budget: A Strong and Stable Economy, Growth and Fairness (and Associated Documents), HC 836, HM Treasury (Ref. 9.21)

9.3.39 The 2011 Budget maintains and extends this focus on supporting growth. This states that the Government will:

- Introduce a powerful new presumption in favour of sustainable development, so that the default is 'yes' and pilot land auctions, starting with public sector land;
- Streamline the system for planning applications and introduce new fast-track planning for major infrastructure;
- The Government will introduce a carbon price floor for electricity generation from 1 April 2013, to drive investment in the low-carbon power sector. The Government also announces that the initial capitalisation of the Green Investment Bank will be £3 billion and that it will start operation in 2012-13;
- Fund an additional 80,000 work experience places for young people, ensuring up to 100,000 places will be available over the next two year;
- Fund up to 50,000 additional apprenticeship places over the next four years; and
- Expand the University Technical Colleges programme to establish at least 24 new colleges.

xiii. HM Treasury/BIS (2011) The Plan for Growth (Ref. 9.22)

9.3.40 The Government published a "*Plan for Growth*" (HM Treasury and BIS, 2011) alongside the Budget setting how the Government intends to support growth and re-balance the economy. This includes commitments to, among other things, ensuring investment in key sectors, including Low Carbon technologies, and significantly improving the UK skills base.

9.3.41 It was supported by a Written Statement "Planning for Growth" by the Minister of State for Decentralisation (23 March 2011) (Ref. 9.23) which confirmed that "*The Government's top priority in reforming the planning system is to promote sustainable economic growth and jobs*." The Statement says that local authorities and decision makers on other development-related consents (including heritage, environmental, energy and transport consents) should place weight on the potential economic benefits of development.

xiv. HM Government (2011) Local Government Resource Review (Ref. 9.24)

9.3.42 The Government has established a Local Government Resource Review (Written Statement by the Secretary of State for Communities and Local Government, 17 March 2011). The review will "*consider the way in which local authorities are funded, with a view to giving local authorities greater financial autonomy and* *strengthening the incentives to support growth in the private sector and regeneration of local economies*." This will include consideration as to how and whether local authorities should retain some or all of any additional business rates arising from new developments and infrastructure.

9.3.43 The first phase of the review was published in July 2011, outlining *Proposals for Business Rate Retention*. This consultation follows the commitment in the coalition Government's Programme for Government to "*provide incentives for local authorities to deliver sustainable development, including for new homes and businesses*", and also outlines how the proposals interact with wider Government initiatives to promote growth, including the existing New Homes Bonus, and considers how they will work alongside the existing architecture of the business rates system which it is not proposing to change (for example rate reliefs and the national business rate multiplier). Enabling local authorities to retain a significant proportion of the business rates generated in their area is intended to provide a strong financial incentive for them to promote local economic growth.

xv. HM Government (2010) Equality Act 2010 (Ref. 9.25)

9.3.44 The Equality Act 2010 created an "Equality Duty" on public bodies which came into force in April 2011 and covers age, disability, gender, gender reassignment, pregnancy and maternity, race, religion or belief and sexual orientation.

9.3.45 The Equality Duty applies to public bodies and is therefore not a direct requirement upon the applicant. However, assessment of "equalities" dimensions by the applicant enables public authorities in their consideration of the application, to fulfil their legal duty to consider these issues.

9.3.46 It applies in England, Scotland and in Wales. The general equality duty is set out in section 149 of the Equality Act. In summary, those subject to the general equality duty must have due regard to the need to:

- eliminate unlawful discrimination, harassment and victimisation;
- advance equality of opportunity between different groups; and
- foster good relations between different groups.

9.3.47 The Act requires equal treatment in access to employment as well as private and public services, regardless of the protected characteristics of age, disability, gender reassignment, marriage and civil partnership, race, religion or belief, sex, and sexual orientation (as defined in the Act) In the case of gender, there are special protections for pregnant women. In the case of disability, employers and service providers are under a duty to make reasonable adjustments to their workplaces to overcome barriers experienced by disabled people.

c) Regional

9.3.48 The Government's revocation of regional strategies was quashed in the High Court on 10 November 2010. However, on the same date the Government reiterated in a letter to the Chief Planning Officer its intention to revoke regional strategies through the Localism Bill. This letter was also challenged but, on 7 February 2011, the High Court held that the Government's advice to local authorities that the proposed revocation of regional strategies was to be regarded as a material consideration in their planning development control decisions should stand. The decision of the High Court was upheld by the Court of Appeal on 27 May 2011. Therefore, the regional strategies remain in place but in the case of development control decisions it is for planning decision makers to decide on the weight to attach to the strategies (see **Volume 1**, **Chapter 4** for a full summary of the position regarding the status of regional planning policy).

i. Regional Planning Guidance 10 for the South West 2001-2016 (RPG 10) (2001) (Ref. 9.26)

9.3.49 RPG10 sets out the broad development strategy for the period to 2016 and beyond. Policy SS 3 of the RPG (The Sub-Regional Strategy) states that planning of development and infrastructure investment in the Central sub-region (where HPC is located) should, amongst other things:

- raise the economic performance of the sub-region; and
- focus housing, employment, retail and social facilities in sustainable locations to reduce social exclusion and rural need.

9.3.50 Policy EC 1 advised that local authorities and other agents including Local Enterprise Partnerships (LEPs) should support the sustainable development of the regional economy by, amongst other things, positively promoting and encouraging new economic activity in the areas where it can bring the greatest economic and social benefits.

9.3.51 Policy EC 3 stated that local authorities and other agencies should aim to provide a range of employment sites, including major strategic sites, suitable for significant inward investment and large scale re-investment by existing companies.

ii. The Draft Revised Regional Spatial Strategy (RSS) for the South West Incorporating the Secretary of State's Proposed Changes 2008 – 2026 (July 2008) (Ref. 9.27)

9.3.52 The draft Revised Regional Spatial Strategy (RSS) looks forward to 2026 and sets out the Government's policies in relation to the development of land within the region.

9.3.53 Development Policy A identifies Bridgwater, Taunton and Weston-super-Mare as three of the twenty-one Strategically Significant Cities and Towns to be the focus for future growth. It sets out five aims for the Strategy:

- improving the quality of the urban environment, including new development and the public realm;
- promoting social cohesion and healthy and secure living conditions through access to good social and community facilities;
- supporting growth in the economy and skills through the availability of a range of premises and land that meet the needs of business;
- securing improvements to public transport, traffic management and use of road space to tackle congestion and poor air quality; and
- making efficient and effective use of land, including through regeneration, and planning for and delivering development and infrastructure in a comprehensive and co-ordinated way.

9.3.54 Development Policy D (Infrastructure) states that the planning and delivery of development should ensure efficient and effective use of existing infrastructure and should provide for the delivery of new or improved transport, education, health, culture, sport and recreation and green infrastructure in step with development.

9.3.55 Development Policy F (Master Planning and delivery of major development) states that major developments should be planned on a comprehensive and integrated basis to ensure that they contribute to the delivery of sustainable communities and a high quality of life. Development should provide for, amongst other things, public transport, cultural, leisure, retail, health care, education and other services and facilities commensurate with the needs of the expected population of the area and delivered in step with growth of that population; and a range of housing types and tenures.

9.3.56 The following policies within the draft RSS are of potential relevance to the socio-economic assessment of proposals at HPC:

- Policy SD1 (The Ecological Footprint) – Provides policy guidance on measures that will be taken in the region to reduce the intensive use of resources and move towards a lower carbon dependent region whilst providing more sustainable settlements;
- Policy SD4 (Sustainable Communities) – provides guidance on how development will be actively managed in order to help create and maintain sustainable communities in the region whilst also ensuring the long-term prosperity of the region;
- Policy CSS (Core Spatial Strategy) – Sets out the core spatial strategy for the region, which makes specific reference to enhancing the economic prosperity of the region, whilst ensuring this stays within the environmental limits of the region; and
- Policy SK1 (Education and Skills) – highlights the role that Local Authorities should play with other partners to help ensure the adequate provision of access for their resident population to further skills and training.

iii. South West Regional Development Agency (SWRDA) (2006) Regional Economic Strategy for South West England (2006 to 2015) (Ref. 9.28)

9.3.57 The Regional Development Agencies (RDAs) in England are due to close by March 2012. However at present they continue to operate and their research and policy objectives remain relevant for this assessment.

9.3.58 The South West Debate exercise, which fed into the Regional Economic Strategy, raised some important challenges for the region; notably the need to secure growth within environmental limits; the need to manage a growing, ageing and more diverse population, and the need for more self-sufficiency in energy, including more renewable energy.

9.3.59 The Regional Economic Strategy identifies three strategic objectives:

- successful and competitive business;
- strong and inclusive communities; and
- an effective and confident region.

9.3.60 The SWRDA has also undertaken more detailed work into specific issues of relevance to the HPC Project. The agency has identified a number of priority sectors for investment including advanced engineering and environmental technologies (including renewable energy and waste) and a budget priority (2009 to 2011) to support efforts to drive the region towards a low carbon economy.

9.3.61 The South West Low Carbon Summit (June 2009) noted the significance of the potential Hinkley Point new build for the region, including skilled employment, the need to address skills gaps through a proposed centre of excellence in Bridgwater, and the potential for HPC to "*become a source of international expertise and create a strong high value business cluster in Somerset" (SWRDA, June 2009).*

iv. The Somerset and Exmoor National Park Joint Structure Plan Review 1991-2001 (2000) (Ref. 9.29)

9.3.62 The Joint Structure Plan Review outlines, amongst other things, policies which include principles for sustainable development (Policy STR1) and development outside towns and rural centres which benefits economic activity (Policy STR6).

v. The Somerset County Plan (2010-13) (Ref. 9.30)

9.3.63 The *Somerset County Plan* (2010-13) sets out the Council's priorities and what it wants to achieve for the next three years. It presents these under the three headings of people, places and prosperity.

9.3.64 Under the '*people'* heading, the Council proposes to re-invigorate local communities and neighbourhoods to work together, reduce inequalities in health, wellbeing, access and education. Under *places*, it seeks to ensure broadband connectivity for more homes and businesses, work with partners to provide more decent and affordable homes, and reduce the size of the Council's own Carbon Footprint.

9.3.65 On *prosperity* the plan notes that Somerset has historically underperformed economically, so aims to help existing businesses grow and attract new ones. It identifies the development of HPC as a *'huge opportunity*' and that the Council will work hard to make sure it is in the best interests of Somerset.

9.3.66 It identifies the need to '*create centres of excellence in specific training areas – such as the nuclear industry*', expand energy sources to boost the economy and provide new jobs, work with partners across many business sectors to attract more tourists to Somerset, improve the infrastructure needed to support economic growth, and improve educational outcomes and learning environments in the County.

vi. The Somerset Sustainable Community Strategy: Somerset: A Landscape for the Future (Ref. 9.31)

9.3.67 The current Sustainable Community Strategy for the county; *Somerset, a Landscape for the Future (2008-2026),* was produced by the Somerset Strategic Partnership in

2008. This identified six key aims: Making a Positive Contribution; Living Sustainably; Ensuring Economic Wellbeing; Enjoying and Achieving; Staying Safe; and Being Healthy.

9.3.68 The Somerset Strategic Partnership Board suspended the formal structure of the partnership in October 2010 and its future role (if any) in the light of the changes described above is currently being reviewed.

vii. Heart of the South West Local Economic Partnership

9.3.69 A Heart of the South West Local Enterprise Partnership (LEP) has been established to cover Devon, Plymouth, Somerset and Torbay, which will replace the Regional Development Agency. This area covers the whole of the County of Somerset including West Somerset and Sedgemoor districts. The Partnership Prospectus (March 2011) identifies a number of key priorities which include:

- securing growth in key urban centres;
- providing support to strong sectors across the area such as tourism, food and drink, and land-based industries;
- encouraging investment in potential growth sectors such as marine technologies and low carbon energy generation (notably nuclear power and renewable energy) that can create and sustain new private sector jobs, rebalancing the economy away from an over-reliance on the public sector;
- create the conditions for high levels of business start-ups and increase the numbers of jobs in expanding SMEs;
- working with businesses to access international markets to grow their customer base and create additional private sector employment;
- attract inward private sector investment from high growth sectors to encourage higher paid quality jobs; and
- encouraging increased levels of indigenous investment to improve the quality and pay levels of existing jobs.

d) Local

9.3.70 The main part of the Study Area for the assessment of the effects of HPC is covered by two tier Local Government. In relation to socio-economic issues Somerset County Council is responsible for education, arts, museums and libraries and social services. The District Councils are responsible for housing, leisure, parks and recreation, and local planning and planning applications. Both tiers are involved in economic development and tourism promotion.

9.3.71 Requirements for the production of policies and targets at the local level are currently undergoing a major overhaul. The Coalition Programme for Government (May 2010) (Ref. 9.32) states that the Government will '*promote the radical devolution of power and greater financial autonomy to local government and community groups*.'

9.3.72 As part of this programme the Government has been reducing the requirement on local authorities to produce plans and strategies and also the abolition of the performance framework which required local authorities to report to central Government on a range of targets. In particular the Government has removed the requirement for local authorities to produce a Local Area Agreement and to monitor and report on associated targets.

9.3.73 The Government is also in the process of revoking statutory guidance set out in *Creating Strong, Safe and Prosperous Communities* (2008) (Ref. 9.33), including requirements to establish a "*Local Strategic Partnership*" and produce a "*Sustainable Communities Strategy*". This is set out in the document *Best Value: New Draft Statutory Guidance Consultation* (DCLG, April 2011) (Ref. 9.34) which is currently in the post consultation phase. The final guidance will be produced in 2011.

9.3.74 The approach to planning policies had already been through major reform with the Planning and Compulsory Purchase Act (2004) (Ref. 9.35) introducing Local Development Frameworks (LDFs) to replace Local Plans for district councils. However, as LDFs have a number of formal stages that they have to go through before they are adopted many local authorities still rely on their Local Plans to act as their statutory plan for the area. In these cases it is necessary to receive approval from the Secretary of State to "save" relevant policies. Neither West Somerset Council nor Sedgemoor District Council have yet adopted a Local Development Framework (LDF). Therefore references to planning policies below refer to "Saved Policies" contained in their Local Plans, and to emerging policies contained in LDFs and other documents.

9.3.75 The Localism Bill (Ref. 9.36), proposes further changes to the powers and responsibilities of local councils, neighbourhoods and communities, including planning, housing and local Government. The Government currently anticipates that this will become law in late 2011.

9.3.76 The paragraphs below set out the relevant current policy at the local level. This focuses on the two immediate districts of West Somerset and Sedgemoor, but also refers to Taunton Deane which forms part of the three district assessment area. It should be noted that some of this may fall away as part of the wider trend from central Government to streamline local policy making and reporting.

i. West Somerset Corporate Plan 2011-12 (Ref. 9.37)

9.3.77 West Somerset Council's Corporate Plan (2011/12) identifies the Council's priorities, objectives and key tasks.

9.3.78 The Council's role as "community leaders in the proposed new nuclear development at Hinkley Point" is identified as one of the Council's two corporate priorities. The Council's key objectives in relation to socio-economic issues at HPC, are set out in the table below:

Table 9.1: West Somerset Corporate Plan: Hinkley Point Objectives and Priorities

Housing
Objective 1: To ensure adequate mitigation for any negative impact on the local housing market from accommodating workers involved in the proposed construction of Hinkley Point.
Objective 2: To maximise the legacy benefit to local people of any new housing built or existing housing utilised during the proposed Hinkley construction.
Economic Development and Tourism
Objective 3: To maximise the sustainable job and skills training opportunities together with the prospects for economic development that will be created as a result of the proposed construction and operation of Hinkley Point.
Objective 4: To ensure adequate mitigation for any adverse impact that there might be on the Tourism Industry as a result of the proposed construction of Hinkley Point.
Community Engagement
Objective 7: To lead the community of West Somerset in responding to the proposed development at Hinkley Point.

9.3.79 Other relevant Council general priorities are to "provide homes for local people" (Objective 11) and "ensure the Tourism Partnership reflects and meets the needs of the whole of West Somerset. (Objective 12).

ii. West Somerset Economic Development Strategy 2009 (Ref. 9.38)

9.3.80 West Somerset Council's Economic Development Strategy (April 2009) is based around the themes of *People*, *Place* and *Business* and drivers of *Quality* and *Sustainability*. Future potential development at Hinkley is identified as one of the key challenges.

9.3.81 The key objectives in relation to each of these indicators are as follows:

People

- to stimulate an aspirational, enterprising and entrepreneurial culture within West Somerset;
- to ensure that the West Somerset workforce has the skills required by business to innovate and improve their competitiveness;
- to tackle pockets of worklessness, meeting LAA targets to reduce claimant numbers; and
- to ensure that all communities are engaged fully in economic decision making.

Place

- to create a network of sustainable rural enterprise hubs to foster business growth across the District;
- to find imaginative and sustainable solutions to transport and communication challenges, particularly in relation to Taunton/Bridgwater;
- to ensure effective, integrated and industry focused marketing of the tourism offer across Exmoor and West Somerset; and

- to ensure that the built environment of the Districts principal settlements is of a quality that will attract private sector investment.

Business

- to develop the quality tourism offer within the District, maximising its existing assets;
- to encourage the growth of small “high value” sectors, appropriate to West Somerset;
- to ensure businesses have access to the support required to enable them to innovate, grow and develop; and
- to encourage business start up and growth through provision of mentoring, support and provision of appropriate workspace.

9.3.82 West Somerset Council’s planning policies are summarised in detail in **Chapter 7** (Legislative and Planning Policy Context). Issues of relevance to the socio-economic assessment are highlighted below. Where policies relate to specific associated development sites, these are summarised in the relevant site specific Chapter.

iii. West Somerset Local Plan (2006) (Policies ‘saved’ from 17 April 2009) (Ref. 9.39)

9.3.83 The West Somerset Local Plan forms part of the development plan for West Somerset. The Local Plan was adopted in April 2006 (with relevant policies ‘saved’ from 17 April 2009).The following saved policies are considered to be potentially relevant for the socio-economic assessment and cover the following themes:

9.3.84 Policies SP1 to 5 set out the “Settlement Hierarchy” and policies relating to settlements. Minehead is identified as a Town, and Watchet and Williton as rural centres. It also identifies villages and small villages. Stogursey, in which the HPC site is located, is identified as a village. In general the plan promotes development in Minehead and the Rural centres, with development in villages, small villages and outside settlements allowed where, among other things, it supports economic and social viability.

9.3.85 Policies BD/5 and ED/1 to ED/8 relate to employment uses. They identify site allocations for employment uses, set out criteria for assessing employment related developments and conversions, and support the expansion of existing businesses and retention of existing employment uses.

9.3.86 Policies A/1 and A/2 set out criteria for diversification of uses within farms and for the protection of the “best and most versatile” agricultural land.

9.3.87 Policies T01 to TO7 address tourism. This promotes sustainable tourism within settlements, with specific policies for different levels and types of settlement, specific policies for tourism in Minehead and Watchet, and criteria for the development of camping and caravan sites and for the extension of existing holiday parks.

9.3.88 Policies SH1 to SH/5 address retail development.

9.3.89 Policies H/1 to H/6 cover housing. Policies cover housing land allocations, homes for agricultural and forestry workers, criteria for affordable housing including site thresholds, and conversion of holiday accommodation.

9.3.90 Policies R/1 and R/4 allow the provision of formal sports facilities and the improvement of playing pitches subject to certain criteria.

9.3.91 Policy PO1, Planning Obligations states that:

"The Local Planning Authority in determining planning applications for significant forms of residential, commercial or industrial development may seek to negotiate appropriate planning obligations with developers to provide or contribute to infrastructure or community facilities directly related to the proposed development and commensurate with the development proposals."

9.3.92 Given that Policy EN/5 (Nuclear Energy Developments) was not saved beyond April 2009, WSC determined that a statement outlining its position with regard to new nuclear energy development was necessary to provide clarity on the matter.

9.3.93 A position statement on major energy generation projects and their associated infrastructure was considered and approved by WSC's Full Council on 23 March 2011. The position statement is as follows:

"This Authority recognises the requirement for continued safe supply of electricity to meet the nation's varied energy needs. It will endeavour to facilitate major energy generating development proposals within its area where it can be clearly demonstrated that;

- *it makes an essential contribution to the nation's energy needs;*
- *it respects the local natural environment in which it is located;*
- *it respects the positive economic and social characteristics of communities affected especially those neighbouring it; and*
- *adequate measures are taken to mitigate the cultural, economic, environmental and social impact of any related development on the communities affected, both in the short and the longer term."*

9.3.94 The officer's report to the Full Council states that, whilst it is recognised that the position statement cannot make policy, it has been produced to facilitate WSC's role in the decision-making process in respect of specific related development proposals within West Somerset.

iv. West Somerset Supplementary Planning Document: Planning Obligations (2009) (Ref. 9.40)

9.3.95 In December 2009 West Somerset Council adopted a Supplementary Planning Document (SPD) on Planning Obligations which sets out in more detail how they will implement policy PO1 of the Local Plan. This includes more detail on affordable housing policies. It also covers Community Buildings and Education. In relation to Community Buildings it states that:-

"Where additional demand from development and local need, can be demonstrated, the District Council will use planning obligations to provide or enhance buildings used for community uses." On education it states that contributions may be sought "Where a residential development of 50+ dwellings is likely to generate additional pupil numbers and it falls in the catchment area of a school which has insufficient existing or anticipated capacity."

v. West Somerset Local Development Framework (LDF) Core Strategy (Options Paper) (January 2010) (Ref. 9.41)

9.3.96 The Core Strategy is at a preliminary stage of preparation and the Options Paper does not include any specific policies relating to socio-economic impacts. The Options Paper does however identify a number of issues relevant to this assessment, grouped under a number of broad headings:

Housing and Community

- the need for more affordable housing; and
- improved provision of sport and recreation facilities.

Settlement Hierarchy and Development Distribution

- reviewing the current settlement hierarchy (see local plan above) to see whether it should be revised to meet current circumstances; and
- testing appropriate locations for development.

Employment Business and Tourism

- promoting tourism and in particular more sustainable tourism;
- increasing the amount of, and broadening the variety of employment opportunities within the District, particularly the knowledge based, high income sector;
- continuing to encourage appropriate training and educational opportunities locally;
- the importance of the agricultural industry to the area and its contribution to sustainable food production; and
- the need to retain more young people within the community (19 to 45 age group particularly).

9.3.97 The paper also identifies the impacts of the proposed development of HPC as a key issue (paragraph 3.7), in particular, the potential impacts on housing demand and traffic. It goes on to state that:

"If these proposals proceed to implementation, the construction phase of the project will have a significant impact upon the Core Strategy area. This would have to be managed in conjunction with the implementation of the Core Strategy's proposals." (paragraph 6.8).

9.3.98 Strategic objectives are set out in Para 5.2.2. These include:

- strengthen the role and function of the District's main settlements;

- increase self-containment within the District's main settlements;
- make a step change in the provision of affordable housing to meet identified local needs;
- create an aspirational, enterprising and entrepreneurial culture within West Somerset; and
- develop the quality of the tourism offer within the District.

vi. Sedgemoor Sustainable Community Strategy 2009-2026 (Ref. 9.42)

9.3.99 The Sustainable Community Strategy for Sedgemoor (2009 to 2026) sets out a vision for Sedgemoor of "*Everybody working together to make Sedgemoor a safer, cleaner, healthier, more pleasant and vibrant district in which to live, work, learn, invest or visit*".

9.3.100 It identifies five priority needs for Sedgemoor: Climate Change; Economic Development, especially raising skills and aspirations; Reducing deprivation; Provision of decent and affordable housing; and, Preparing for an increasingly elderly population.

9.3.101 Key activities of relevance to this assessment include:

- ensuring that local communities have a say in significant development proposals (and specifically energy developments) and that local impacts of development are taken into account, positive long-term legacies secured, and a mechanism for community benefit explored;
- promoting "*Smart Growth – Smart Action*", re-structuring the economy, increasing knowledge intensive jobs and businesses, securing more inward investment and tourism expenditure, helping existing business grow and maximising benefits of this to local residents;
- improve Bridgwater including its image, revitalising the town centre and making it an engine of economic prosperity through the "*Bridgwater Challenge*";
- addressing worklessness and getting people back into work or training and promoting the use of local labour and businesses;
- working with communities in deprived wards to improve housing, educational attainment, health and quality of life and with individuals to improve their health and re-enter the labour market;
- transforming schools through Building Schools for the Future, supporting the College, including the development of a new Energy Centre, and developing a Higher Education offer;
- provide a range of affordable, decent and warm accommodation, tackling rented and private homes in poor condition, and preventing homes from getting in to disrepair;
- tackling crime and anti-social behaviour, including understanding the impacts of previous large construction projects; and
- work with investors and developers to understand local needs and deficits in social and leisure infrastructure and to find ways of making improvements that

have a sustained impact and contribute to the wider regeneration of towns and communities.

9.3.102 The Strategy also includes summaries of area based plans for Bridgwater and Burnham and Highbridge, along with the more rural areas. For Burnham and Highbridge the identified priority is to ensure that their economies continue to grow and prosper, and in particular the tourism, retail and manufacturing sectors. The key projects are to improve the town centres and, in Burnham, the seafront, provide new sites for business and training for the local workforce.

vii.Sedgemoor Economic Masterplan 2008-2026 (Ref. 9.43)

9.3.103 The Sedgemoor Economic Masterplan (2008 to 2026) sets out the Council's approach to economic development, noting that it needs to work across boundaries with neighbouring authorities.

9.3.104 The Masterplan is based around three themes: Place; Business and Investment; and People. The table below summarises the key commitments under each theme.

Table 9.2: Sedgemoor Economic Masterplan: Major Commitments

Place
1. Bridgwater will be the South West's leading exponent of a 21st Century enterprise and business hub, an exemplar town offering outstanding services and facilities, on a par with large urban centres, for knowledge based industries, set in a vibrant leisure, cultural and retail centre.
2. Burnham on Sea will be a good example of the successful regeneration of small coastal towns, with regeneration led by the private sector following catalytic public sector investment.
3. Cheddar and the Hills/Levels and Moors: as a sustainable rural community and one of the country's leading examples of a sustainable activity-led tourism product based on the natural environment.
Business and Investment
4. Sedgemoor will be one of the UKs leading centres for energy related business, employment and skills, with Hinkley, Puriton and Bridgwater College as the foundation, and other initiatives based on renewable energy and low carbon technologies.
5. A combination of enterprises based in Bridgwater and a large number of home-based businesses (through a progressive policy on home working and property adaptations in rural areas), will establish Sedgemoor as a leading centre for creative, digital and media industries, with ICT infrastructure linking smaller businesses to regional, national and international networks.
6. A regionally significant location for inward investment, with an established programme of linking local businesses and residents to business and employment opportunities from new investment and in order to grow the energy and logistics sectors.

People
7. Bridgwater College will be the leading provider of rural based further and higher education, with centres of excellence in sectors directly relevant to the Sedgemoor and Somerset economy, and drawing students from all over England.
8. Outstanding schools, using Building Schools for the Future and the newly established Education Trust as the driver, with consistently improving attainment levels, playing a central role in improving the opportunities available to young people in terms of University, further education and moving in to employment.
9. Rejuvenated neighbourhoods and communities, with areas historically affected by high levels of deprivation, established on an upward curve, moving out of the most disadvantaged neighbourhoods nationally, as more effective inter agency working including education, health, police and others provide new opportunities for those excluded from the mainstream economy.
Cross Cutting
10. Sedgemoor will be recognised as the most enterprise driven and business customer focused Council in the South West, with planning polices which support enterprise and investment, and a Senior Member and Officer Team with the capacity and experience to secure and support new investment of all types.

9.3.105 Supporting the Economic Masterplan, Sedgemoor District Council has an adopted Employment and Skills Charter, which informs the agreement of local employment, education and training measures within Section 106 Planning Obligations.

viii. Sedgemoor Local Plan 1991-2011 (2004) (Policies ‘saved’ from 27 September 2007) (Ref. 9.44)

9.3.106 The Local Plan was adopted in 2004 (with relevant policies ‘saved’ from 27 September 2007).The following saved policies are considered to be potentially relevant for the socio-economic assessment and cover the following themes:

9.3.107 The Local Plan, noting that the Structure Plan identified Bridgwater and Burnham/Highbridge as “Towns”, seeks to concentrate development in these towns, subject to a range of criteria (paragraphs 3.05 and 3.06). It also identifies rural centres and villages, the latter include Cannington, Combwich, Stockland Bristol and Fiddington which are close to the border with West Somerset and the HPC development site (paragraph 3.11).

9.3.108 **Chapter 4** of the Plan covers housing. Saved policies address housing targets (H60), criteria for residential development in the Towns and Villages (H2 and H3), identify a number of specific sites allocated for housing (paragraphs 4.27 to 4.60), exceptions policies for rural housing meeting local needs (policy H31), a presumption in favour of the provision of residential caravans and mobile homes as important in meeting the need for affordable accommodation, subject to a range of criteria, and policies relating to agricultural dwellings. **Chapter 5** of the Plan covers Employment and Economic Development. This includes a number of site specific proposals as well as generic policies relating to criteria for assessing applications for employment uses in different types of locations e.g. towns and villages (paragraphs 4.86 to 4.91).

9.3.109 Other saved policies considered to be potentially relevant include: the Protection of Recreational Space (Policy RLT1); provision of outdoor sports facilities with new housing (Policy RLT3); directing new hotel development to Bridgwater, Burnham on Sea or Axbridge or to locations adjacent to motorways or other main routes, or as a replacement for static caravans on an established site (Policy RLT15); criteria for allowing the improvement or extension of, and safeguarding of, existing holiday sites (Policies RLT18 and RLT20).

ix. Sedgemoor Local Development Framework (LDF) Core Strategy (Proposed Submission) (September 2011) (Ref. 9.45)

9.3.110 The Sedgemoor LDF Core Strategy (Proposed Submission) was consulted on from September to November 2010. Changes prior to submission proposed as a result of the consultation process were reported and endorsed by Sedgemoor District Council's Executive Committee on 9 February 2011.

9.3.111 The Core Strategy (Proposed Submission) was submitted to the Secretary of State on 3 March 2011 and an Examination in Public (EiP) was held in May 2011. Once adopted, the Core Strategy will form part of the Development Plan for Sedgemoor. EDF Energy submitted representations objecting to the Core Strategy (Proposed Submission), relating to **Chapter 4** 'Major Infrastructure Projects' (and policies MIP1, MIP2 and MIP3 contained in that chapter) and those sections relating to housing and Hinkley Point. EDF Energy also participated at the relevant EiP hearings. See **Volume 1**, **Chapter 4** for a full summary of the position regarding the status of the Core Strategy.

9.3.112 Emerging policies MIP1, MIP2 and MIP3 relate specifically to the HPC Project, as set out in the re-drafted **Chapter 4** (dated 29 July 2011).

9.3.113 Policy MIP1 (Major Infrastructure Proposals) explains that applications for major infrastructure development will be considered against the relevant national planning policy and the strategy and relevant policies of the development plan. The objective from the Council's perspective is that major infrastructure proposals should, where possible, contribute positively to the implementation of the spatial strategy and meet the underlying objectives of it.

9.3.114 Policy MIP2 (Hinkley Point C Associated and Ancillary Development) sets out the considerations that the Council will take into account in the preparation of a LIR in responding to proposals for development associated with, or ancillary or related to the HPC Project, where they are not the determining authority. Such considerations include: directing accommodation proposals to a range of sites, primarily in Bridgwater; measures to avoid, minimise and then mitigate adverse impacts on the transport network; meeting the accommodation needs of the temporary workforce in a way that does not have an unreasonable adverse effect on the housing market; providing appropriate community facilities where addition demand is generated by the project; delivery of education, employment and training opportunities for the local community; and the delivery of investment in infrastructure, buildings and green infrastructure.

9.3.115 Policy MIP3 (Hinkley Point C: Planning Obligations and Mitigation) states that the Council will seek to ensure, wherever possible, that the proposals avoid, minimise and mitigate (including, where appropriate, compensate for) impacts during the construction, operation, decommissioning, and restoration phases.

9.3.116 The Core Strategy consists of an overarching strategy, policies for major infrastructure projects, including HPC, District-wide policies on a range of key themes, and place making policies for specific locations including Bridgwater and Burnham and Highbridge.

9.3.117 Following guidance from the previous Government the spatial vision for Sedgemoor is based on the Somerset and Sedgemoor Community Strategies described above. As noted above this is likely to cease to be a statutory requirement. The Strategy is structured around the four themes of: living sustainably; ensuring economic wellbeing; enjoying and achieving; and, being healthy. In addition, Bridgwater is seen as the "focal point" for the District and driver of economic prosperity.

9.3.118 The Strategy identifies nine strategic objectives of which the following five are considered to be potentially relevant to this assessment:

- S03, Living Sustainably: To Provide Everyone with the Opportunity to Live in a Decent Home.
- S04, Living Sustainably: To Create More Sustainable Communities.
- SO6, Ensuring Economic Wellbeing: To ensure the economic wellbeing of our communities, by developing an economic blueprint to shape the restructuring of our economy and transform the workforce.
- SO7, Ensuring Economic Wellbeing: To strengthen the retail competitiveness of the town centres whilst broadening their appeal as places to shop, work, live and visit.
- SO9, Being Healthy: To improve the health and well-being of our communities by addressing inequalities and poverty, ensuring access to key services and encouraging healthy lifestyles.

9.3.119 The Strategy re-enforces Bridgwater as the "principal town", expected to accommodate 70% of additional jobs and homes, with Burnham-on-Sea and Highbridge being "*focal points for more limited growth focusing on the need to capture investment to regenerate and sustain the town centres and to promote self-containment by reducing the levels of out-commuting*." (paragraph 3.15). It also identifies seventeen "*Key Rural Settlements*" – including Cannington, Puriton, and North Petherton, and a further ten "*Other Sustainable Settlements*", including Combwich.

9.3.120 Policy S2 identifies the Council's approach to Infrastructure Delivery, based on the Infrastructure Delivery Study undertaken by the Council (see below). This includes the Council's intention to seek funding for "*Core Infrastructure*" through a Community Infrastructure Levy and for "*Onsite and Offsite Infrastructure*" through Section 106 planning agreements. The latter includes affordable housing and social infrastructure: education, sport and open space, healthcare, community and cultural facilities, local labour agreements and emergency services.

9.3.121 District-wide policies considered to be of potential relevance include Policy D5 (Housing) including proposed targets, location and mix, Policy D6 (Affordable Housing), Policy D11 (Economic Prosperity and Long Term Future), Policy E11 (Economic Prosperity) which sets a target of a minimum of 9,160 new jobs by 2026, and the promotion of skills and local labour, Policy D12 (Tourism) which supports the growth of tourism in the area subject to a range of criteria; Policy D13 which promotes retail and leisure growth in key town centres including Bridgwater and

Burnham, Policy D18, which promotes improvements to educational provision, including schools and Bridgwater College, Policy D19 which promotes the retention and enhancement of health provision, Policy D21, which seeks to "provide additional, extended or enhanced community and cultural facilities".

9.3.122 The Placemaking policies for Bridgwater (Policy P1) seek, in large part to support the implementation of the Bridgwater Vision, described above, including the transformation projects. They also identify Hamp, Newtown and Victoria, Sydenham and Eastover as housing renewal areas. The proposals provide strong support for Economic Development in Bridgwater, stating:

> *"All employment proposals in Bridgwater will be supported where they add higher value to the economy through the provision of local employment opportunities, the promotion of higher skilled jobs and/or allow for the expansion of appropriate existing businesses." Policy P2 sets out specific policies for the Town Centre.*

9.3.123 Placemaking policies for Burnham on Sea and Highbridge (Policy P3) focus on increasing self-containment, enhancing the "service" centre role of the towns, supporting development and regeneration to meet local needs, and consolidating and enhancing existing services. Outside of the two main towns, the main thrust of policies is to enhance the role of settlements as service centres for their communities, support the need of local communities and enhance the sustainability and/or increase the self-containment of settlements. Subject to criteria new housing will be allowed within settlement boundaries, but only in exceptional circumstances in "Other Sustainable Settlements".

x. Sedgemoor District Council Infrastructure Delivery Strategy (2010) (Ref. 9.46)

9.3.124 The Sedgemoor Infrastructure Delivery Strategy was published in June 2010. It sets out the likely infrastructure required to support the levels of housing development identified in Sedgemoor's emerging Core Strategy. This includes a review of current infrastructure provision and estimates of additional required provision. This suggests that the development at HPC could have impacts on local provision and that Planning Obligations and/or a packaged of Community Benefits may be required. It notes that discussions with the HPC promoter are at an early stage but that possible investments include park and rides, cycleways and footpaths, provision of sport and recreation and provision of healthcare and education. It notes (paragraph 2.5) that it is essential that "*any requirements (will need to be) set in a robust evidence base*."

xi. Hinkley Point C Project Supplementary Planning Document (Consultation Draft) (February 2011) (Ref. 9.47)

9.3.125 Sedgmoor District Council and West Somerset Council have jointly prepared draft supplementary planning guidance in relation to the HPC Project. Public consultation on the Consultation Draft version of the Hinkley Point C Project Supplementary Planning Document ("the draft HPC SPD") commenced on 1 March 2011 and concluded on 12 April 2011. EDF Energy submitted representations which object to the draft HPC SPD.

9.3.126 Following the Sedgemoor Core Strategy EiP and subsequent correspondence with the Inspector, it is clear that the SPD cannot set tests, policies or requirements for the IPC to apply to the consideration of the HPC Project. If the Councils continue with the SPD preparation, its text will need to be considered in this light and it could not carry any significant weight in the determination of the DCO application. As it may be relied upon by some stakeholders, however, the principal contents of the draft HPC SPD as it relates to the assessment of socio-economic effects are summarised below.

9.3.127 Project-wide issues and policies include:

- An expectation from the Councils that the project promoter will help support, and produce a delivery plan for, a Heart of Somerset Low Carbon Business Cluster.
- Expectations for a comprehensive scheme of economic, community/social, environmental and safety measures to mitigate and compensate for the new and increased levels of impact and harm associated with the HPC project that takes account of the needs of the communities of the two Council areas as well as the needs and impacts of the HPC workforce.
- The development and implementation of Employment and Skills Charters to support and improve local access to jobs and training.
- Support for a local business supply chain and services approach.
- Workers to be accommodated in existing settlements in proportions that reflect the local settlement hierarchy, with a higher proportion (permanent or temporary directed to Bridgwater).
- Production by the promoter of a Worker **Accommodation Strategy** based on a series of detailed principles including: sites being in line with local planning policies; proposals minimising need to travel to work and leisure; majority of accommodation should be permanent and provide a legacy; impact on local communities minimised and cohesion and regeneration enhanced; promotion of healthy lifestyles, requirement for socio-economic assessment of proposals of over 100 bedspaces, promotion of healthy lifestyles and requirement for Code of Conduct for Construction workers.
- Any on-site campus should be the minimum required for operational purposes.
- In Bridgwater accommodation should help deliver the Bridgwater Vision and temporary provision should be minimised.
- Workers use of tourism accommodation should be monitored. Criteria are set out for dealing with proposals for extended tourist accommodation or year round use of existing accommodation.
- Maximising the opportunities for the Hinkley Visitor Centre to benefit the wider tourism economy and strategic enhancements to existing attractions, such as Butlins family resort in Minehead and Brean to Burnham-on-Sea and Highbridge, to maintain their reputation and ‘pull’.
- The promoter should work with the Councils to support providers of “latent” accommodation and ensure that community relations, health and safety, emergency services and legal issues are covered.
- The promoter should contribute to the delivery of affordable housing to redress any impacts on the local housing market.
- That the promoter should protect and promote the local tourism economy.

- That a partnership approach to sports and recreation provision should be developed through which the HPC promoter should provide for the needs of its workforce, whilst ensuring facilities are available and accessible to residents. It identifies five potential locations for such provision: Bridgwater, Bridgwater Gateway, Cannington, Stogursey and Williton.

9.3.128 In relation to the on-site accommodation campus, it sets out expectations of what might be included. This includes: a robust justification for why the campus is essential including the specific types of workers; the need to avoid impacts on the residents of Shurton and Burton; the inclusion of a medical facility/clinic, and administration and security office, shops and amenity facilities, subject to them being justified in relation to the scale of the campus and impacts on the wider area; an education building, and sport facilities.

9.3.129 The SPD also contains reference to the Dillington Visions, at Appendix A of the SPD. These are a series of thematic vision statements and joint objectives for the HPC Project. These relate to the following topics:

- Economic Development – To ensure that the HPC development acts as a driver for achieving a more dynamic, entrepreneurial, inclusive and sustainable economy in Somerset and the wider region.
- Developing a Low Carbon Future – Ensure a strong business and educational reputation for low carbon and environmental technologies.
- Education, Employment and Skills – Ensure the HPC development maximises employment and skills opportunities for local people, whilst inspiring young people to achieve and seek to follow careers in the science, technology, engineering and manufacturing sectors.
- Community Well-being – associated with generating greater community cohesion and support the delivery of strategic objectives by implementing a comprehensive scheme of community well-being and safety measures that take account of the needs of the communities of West Somerset, Sedgemoor and Somerset as a whole, as well as the needs and impacts of the HPC workforce.
- Housing – ensure the Hinkley C development provides housing solutions that enable workers and their families to integrate into the community and are economically active at a local level, whilst making a positive contribution to the Councils' Housing Strategies and their wider strategic planning objectives.

xii.The Bridgwater Vision (Ref. 9.48)

9.3.130 The Bridgwater Vision (2009) sets out a "Vision" for the town which, as noted in a range of policies, is a priority location for regeneration and investment.

9.3.131 The Vision notes some of the existing projects which support the vision which includes "*the opportunity to maximise local community benefits from the potential construction of a new nuclear power station at Hinkley Point including new jobs, not only in construction, but also contributing to the development of a knowledge economy providing the catalyst for a higher skilled workforce*." Also identified are the Energy Skills Centre, the BAE systems site at Puriton, and the development of "North East Bridgwater" as a sustainable urban extension.

9.3.132 The Vision breaks the town down into thirteen character areas, linked by a green network and an access and movement strategy. It then goes on to identify a series of "catalyst" projects in the central area which can help promote change.

9.3.133 Sedgemoor District Council's planning policies are summarised in detail in **Chapter 7** (Legislative and Planning Policy Context). Issues of relevance to the socio-economic assessment are highlighted below. Where policies relate to specific associated development sites, these are summarised in the relevant site specific Chapter.

xiii. Taunton Deane Borough Council, Grow and Green, A New Economic Development Strategy for Taunton Deane, 2010 (Ref. 9.49)

9.3.134 Although not one of the two immediate host Districts for HPC, Taunton Deane Borough Council is within the three district assessment area and its economic development policies are potentially relevant.

9.3.135 Taunton Deane's Economic Development Strategy has three objectives. These are:

- to create 16,500 or nearly 30% more jobs in Taunton by 2026;
- to create better quality jobs which will close Taunton's earnings gap with the rest of the South West region; and
- to create a dynamic 'green economy' in Taunton which delivers fresh business and job opportunities.

9.3.136 The Strategy highlights the role of Somerset College and the potential links with the proposed Energy Skills Centre at Bridgwater College.

xiv. Summary

9.3.137 The policy review above demonstrates that there are a large number of policies at the national, regional and local levels relevant to the assessment of the impacts of HPC.

9.3.138 In order to assess the socio-economic impacts of the proposed development against these policies, as required by NPS EN1 (paragraph 5.12.4) the matrix set out in **Table 9.3** below, has been created which seeks to capture the key policy areas covered which need to be addressed in the assessment and can be referred to in the baseline assessment and review of impacts in the following sections.

9.3.139 The table splits the policy requirements into three categories:

- **Process and Criteria Policies**: are those which set out how the assessment should be undertaken, the weight given to different issues in the assessment, and how impacts should be addressed.
- **Assessment of Impact and Mitigation**: are those areas identified by policy makers in which the proposals at HPC might have an impact, which, if a negative impact, might require mitigation.
- **Enhancement and Legacy**: Are those areas identified, predominantly in local policy, where potential positive impacts of the HPC scheme might be delivered in a way which could be enhanced to achieve wider policy objectives.

9.3.140 The distinction between the second and third categories is important in order to identify areas in which the applicant might be expected to minimise or mitigate impacts as a requirement, and those in which longer term partnership working might provide enhanced outcomes but for which, under the 'process and criteria' rules the applicant couldn't reasonably be required to contribute.

Table 9.3: Summary/Reference to Policy

	National	Regional and Sub-Regional	Somerset	West Somerset	Sedgemoor
Process and Criteria					
Assessment to identify likely local and regional significant impacts and mitigation for negative effects	EN1				
Assessment to be Evidence Based	EN1				
Assessment to include baseline conditions and review against local planning policies	EN1		✓	✓	✓
Mitigation measures to be identified.	EN1		✓	✓	✓
Planning obligations should meet standard tests. Planning authorities should ensure that they do not "impose unnecessary burdens on development."	EN1, Ministerial Statement				
Promotion of growth and national, regional and local levels and presumption in favour of sustainable development	Plan for Growth and Ministerial Statement	✓	✓	✓	✓
Assessment of Impacts and Mitigation: Issues to be Addressed					
Workforce Requirements (Creation of jobs and training opportunities)	EN1			✓	✓
Labour Market Impacts: Demand for Labour (including cumulative regional demand)	EN1	✓		✓	✓
Impact of labour force on local population &demographics	EN1		✓	✓	✓
Impact on demand for services and facilities	EN1		✓	✓	✓
Impact on social cohesion	EN1			✓	✓
Effects on tourism	EN1		✓	✓	✓
Effects on health and wellbeing	EN6			✓	✓
Effects on Housing Market				✓	✓
Effects on Property Values					✓
Spatial Impacts on Towns and Villages				✓	✓

	National	Regional and Sub-Regional	Somerset	West Somerset	Sedgemoor
Enhancement& Legacy					
Provision of infrastructure and visitor facilities and tourism	EN1	✓	✓	✓	✓
Economic benefits	EN1	✓	✓	✓	✓
Nuclear /Low Carbon Cluster/Higher Value Services		✓	✓	✓	✓
Skills and Labour Market Opportunities		✓	✓	✓	✓
Inward Investment		✓	✓	✓	✓
Education			✓	✓	✓
Housing				✓	✓
Area Impacts/Regeneration and Placemaking				Villages Williton Minehead	Bridgwater Cannington Combwich
Broadband and Connectivity			✓	✓	✓
Deprivation and Social Exclusion				✓	✓

9.4 Methodology

a) Study Area

9.4.1 The geographical extent of the study area for this socio-economic assessment includes the full extent of the project, including the HPC development site, all associated development sites and the surrounding area as defined by each socio-economic topic.

9.4.2 The following describes the geographic areas which have been used in the baseline studies for each impact topic. The precise areas used are partly influenced by data availability issues and in some cases also reflect the boundaries of relevant service planning areas, e.g. for school or health facilities.

i. Administrative Areas

9.4.3 In terms of socio-economic baseline data, the study area is based on areas of administrative geography including National (England and Wales), Regional (South West), County (Somerset) and Local Authority/District (West Somerset, Sedgemoor and Taunton Deane).

ii. Construction Workforce Spatial Distribution Areas

9.4.4 Additionally, some analysis is conducted on a ward-based approach, based on areas derived from the Gravity Model which has been used in the **Transport Assessment**. This model includes inputs from the socio-economic assessments on the workforce profile, skills profile of the resident workforce, and accommodation location and availability. It then, based on travel times, allocates the workforce across the area.

9.4.5 There are two study areas used within this assessment derived in this way:

- *60-Minute Travel Time:* This is a collection of wards within a defined 60-minute travel distance from the HPC development site, including wards in Taunton Deane, Sedgemoor, West Somerset, Mendip, South Somerset and North Somerset. It represents the estimated extent of daily travel time to the Hinkley Point site by non-home based workers who may move into the area to work on the project.
- *Construction Daily Commuting Zone:* The Construction Daily Commuting Zone (CDCZ) is defined as the local authority districts within an approximate 90 minute commute time (c 50-55 miles) of the HPC development site. This area includes the county of Somerset (Mendip, Sedgemoor, South Somerset, Taunton Deane and West Somerset districts), the West of England area (Bath and North East Somerset, City of Bristol, North Somerset and South Gloucestershire unitary authorities), the following districts in Devon: East Devon, Exeter, Mid Devon, North Devon and Teignbridge, plus West Dorset district and Newport unitary authority in Wales. This is used primarily to define the local (home-based) labour market for construction phase. The definition of the CDCZ involves consideration of a range of factors which affect workers' willingness to commute, including time, distance and travel allowances; plus findings from other studies of the mobility of UK construction workers. The CDCZ is used primarily to define the home-based labour market for the construction phase.

9.4.6 It varies slightly from the CDCZ used in the transport gravity model, as it uses local authority rather than ward boundaries. This allows the use of more recent and wider datasets for analysis of the local labour market, and broadly corresponds with the areas used for the Sizewell studies. **Figure 9.1** outlines the Study Areas defined above. A full description of detailed inputs to the determination of the 60-minute travel distance and CDCZ is included in **Technical Note 1: Workforce Profile** (**Appendix 9A**), with specific elements covered in **Technical Note 4: Accommodation Datasets** (**Appendix 9D**) and **Technical Note 3**: **Spatial Distribution** (**Appendix 9C**) and Chapters 8, 10 and 15 of the **Transport Assessment**.

iii. Ward Clusters (Distribution of Non-home-based Workers)

9.4.7 Data to outline the baseline position in terms of local population and employment dynamics have also been collected on a 'ward cluster' basis, which outlines 12 spatial areas with anticipated proportions of non-home-based construction workers (based on the Gravity Model distribution). These areas are outlined in the following list:

- *Bridgwater ward cluster:* Bridgwater Bower, Bridgwater Eastover, Bridgwater Hamp, Bridgwater Quantock, Bridgwater Sydenham, Bridgwater Victoria, King's Isle, North Petherton, and Sandford.
- *Burnham and Highbridge ward cluster:* Berrow, Brent North, Burnham North, Burnham South, Highbridge, Huntspill and Pawlett, Knoll, Puriton, Wedmore and Mark, West Poldens, Woolavington.
- Cannington ward cluster: Cannington and Quantocks.
- *Cheddar ward cluster:* Axbridge, Axe Vale, Cheddar and Shipham.
- *Glastonbury ward cluster:* Glastonbury St Benedict's, Glastonbury St Mary's, Moor, Street North, Street South, Street West, East Poldens, Turn Hill, Wessex.

- Hinkley Point and Stogursey ward cluster: Quantock Vale.
- *Minehead ward cluster:* Alcombe East, Alcombe West, Aville Vale, Carhampton and Withycombe, Dunster, Minehead North, Minehead South, Porlock and District.
- *Somerset South ward cluster:* Curry Rivel, Islemoor, Blackdown, Monument, Neroche, North Curry, Stoke St. Gregory, Wellington East, Wellington North, Wellington Rockwell Green and West.
- *Somerset West ward cluster:* Bradford-on-Tone, Milverton and North Deane, Brompton and Ralph Haddon, Quarme.
- *Taunton ward cluster:* Bishop's Hull, Bishop's Lydeard, Comeytrowe, Norton Fitzwarren, Ruishton and Creech, Staplegrove, Taunton Blackbrook and Holway, Taunton Eastgate, Taunton Fairwater, Taunton Halcon, Taunton Killams and Mountfield, Taunton Lyngford, Taunton Manor and Wilton, Taunton Pyrland and Rowbarton, Trull, West Monkton.
- *Watchet and Williton ward cluster:* Crowcombe and Stogumber, Old Cleeve, Watchet, West Quantock, Williton.
- *Weston-super-Mare:* Banwell and Winscombe, Blagdon and Churchill, Clevedon Central, Clevedon East, Clevedon North, Clevedon South, Clevedon Yeo, Congresbury, Hutton and Locking, Kewstoke, Weston-super-Mare Central, Weston-super-Mare Clarence and Uphill, Weston-super-Mare East, Weston-super-Mare Milton and Old Worle, Weston-super-Mare North Worle, Weston-super-Mare South, Weston-super-Mare South Worle, Weston-super-Mare West.

iv. Urban Areas of High Population Density

9.4.8 Additionally, where applicable, data has been collected to reflect the major urban areas within the study area (Bridgwater, Taunton and Weston-super-Mare). The following wards are used to define these urban areas (ONS ward codes are given in brackets):

- *Bridgwater: (*40UCGN) Bridgwater Bower; (40UCGP) Bridgwater Eastover; (40UCGQ) Bridgwater Hamp; (40UCGR) Bridgwater Quantock; (40UCGS) Bridgwater Sydenham; (40UCGT) Bridgwater Victoria.
- *Taunton:* (40UEGH) Bishop’s Hull; (40UEGM) Comeytrowe; (40UEGX) Taunton Blackbrook and Holway; (40UEGY) Taunton Eastgate; (40UEGZ) Taunton Fairwater; (40UEHA) Taunton Halcon; (40UEHB) Taunton Killams and Mountfield; (40UEHC) Taunton Lyngford; (40UEHD) Taunton Manor and Wilton; (40UEHE) Taunton Pyrland and Rowbarton.
- *Weston-super-Mare: (*00HCPQ) Weston-super-Mare Central; (00HCPR) Weston-super-Mare Clarence and Uphill; (00HCPR) Weston-super-Mare East; (00HCPT) Weston-super-Mare Milton and Old Worle; (00HCPU) Weston-super-Mare North Worle; (00HCPW) Weston-super-Mare South; (00HCPX) Weston-super-Mare South Worle; (00HCPY) Weston-super-Mare West.
- *Watchet/Williton: (*40UFGM) Watchet; (40UFGP) Williton.
- *Minehead:* (40UFFX) Alcombe West; (40UFGF) Minehead North; (40UFGG) Minehead South.

- *Burnham-on-Sea/Highbridge: (*40UCGU) Burnham North; (40UCGW) Burnham South; (40UCHA) Highbridge.
- *Wellington: (*40UEHG) Wellington East; (40UEHH) Wellington North; (40UEHJ) Wellington Rockwell Green and West.
- *Cheddar:* (40UCGY) Cheddar and Shipham.

v. Other Spatial Scales

9.4.9 The following list outlines other spatial areas of study related to specific areas of socio-economic effect:

- *Local labour market for operational phase* – this is defined as the immediate districts of West Somerset, Sedgemoor and Taunton Deane. Approximately 95% of existing Hinkley Point B personnel is resident in these three districts.
- *Employment/economy/wider economy* – baseline data has been collected for the 60-minute travel distance, and CDCZ, but with a secondary focus on the more immediate districts of West Somerset, Sedgemoor and Taunton Deane.
- *Demographic/settlement characteristics – t*he main focus is primarily on West Somerset, Sedgemoor and Taunton Deane districts, which are likely to house the majority of the non-home-based workforce. There is a secondary focus on the wards in the more immediate vicinity of the site.
- *Housing market/accommodation* – primarily the three districts as above for demographic/settlement characteristics.
- *Crime/police/fire* – for police services, the main focus is on the Somerset West police district of the Avon and Somerset Constabulary. This includes the three local authority areas of Taunton Deane, West Somerset and Sedgemoor. There are four neighbourhood areas in the police district: Bridgwater, Burnham-on-Sea, Minehead and Taunton.

9.4.10 The local study areas for each of the associated development sites are based on Mid-level Super Output Areas (MSOAs) and defined individually in each chapter.

vi. The Immediate Area around Hinkley Point C

9.4.11 The definition of the Immediate Area to the development is based partly on the representation of parish and town councils on the Hinkley Point Site Stakeholder Group. Although it is not possible to collect comprehensive data at this scale, this area is included in the assessment in terms of mitigation proposals. The constitution of the Hinkley Point Site Stakeholder Group (Ref. 9.50) includes membership from the following parish and town councils:

- Bridgwater Town Council (covering Bridgwater Bower, Eastover, Hamp, Quantock, Sydenham and Victoria wards).
- Cannington, Fiddington, Nether Stowey, Otterhampton, Over Stowey, Spaxton and Stockland Parish Councils (in Cannington and Quantocks ward).
- Chilton Trinity and Wembdon Parish Councils (in Sandford ward).
- East Quantoxhead Parish Meeting (in West Quantock ward).
- Holford, Kilve, Stogursey and Stringston Parish Councils (in Quantock Vale ward).

- Pawlett Parish Council (in Huntspill and Pawlett ward).

b) Baseline Assessment

9.4.12 Baseline information has been identified through:

- Analysis of publicly-available demographic datasets including analysis of nationally recognised data and survey information obtained from the Office of National Statistics (ONS) and other Government departments including the Department of Communities and Local Government. This includes 2001 Census data and mid-year population estimates (2001-2009) (Ref. 9.51), Annual Business Inquiry data (2008) and updated ABI/BRES (2009) data (Ref. 9.52), Department of Work and Pensions Jobseekers Allowance Claimant Count data (Ref. 9.53) and the Government's Indices of Multiple Deprivation (2010) (Ref. 9.54).
- Work undertaken through various accompanying Technical Notes, listed here and included as appendices:
  - Technical Note 1: Workforce Profile (**Appendix 9A**).
  - Technical Note 2: Demographic Benchmarks (**Appendix 9B**).
  - Technical Note 3: Spatial Distribution (**Appendix 9C**).
  - Technical Note 4: Accommodation Datasets (**Appendix 9D**).
  - Technical Note 5: Leisure Audit and Estimated Demand (**Appendix 9E**).
  - Technical Note 6: Community Cohesion (**Appendix 9F**).
- Work on the transport gravity model which has been used to assess the spatial distribution of the workforce was undertaken jointly by the Socio-Economic and Transport workstreams. A full description of the model and its inputs is contained in the **Transport Assessment**.
- Consultation with appropriate Statutory Bodies as detailed.
- A study of local education facilities has been undertaken using pupil place planning documents, School Organisation Plans (Ref. 9.55) and Annual Schools Census data (2010) (Ref. 9.56).
- A study of primary healthcare facilities has been undertaken based on NHS Business Services (2010) data and data obtained from NHS Choices (2011).

9.4.13 The following table outlines the key data sources used in the production of the baseline assessment and those used elsewhere in the socio-economic assessment. No specific surveys were commissioned or undertaken for this ES assessment.

Table 9.4: Key Data Sources

NATIONAL
• Mid-year population estimates (ONS); • Estimates of internal migration flows (ONS); • Sub-national population projections (ONS); • Annual estimates of total employment and jobs density (ONS); • Annual Business Inquiry/Business Register and Employment Survey (ONS); • 2001 Census (ONS); • Annual Population Survey estimates (ONS); • Job-Seekers Allowance Claimant count unemployment data (ONS); • Working age benefit claimant data (DWP); • Annual Survey of Hours and Earnings (ONS); • Employment forecasts for the construction sector (Construction Skills Network); • Indices of Multiple Deprivation 2010 (DCLG); • GCSE exam attainment data (DCSF); • Recorded crime statistics (Home Office).
REGIONAL/COUNTY/DISTRICT
• Avon and Somerset Constabulary 12-month crime figures: • Regional Spatial Strategy for the South West (GOSW); • South West England Regional Assembly (SWRA)/ Development Agency (SWRDA), including RSS/RES/Sustainability Appraisals etc • South West Observatory, South West economy projections; • South West Public Health Observatory, health indicator set; • Fordham Research, Strategic Housing Market Assessment for Taunton and South Somerset housing market areas; • Somerset County Council, School Organisation Plan; • Somerset Primary Care Trust, strategic review of primary care infrastructure; • Somerset Strategic Partnership, local area agreement, sustainable community strategy and economic strategy; • West Somerset, Sedgemoor and Taunton Deane Districts, policy and data documentation • South West Tourism, accommodation database; accommodation occupancy surveys; • Socio-Economic Workshops and meetings of Somerset Nuclear Energy Group.

c) Consultation

9.4.14 Extensive consultation has been undertaken throughout the environmental assessment process, including formal stages as prescribed by the IPC, through a Planning Policy Agreement with the local authorities, which established a dedicated socio-economic work stream, and through other formal and informal consultation.

9.4.15 The **Consultation Report** describes the full process which EDF Energy has gone through which includes the process for Infrastructure Planning applications as set out in primary and secondary legislation, including meetings held with Sedgemoor District Council, West Somerset Council and Sedgemoor County Council throughout the EIA process to discuss the scope of the assessment. In addition, a set of initial workshops were held with local authorities and other key stakeholders to identify and confirm the likely socio-economic impacts associated with the proposed development, and to identify possible measures to mitigate these impacts.

9.4.16 The **Consultation Report** also identifies responses to all comments made by individuals, statutory bodies and other organisations, and includes a socio-economic section, cross referenced with this chapter and the appended **Technical Notes**.

9.4.17 A formal Socio-Economic Taskgroup, incorporating representatives from SDC, WSC, SCC and EDF Energy was established in October 2010. The working group has considered the methodology adopted for the estimation of employment numbers and the consequent impacts on accommodation and public services.

9.4.18 A series of **Technical Notes** were prepared as part of this consultation process and these are appended.

d) Assessment Methodology

i. Value and Sensitivity

9.4.19 The main sensitive receptors for the socio-economic assessment are the housing and labour markets, public services and communities at a number of spatial levels. It is not possible to ascribe a relative 'value' to each of these receptors as impacts could be felt at all spatial scales and are as significant to individuals and communities in a local area as they are at the regional scale.

9.4.20 There has therefore been a focus on the "sensitivity" of each receptor, and, in particular on their ability to respond to change based on recent rates of change and turnover. The socio-economic environment is a dynamic and adaptive one with constant background change and turnover, for example people moving into and out of the area and changing jobs. This is a particular feature of the construction sector.

9.4.21 The baseline assessment identifies the extent of this background change and then, where possible, the scale of likely impacts has been benchmarked against this change.

ii. Magnitude and Significance

9.4.22 The significance levels therefore combine an assessment of the overall magnitude or scale of the impact, and compare this to the ability of each receptor to respond to change. Potential impacts have been considered in terms of permanent or temporary, adverse (negative) or beneficial (positive) and cumulative.

9.4.23 Some impacts cannot be quantitatively assessed; in such cases a qualitative assessment has been used. In addition, the magnitude of the impact does not necessarily correlate with the impact significance. The key influences on the determination of impact significance include:

- the magnitude of the potential impact;
- the geographical extent of the impact;
- the duration and reversibility of the impact;
- the capacity of the relevant area to absorb the impact; and
- recent rates of change in the locality.

9.4.24 Thus, for example, a key (major or moderate) significant impact would be likely to be: of major or at least moderate magnitude, affect a wide area, be permanent or irreversible and difficult to absorb in the relevant area. The sources of impact may arise during construction and/or operational phases. Due to the nine year construction for the HPC Project the duration of many of the temporary impacts will be long term although their magnitude will vary over the project depending on the level of workforce at any one time. Most of the assessments focus on the "peak" of the construction period. This enables it to demonstrate the maximum scale of beneficial impacts and ensure mitigation measures meet the worst case for adverse impacts.

9.4.25 The table below identifies those impacts where significance can be defined with reference to the baseline and quantitative indicators. Other qualitative assessments are based on professional judgement.

9.4.26 The criteria have been reviewed and updated in response to comments on the Stage 2 Environmental Appraisal and discussions with the local authorities and their advisers. They seek, as far as possible, to identify quantitative criteria as to the level of change in relation to the current capacity of the area (for example for schools and accommodation) or in the context of current annual rates of turnover and change in population. This recognises the dynamic nature of the environment with which the HPC development will interact.

Table 9.5: Level of Significance (Magnitude and Sensitivity) of Impacts Assessed

Impact	Major	Moderate	Minor	Negligible
Economic				
Labour Market: Change in Level of Construction Employment in Regional (CDCZ) Economy	7.5% to 10% change in construction employment	5% to 7.5% change in construction employment	2.5 % change to 5% change in construction employment	Up to 2.5% change in construction employment
Change in Level of Employment in Local (3 District) Economy	1.5 to 2% change in resident based employment (3 districts)	1 to 1.5% change in residence based employment	0.5% to 1% change in resident based employment	0 to 0.5% change in resident based employment
Business and Supply Chain	To be assessed qualitatively	To be assessed qualitatively	To be assessed qualitatively	To be assessed qualitatively
Accommodation				
Overall Supply	Within 16,800 at August peak (20% of stock excluding Owner Occupied)	Within 12,600 at August peak (15% of stock excluding Owner Occupied)	Within 8,400 at August peak (10% of stock excluding Owner Occupied)	Within 4,200 units at August peak Within 14,200 off peak
Tourist Sector	Within 5,000 at August peak (beneficial at all other times)	Within 4,000 at August peak (beneficial at all other times)	Within 3,000 at August peak (beneficial at all other times)	Within 2,000 units at August peak (beneficial at all other times)

Impact	Major	Moderate	Minor	Negligible
Private Rented Sector	Up to 10,200bedspaces (20% of stock – estimated annual turnover)	Up to 5,080 bedspaces (10% of stock)	Up to 2,540 units (5% of stock)	Within 1,270bedspaces (2.5 % of stock)
Owner Occupied Sector	Within 20% of annual turnover of owner-occupied sector	Within 15% of annual turnover	Within 10% of annual turnover	Within 5% of annual turnover
Latent Sector	Up to 1,200 additional units (c.100% of projected annual housing growth in three district area	Up to 900 additional units (c.75% of projected annual housing growth in three district area	Up to 600 additional units (c.50% of projected annual housing growth in three district area	Up to 300 additional units (c.25% of projected annual housing growth in three district area
Population Dynamics				
Population	effect of new non-home-based workers represents 50%+ of annual average new residents	effect of new non-home-based workers represents 20 to up to 50% of annual average new residents	effect of new non-home-based workers represents 10 to up to20% of annual average new residents	effect of new non-home-based workers represents less than 10% of annual average new residents
Public Services				
Education	Effect of new population if additional means exceeding current capacity in ward cluster, where baseline levels were not already exceeding capacity	Effect of new population if additional takes surplus capacity to within 5% of total capacity	Effect of new population if additional takes surplus capacity to within 10% of total capacity	Effect of new population if additional means no change to within 10% of surplus capacity, or no change from baseline significance
Leisure	Provision of major new facility/ies over and above planning requirement	Basic requirement met and additional contribution made to off site provision	Sports Facilities Calculator requirement provided on site and/or through S106	No impact on demand for or supply of sports provision
Police and Emergency Services	Increase of up to 20% in crime in the policing district	Increase of up to 10% in crime in the police district	Increase of up to 5% in crime in the policing district	Increase of up to 1% in crime in policing district
Health	Net increase in demand of 5+GPs	Net Increase in demand of 3 to 5 GPs	Net Increase in demand of 1 to 3 GPs	Net increase in demand equivalent to less than 1GP
Operational Impacts				
Employment	Increase >75% in employment in higher value added sectors in 3 district area	Increase of 50-75 % in employment in higher value added sectors in 3 district area	Increase of 25-50 % in employment in higher value added sectors in 3 district area	Increase of up to 25 % in employment in higher value added sectors in 3 district area

Impact	Major	Moderate	Minor	Negligible
Wider Economic Impact	To be assessed qualitatively	To be assessed qualitatively	To be assessed qualitatively	To be assessed qualitatively
Agricultural Land Use Impacts				
Loss of land and farming activity	Agricultural land lost represents > 10% of agricultural land in Somerset	Agricultural land lost represents 5-10% of agricultural land in Somerset	Agricultural land lost represents 1-5% of agricultural land in Somerset	Agricultural land lost represents < 1% of agricultural land in Somerset
Severance of farm units	Low significance on local farm units is considered given the design features and scale of the proposed development			
Direct economic impact of loss of agricultural land where in agri-environment schemes	No impact as financial arrangements have been made with land-holders for EDF Energy to acquire land.			

iii. Cumulative Effects

9.4.27 As part of the Stage 2 Consultation it was suggested by SDC and WSC in their joint response that the labour market impacts and the consequent impacts on demand for accommodation and public services/community facilities should be considered alongside the wider labour force requirements of the proposed off-site associated developments and the HPC development site. The interactive cumulative construction employment impacts of the HPC Project (i.e. the HPC development and all the associated developments) are assessed in **Volume 2**, **Chapter 9** of this ES. In addition, an assessment of the cumulative impacts of HPC project-wide development alongside external projects (i.e. construction/development projects elsewhere in the local area and region) is set out in **Volume 11**, **Chapter 6** of this ES.

9.4.28 The assessment of the socio-economic impacts follows IPC guidance for the potential effects to be based on evidenced impacts. In relation to the accommodation campuses at the HPC development site and in Bridgwater, West Somerset Council and Sedgemoor Council have made representations on potential impacts. The assessment of potential impacts of these campuses are contained in separate Chapters of this Environmental Assessment, although they are, in the main, qualitative. In recognition of this EDF Energy is taking a precautionary approach, and extensive measures to avoid, and where necessary mitigate impacts are proposed. These are described in the relevant chapters.

iv. Assessment of Likely Significant Effects

9.4.29 The assessment of likely significant socio-economic effects within the study assessment area has been undertaken by reference to the likely changes from the baseline conditions and the effects of those changes as a result of the proposed HPC Project. The assessment has considered the following potential effects:

- *Demographic change*: Changes in the local population level and structure. For example, there is likely to be a large non-home-based and male population during the construction phase, a proportion of whom could be accompanied by families; there would be smaller numbers with a longer term presence during the operational phase.

- *Direct and indirect employment change*: As above, changes in direct site employment levels will result in changes to employment levels in the local employment structure. These will depend on both project characteristics, and associated policies, but there is likely to be a major increase in local employment/opportunities. There will also be a multiplier effect with indirect (e.g. local supplier firms) and induced (e.g. local service jobs) effects from the HPC Project. There may also be some potential loss of labour from other local employers to the HPC Project.
- *Local expenditure effects*: Expenditure by the workforce, and from HPC contracts/payments, will lead to changes in spending in the local economy and possibly in the provision of local outlets. The proposed HPC Project could also help to offset the closure of existing Hinkley Point Power Station Complex (i.e. Hinkley Point A and Hinkley Point B).
- *Wider economic effects*: There could be potential effects on key economic sectors (e.g. construction, tourism), and on the development potential and image of the area.
- *Accommodation effects*: Increased demand for accommodation in the area, including local accommodation services such as B&Bs, guest houses and caravan sites; and the local housing market. The demand for local accommodation could have implications on residential property values.
- *Impact on local social conditions and associated services*: HPC Project-related demographic changes have the potential for impacts on local social conditions and associated services. For example, during construction there could be a change in demand for local health, school and policing services, and with possible issues for the local population (e.g. impact on school places, crime in the community; traffic flows/noise).
- *Other less tangible socio-cultural change*: Changes in the level and structure of employment and demographic changes potential could have the potential to affect quality of life, community character/cohesion and distributional effects. Parts of the local community may be differently affected by the development, or there could be a shift in the character of some communities (especially those close to or on key routes to the HPC project).
- **I***mpact on agricultural land and the agricultural economy and labour market*: This chapter includes an assessment of the socio-economic impact of the potential loss of agricultural land, severance within farm units, and the related direct and indirect socio-economic impacts. This assessment has not involved the undertaking of site surveys or detailed financial implications for individual farm units. The socio-economic receptors related to agricultural land are identified as the wider sub-regional economy, and site-specific features including individual farm units, in terms of disruption to farm operations, loss of land and severance of land/access.

v. Mitigation and enhancement

9.4.30 In parallel with the assessment process EDF Energy has been working with the local authorities and other public agencies to identify and plan for activities to avoid and/or mitigate any negative impacts from the development and to enhance positive effects in the construction phase and once HPC is operational.

9.4.31 Some of these actions are regarded by EDF Energy as basic good management practice and are therefore included as a part of the "central case" against which impacts are assessed. These for example include employment and training activities to secure local recruitment and a worker code of conduct to help govern worker behaviour. If, after undertaking these activities, significant adverse impacts are still assessed as likely, further mitigation measures are identified.

9.4.32 Where there are uncertainties, and conclusions on the significance of impacts would be sensitive to changes in assumptions or outcomes, EDF Energy has adopted a precautionary approach, establishing a monitoring system to enable impacts to be managed to avoid exceeding acceptable limits or setting in place thresholds after which additional mitigation measures would be triggered. This is an important element in the adaptive approach to assessment for this major project.

9.4.33 EDF Energy has produced a number of additional documents (which are separate stand alone application documents unless otherwise stated) which include implementation strategies which set out the actions that will be undertaken. These include:

- **Economic Strategy**, including:
  - Construction Workforce Development Strategy
  - Education Strategy (Inspire)
  - Project Supply Chain Engagement Strategy
  - Public Information Centre Management Strategy
- **Accommodation Strategy** (Including **Accommodation Management Plan**).
- **Community Safety Management Plan**
  - Summary document of Outline Contingency Response Arrangements (and associated Strategic Relationship protocols)
  - Worker Code of Conduct
- **Health Impact Assessment**, including Health Action Plan

9.4.34 Where likely impacts are identified but specific strategies not required, EDF Energy has identified required mitigation measures. These mitigation measures will be controlled through the use of Requirements and set out in the draft Section 106 agreement for the site preparation works and the **Section 106 Heads of Terms,** an Appendix to the **Planning Statement**.

9.4.35 These measures are listed in relation to the relevant impacts in **Section 9.7 and 9.8** of this chapter, and a summary of the likely significant residual effects, following the proposed mitigation and enhancements is provided.

vi. Limitations, Constraints and Assumptions

9.4.36 **Table 9.6** outlines the assumed activities and timescales, for the construction phase of the proposed development.

Table 9.6: Assumed Duration and Timescales of Construction and Operational Phase of the proposed development

Activity	Assumed Timescale
Enabling and Site Preparation Works	From Q2 2011
Site Campus	Construction: April 2013 to July 2014 Operation: July 2014 to May 2020 June 2020 to March 2021
Unit 1 Construction: Unit 2 Construction: Construction of Intermediate Waste and Spent Fuel Store	Q1 2013 to Q4 2018 Q2 2013 to Q2 2020 Q3 2018 to Q4
Operational Phase	From Q1 2019 and Q2 2020 for units 1 and 2 respectively and for approximately 60 years

9.4.37 In order to assess the likely impacts of HPC a Central Case has been produced for each of the construction and operational phases. These are set out below.

vii. Construction Central Case

9.4.38 The construction programme is likely to have the most significant, and complex, impacts and therefore a very detailed set of assumptions has been produced to support this assessment.

9.4.39 **Table 9.7** shows the likely profile of the workforce required to construct HPC. A full summary of the assumptions is contained in **Technical Note 1: Workforce Profile** (**Appendix 9A**) but the key points are:

- An assumed 108 month construction period for the main power station, with a further 30 months for the Spent Fuel Store and Intermediate Waste Storage Facility.
- The workforce is broken down between different contracts and skill types – civils, mechanical and electrical (M+E), professional, managerial, administrative and other, and operational staff to reflect different characteristics and enable an assessment of likely recruitment.
- A workforce build up from July 2011 for enabling and then site preparation works, with a step up after development consent for the HPC Project. If these dates move the phasing is likely to remain the same, as will the total workforce requirement with an extended completion date.
- The inclusion of associated development construction works within the "civils curve." Individual details for each site, including operations, are dealt with in the socio-economic chapter for each site (see **Volumes 3** to **10** of this ES).
- For the on-site accommodation campus the operational workforce, which is not included in the workforce profile, will be around 60 posts with a total headcount of around 115. Most of these workers will be part time working in catering and

cleaning. It is assumed that 95% of these workers will be home based. The non-home based workers (c.5 to 7) would be negligible in the context of the overall non-home based workforce.

- The numbers give an average daily workforce for each month expressed as Full Time Equivalents (FTE) and consistent with the proposed shift patterns.
- Given the nature of the construction programme most operatives are likely to be full time; although there is likely to be a significant turnover of workforce over the construction programme reflecting the requirement specialist contractors and skill types. This means that there are likely to be at least 20,000 to 25,000 different individual posts in the main 108 month construction period, with a peak headcount of 5,600.
- These numbers have informed EDF Energy's engagement with public authorities and others and also the **Accommodation Strategy** and workforce modelling for the **Transport Assessment**.

9.4.40 The table below provides figures for each year, and the main contract breakdowns. Year 10, follows the main nine year construction period with the workforce being mainly operational with a small remaining workforce required for the construction of the Spent Fuel Store/Intermediate Level Waste Store.

Table 9.7: Predicted Workforce by Main Contract Breakdowns by Year of Construction

Year	Month	Workforce	Civils	M+E	Prof. and man. and other	Operational	Campus Operational Staff not included in main workforce profile
1	4	180	130	0	40	0	
2	16	700	530	0	170	0	
3	28	2,980	2,240	0	740	0	
4	40	4,340	2,980	250	1,060	50	120
5	52	4,840	1,970	1,580	1,170	120	120
6	64	5,600	990	3,030	1,330	250	120
7	76	4,970	520	2,900	1,130	410	120
8	88	4,020	370	2,210	850	600	120
9	100	2,140	380	630	330	800	120
10	112	1,350	340	0	110	900	

Numbers may not add due to rounding

9.4.41 The project will, in the early stages, require a predominantly civil construction workforce, which will cover the site preparation works, the construction of the power station structure and of the associated development sites. Mechanical and electrical workers will begin to build up from around Month 36, and by the time of peak construction (month 64) will be by far the largest component of the workforce. Professional, managerial and other supporting roles will be in proportion to (approximately 15-25%), and follow the phasing of, the construction workforce.

Operational staff will build up over the construction period from around the beginning of year 3 (month 35), rising to a peak of 900 by completion of the power station.

9.4.42 It is anticipated that the workforce will peak at around 5,600 in the sixth year of the project.

Likely Recruitment: Home-Based and Non-home-based Workers

9.4.43 In order to assess the impacts of this workforce in the local area it is necessary to understand where the workforce is likely to be recruited from. This allows for the identification of the extent to which workers are “additional” to the current population, and impacts on labour markets at the local and regional scale.

9.4.44 This was achieved through the identification of the extent to which the workforce is expected to be split between home-based and non-home-based workers.

- Home-based-workers (HB) are those who live within 90 minutes of the HPC site (the Construction Daily Communing Zone (CDCZ)) and will commute daily to HPC from their home.
- Non-home-based (non-home-based) workers are those who will move to the South West to work at HPC.

9.4.45 The split between home-based and non-home-based workers for each construction contract package will vary depending on the skill levels required and the timing within the project of demand. A detailed description of the skills and labour market assessment used to identify the home-based/non-home-based split is set out in **Technical Note 1**. It should be noted that the assessment uses benchmarks of developments with active local employment training programmes and therefore assumes the implementation of a **Construction Workforce Development Strategy** as identified in the Mitigation section below.

9.4.46 **Table 9.8** below shows the assumed home-based/non-home-based split over the lifetime of the project. This shows that the split at the start of the construction phase will be close to even. Over time, as more specialised skills are required, with regional and national labour pools, and the overall workforce grows, the proportion of non-home based workers rises. Then, as the scheme moves towards completion the home based proportion rises significantly as the operational workforce, ultimately all of whom will be home based workers form the majority of the workforce. It should be noted that for each year these numbers form the central point in a range of plus or minus 10%. These figures are therefore used as the “central case” but the impact assessments below test thresholds and sensitivities should they vary.

Table 9.8: Estimated Breakdown of Home-Based and Non-Home-Based Workers by Month of Construction Period

Year	Month	Home-based	Non-home-based
1	4	51%	49%
2	16	45%	55%
3	28	45%	55%
4	40	42%	58%
5	52	39%	61%
6	64	34%	66%
7	76	35%	65%
8	88	37%	63%
9	100	43%	57%
10	112	82%	18%

Workforce Demographic Breakdowns

9.4.47 The breakdown of the workforce by different demographic categories – particularly age, gender and family status – could affect the type and significance of impacts on the local area. **Technical Note 2: Demographic Benchmarks** (**Appendix 9B**) sets out the source information for the demographic assumptions set out in this section.

Age and Gender

9.4.48 **Table 9.9** below which shows the likely gender and age split at the peak of construction.

9.4.49 This shows a likely gender split that is predominantly male reflecting the current profile of the construction industry (see **Appendix 9B**), with slightly higher female recruitment for home- based workers due to the employment profiles of the types of jobs that will be recruited locally (including administrative and support staff) and EDF Energy's commitment to seek to promote construction as a career to all groups as part of the **Construction Workforce Development Strategy, Appendix C to the Economic Strategy**. The age profile is split relatively evenly between the three broad age groups.

Table 9.9: Estimated Gender and Age Breakdown of Home-Based and Non-home-based Workers at Peak Construction

	Home-Based		Non-home-based		All	
Age	Male	Female	Male	Female	Male	Female
Under 35	570	90	1,180	130	1,750	220
35-49	610	100	1,220	140	1,830	240
50+	470	70	920	110	1,390	180
All Ages	1,650	260	3,320	380	4,970	640
%age	86%	14%	90%	10%	89%	11%

Numbers may not add due to rounding

Family Type Households/Households with Dependents

9.4.50 **Table 9.10** shows the likely number of family type households/households with dependent children based on assumptions from the monitoring of Sizewell B, validated against recent data on moving groups and the composition of in-migrant households. This is again based on peak workforce. For each group this reflects a central point in a range. Thresholds and sensitivities are dealt with under relevant impacts.

Table 9.10: Estimated Non-Home Based Family Type Households and Children at Peak Construction

	TOTAL
Family Type Households	500
Non-Worker Adults	600
All Children	425
Pre-school	85
All School Age	298
Primary Age	174
Sec. Age	124
16 to 18	43

Other Demographic Breakdowns

9.4.51 There are two other demographic groups identified under the Equalities Act for which there is benchmark data available at a national and regional level. These are people with disabilities and ethnic/national groups.

9.4.52 **Technical Note 2** identifies the proportions of each of these groups in the UK and regional levels.

9.4.53 Currently 1% of the construction workforce in the South West is identified as being from a Black and Minority Ethnic Group and 1% from outside the UK. These proportions are higher for the country as a whole and on major projects can vary greatly. It is therefore not possible to set a likely benchmark for these groups for the HPC project.

9.4.54 There are a number of definitions of disability which are discussed in **Technical Note 2**. These suggest a range, depending on definition and method of reporting, from under 2% of the workforce of some major projects being disabled to up to 15% based on a wider definition and survey based method from the Labour Force Survey. A benchmark has therefore not been set in this assessment but EDF Energy will monitor recruitment and meet its legal requirements in relation to disabled workers.

Accommodation Assumptions and Spatial Distribution of the Workforce

9.4.55 The detailed background context for assumptions on the split of the HPC workforce between different types of accommodation and across the area are set out in **Technical Notes 3 and 4: Spatial Distribution and Accommodation Datasets**.

9.4.56 **Technical Note 3** uses the accommodation baseline to identify the capacity to accommodate non-home-based workers within a 60 minute travel zone of HPC, which is based on park and ride combined with a direct bus strategy for key clusters, as set out in the **Transport Assessment**.

9.4.57 **Technical Note 4** splits capacity between four broad types; tourist accommodation; private rented accommodation; owner occupied property; and latent accommodation, taking into account affordability. It also assumes the development of the three purpose built accommodation campuses as set out in the development description and individual assessments for the specific associated development sites, and that these will be filled to 97% occupancy to allow for some turnover.

Table 9.11: Accommodation Capacity Assumptions for Gravity Model at Peak Construction

Type	%	Number
Campus	39%	1,450
Tourist Accommodation	16%	600
Private Rented	20%	750
Owner Occupied	14%	500
Latent Accommodation	11%	400
TOTAL Non-home-based		**3,700**

9.4.58 The assumed split between types is shown in **Table 9.11**, above. The note also identifies the likely Home Based HPC labour force in the CDCZ using occupational data from the census. This capacity is fed into a “Gravity Model” which distributes the workforce across the 60 minute area based on this capacity and a “distance decay” function.

9.4.59 **Technical Notes 3 and 4** describe how this population would, on the basis of this model, spread spatially, across the 60 minute travel zone. This includes the spread between the main settlements in the area and between the different types of housing.

9.4.60 The outcome of this assessment for non-home-based workers is set out in **Table** 9.12 below. It should be noted that this is a “central case” to allow the assessment and, where necessary mitigation, of impacts, and the assessments below will test sensitivities and thresholds against relevant impacts.

Table 9.12: Non-home-based Workforce by Settlement Cluster and Accommodation Type, Central Case at Peak Construction

	Latent	Tourist	Private Rented	Owner Occupied	Campus	All
Bridgwater	140	70	110	110	970	1,400
Burnham and Highbridge	40	200	60	70	–	370
Cannington	30	30	20	40	–	120
Cheddar	10	40	10	10	–	70
Glastonbury	0	40	20	20	–	80
Hinkley Point/Stogursey	0	0	10	10	480	500
Minehead	20	50	30	20	–	120
Somerset South	0	10	30	20	–	60

	Latent	Tourist	Private Rented	Owner Occupied	Campus	All
Somerset West	0	10	10	0	–	20
Taunton	120	30	130	80	–	360
Watchet and Williton	40	60	30	20	–	150
Weston-super-Mare	0	70	290	100	–	460
TOTAL	**400**	**600**	**750**	**500**	**1,450**	**3,700**

9.4.61 For home based-workers, where precise ward based location is less sensitive for the purposes of socio-economic assessment (as the population is not additional to the area) the following assumptions have been identified on the basis of the assessment areas identified. The range shows the assessments based on the transport gravity model and an alternative based on experience at Sizewell. For the three districts the estimates are within 10%, with slightly greater but not significant variation for the rest of Somerset (the current administrative County) and the rest of the CDCZ.

Table 9.13: Home-Based Workforce by Broad Area at Peak Construction

	Number of Workers
3 Districts (West Somerset, Sedgemoor and Taunton)	900 to 970
Rest of Somerset	230 to 290
Rest of CDCZ	640 to 760

viii. Operational Workforce Central Case

9.4.62 The operational workforce of the completed power station, with both reactors in operation, is approximately 700 direct EDF Energy employees and up to 200 contract staff – totalling 900. The contractor support also increases significantly to over 1,000 for during each unit's refuelling outage (approximately every 15-18 months).

9.4.63 This workforce will have built up during the construction of HPC and are therefore included within the workforce profile described above.

ix. Other Assumptions

9.4.64 The assessment of effects expected to arise from the proposed development is carried out against socio-economic baseline conditions as defined by the data sources referenced above. As with any dataset they represent a set point in time and can change due to wider changes in economic conditions or demographic trends. As far as possible the assessment has aimed to reflect the dynamic nature of this environment by using future projections and identifying sensitivities to change. The assessment is also being undertaken at a time of rapidly evolving policy change at all levels of government.

9.4.65 **Table 9.6** outlines the assumed activities and, timescales, for the construction phase of the proposed development which forms the basis of the central case.

9.4.66 Given the long timescale involved, with construction expected to run from 2011 to 2019 when unit 1 is operational and 2020 when unit 2 is operational, and an operational life of 60 years for each reactor, there is the potential for variation. This is partly handled by the inclusion of ranges and consideration of alternative scenarios in several estimates. The proposed HPC Project should however, be the subject of regular monitoring and revisions may be required as new information becomes available. An adaptive assessment process is required, using a 'plan-monitor–management' approach.

9.4.67 The predictions of impacts are primarily for peak construction and full operation. The latter should be relevant for much of the operational life of the station. For the former, the shoulders and peak construction may apply to only about three years (c mid 2014-mid 2017) of a nine year programme. However, predictions for peak construction provide an important indicator of the maximum effects, and a justifiable precautionary approach.

9.5 Local Area: Socio-Economic Baseline

a) Introduction

9.5.1 This section of the ES describes the socio-economic baseline for the HPC Project and summarises key characteristics of the local area's socio-economic baseline, including demographics, economy and employment, accommodation, education, health and other community facilities.

b) Baseline Characteristics

i. Population and Population Density

9.5.2 The three immediate districts of Sedgemoor, Taunton Deane and West Somerset have a combined population of 256,200 (ONS, mid-2009 population estimates). Sedgemoor (112,100) and Taunton Deane (108,700) are of a roughly similar population size, whilst West Somerset has a much smaller population (35,400).

9.5.3 The largest settlements in the area are Weston-super-Mare (mid-2009 population 79,200), Taunton (54,200) Bridgwater (36,200) and Burnham-on-Sea/Highbridge (19,100).The smaller settlements of Minehead (population, 10,100) and Watchet/Williton (6,600) are located in West Somerset. **Figure 9.2** identifies population density by output area for the 60-minute travel distance area, highlighting the key settlements in the area.

9.5.4 Sedgemoor and West Somerset are predominantly rural districts, with relatively low population densities. Taunton Deane is also significantly rural in nature, but has a higher proportion of its population in larger urban settlements (the Taunton and Wellington urban areas).

9.5.5 **Table 9.14** summarises the total population and population density in each of the three districts; in the overall study including the 60-minute travel distance and CDCZ; and the major urban areas within the ward clusters.

Table 9.14: Population and Population Density in Districts, Wards and Urban Areas

Area	Total Population	Area Size (Ha)	Population Density
Districts			
Sedgemoor	112,100	56,436	2.0
Taunton Deane	108,700	46,236	2.4
West Somerset	35,400	72,535	0.5
Study Area			
60-Minute Travel Distance	410,329	148,024	2.5
CDCZ	2,388,400	990,698	2.4
Ward Clusters			
Bridgwater	50,380	13,651	3.7
Burnham and Highbridge	41,353	23,540	1.8
Cannington	7,142	12,315	0.6
Cheddar	11,026	7,706	1.4
Glastonbury	29,182	20,062	1.5
Hinkley Point	2,104	6,144	0.3
Minehead	17,405	19,736	0.9
Somerset South	28,264	26,532	1.1
Somerset West	10,031	32,291	0.3
Taunton	77,748	11,068	7.0
Watchet and Williton	11,026	14,035	0.8
Weston-super-Mare	124,668	16,844	7.4
Wider Scales			
Somerset	523,500	345,055	1.5
South West	5,231,200	2,383,674	2.2
England	51,809,700	13,027,872	4.0

Source: ONS, mid-year population estimates, 2010

ii. Age and Gender Profile

9.5.6 The three immediate districts have higher proportions of older people, and lower proportions of working age people, compared with the national average. This disparity is particularly striking in West Somerset district, where 29% of the population is above working age (60/64 years or over) compared with a regional average of only 19%. This is outlined in **Table 9.15** below.

9.5.7 Overall, the 60-minute area has a slightly higher than national average proportion of working-age residents, a lower proportion of children and a higher proportion of older people. In terms of the urban areas within this study area, Minehead, Watchet/Williton and Burnham-on-Sea/Highbridge have disproportionately older populations compared to other scales. The proportion of males to females is generally consistent across the 60-minute travel area and CDCZ with wider scales (approx 49:51), although there are some variations at lower spatial scales:

Table 9.15: Age Profile

Area	% Children (0-15)	% Working Age (16-59/64)	% Older People (Age 60/64+)	Gender (M:F)
Districts				
Sedgemoor	18.3%	57.5%	24.2%	49:51
Taunton Deane	18.6%	57.9%	23.5%	48:52
West Somerset	14.2%	51.6%	34.2%	48:52
Urban Areas				
Bridgwater	18.8%	65.4%	15.8%	49:51
Taunton	17.1%	63.7%	19.3%	48:52
Weston-super-Mare	17.1%	63.5%	19.4%	49:51
Watchet/Williton	16.1%	59.0%	24.9%	48:52
Minehead	13.1%	54.3%	32.6%	46:54
Burnham-on-Sea/Highbridge	14.9%	58.4%	26.7%	48:52
Wellington	18.1%	60.8%	21.1%	48:52
Cheddar	15.9%	61.8%	22.3%	48:52
Ward Clusters				
Bridgwater	18.2%	64.9%	16.9%	49:51
Burnham and Highbridge	15.6%	60.1%	24.3%	48:52
Cannington	15.5%	61.7%	22.8%	50:50
Cheddar	16.9%	62.5%	20.7%	48:52
Glastonbury	17.0%	62.4%	20.6%	49:51
Hinkley Point and Stogursey	14.5%	58.0%	27.5%	50:50
Minehead	12.5%	56.1%	31.5%	47:53
Somerset South	16.6%	60.9%	22.5%	48:52
Somerset West	15.8%	61.7%	22.5%	50:50
Taunton	17.3%	63.4%	19.2%	48:52
Watchet and Williton	14.4%	58.9%	26.7%	48:52
Weston-super-Mare	16.9%	63.4%	19.7%	49:51
Study Area				
60-Minute Travel Distance	16.7%	62.4%	20.9%	49:51
CDCZ	17.6%	60.3%	22.1%	49:51
Wider Scales				
Somerset	16.9%	62.2%	20.9%	49:51
South West	16.4%	64.2%	19.3%	49:51
England	17.5%	66.2%	16.3%	49:51

Source: ONS, mid-year population estimates, 2009

iii. Recent Population Growth

9.5.8 The population of the three immediate districts increased by an estimated 9,850, or 4%, between mid-2001 and mid-2009. This rate of population growth is similar to the Somerset average (5.0%), but slightly below the South West average (5.8%). Within this area, population growth has been concentrated mainly in Sedgemoor (an increase of 5,001 or 4.7%) and Taunton Deane (an increase of 4,777 or 4.6%). The population of West Somerset increased by only about 100 persons, or 0.2%, between 2001 and 2009. Recent population growth in the Bridgwater area has been in the region of 3,400 people, or 7.2% since 2001.

Table 9.16: Distribution and Growth of Resident Population in Immediate Districts, 2001-2009

Area	Mid-2001	Mid-2009	% Growth
Districts			
Sedgemoor	106,000	112,100	5.8%
Taunton Deane	102,600	108,700	5.9%
West Somerset	35,100	35,400	0.9%
Ward Clusters			
Bridgwater	47,001	50,380	7.2%
Burnham and Highbridge	40,512	41,353	2.1%
Cannington	7,013	7,142	1.8%
Cheddar	10,507	11,026	4.9%
Glastonbury	27,866	29,182	4.7%
Hinkley Point and Stogursey	2,078	2,104	1.3%
Minehead	17,369	17,405	0.2%
Somerset South	27,881	28,264	1.4%
Somerset West	9,692	10,031	3.5%
Taunton	73,680	77,748	5.5%
Watchet and Williton	11,110	11,026	-0.8%
Weston-super-Mare	113,927	124,668	9.4%
Study Area			
60-Minute Travel Distance	388,636	410,329	5.6%
CDCZ	2,238,500	2,388,400	6.7%
Wider Scales			
Somerset	498,700	523,500	5.0%
South West	4,943,400	5,231,200	5.8%
England	49,449,700	51,809,700	4.8%

Source: ONS, mid-year population estimates

9.5.9 The latest official 2008-based sub-national population projections for local authority areas were published by ONS in May 2010 (Ref. 9.57). These provide trend-based projections for the twenty five year period from 2008 to 2033, although the focus here is on projected population change from 2008 to 2018, as this is considered to be more relevant to the likely timescale of the Hinkley Point development.

9.5.10 The latest projections for the immediate districts are summarized in **Table 9.17**. Future population growth in Sedgemoor and Taunton Deane is expected to be similar to the national average, but below projected growth in the South West region. Projected growth is higher in Sedgemoor (8.1%) than Taunton Deane (6.7%). Future population growth is expected to be much slower in West Somerset, amounting to an increase of only 3.1% between 2008 and 2018. In absolute terms, the overall population growth in the three immediate districts is expected to be 17,500 between 2008 and 2018, equivalent to a net increase of 1,750 per annum. This overall increase is expected to be distributed as follows:

- Sedgemoor – an overall increase of 9,100, or 910 per annum.
- Taunton Deane – an increase of 7,300, or 730 per annum.
- West Somerset – an increase of 1,100, or 110 per annum.

Table 9.17: Sub-National Population Projections, 2008-2018

Area	Mid-2008	2018	% Growth
Districts			
Sedgemoor	112,300	121,400	8.1%
Taunton Deane	108,600	115,900	6.7%
West Somerset	35,600	36,700	3.1%
Sub Total	*256,500*	*274,000*	*6.8%*
Wider Scale			
Somerset	524,200	558,700	6.6%
South West	5,210,400	5,647,300	8.4%
England	51,464,600	55,252,200	7.4%

Source: ONS, 2008-Based Sub-National Population Projections (published May 2010).

9.5.11 The sub-national projections indicate future changes in the age structure of the population, with a roughly static working age population and significant growth in the numbers above working age. These changes in age structure are expected to be more marked in the immediate districts than at the regional or national level. The overall population growth between 2008 and 2018 in the three districts is expected to be divided by broad age group as follows:

- *Children (aged 0-15 years*) – numbers in this age group are expected to increase by 1,200, or 2.6%, between 2008 and 2018. This is well below the projected rate of growth in the South West (5.5%) and nationally (7.2%). Numbers in this age group are expected to decline in West Somerset, but this will be offset by growth in Sedgemoor and Taunton Deane.
- *Working age population (16 to 59/64 years)* – numbers are expected to increase by only around 400 or 0.3% between 2008 and 2018. Again, this is significantly below the projected rates of growth at regional (4.0%) and national level (3.7%). Growth in Sedgemoor and Taunton Deane will again offset a projected decline in the working age population in West Somerset.

- *Above retirement age (60/64 years and over)* – growth in this age group is expected to account for the bulk of the overall projected population increase. Numbers above retirement age are forecast to increase by 15,900by 2018. This is above the forecast rates of increase in the South West (22.4%) and nationally (19.3%). Those above retirement age are expected to account for 91% of the projected population growth in the three immediate districts between 2008 and 2018. This compares with only 60% in the South West and 50% in England as a whole.

Table 9.18: Sub-National Population Projections, by Age Group 2008-2018

Area	% Growth 0-15	% Growth 15-60/65	% Growth 60/65+
Districts			
Sedgemoor	4%	2%	32%
Taunton Deane	5%	0%	28%
West Somerset	-2%	-7%	27%
Wider Scale			
Somerset	2%	-1%	32%
South West	6%	4%	22%
England	7%	4%	19%

Source: ONS, 2008-Based Sub-National Population Projections (published May 2010). Figures are trend-based projections; they show what the population will be if recent trends continue.

iv. Migration

9.5.12 The latest statistics on internal migration (Ref. 9.58) flows at local authority area level are for mid-2008 to mid-2009. The migration data for 2008/09 shows an annual net inflow of around 300 persons into Sedgemoor, 600 into Taunton Deane and 100 into West Somerset (**Table 9.19**).

9.5.13 This overall inflow of population conceals a net outward migration of young people in the 16-24 age group; in 2008/09, this amounted to a net outflow of around 300 young people from Sedgemoor, 200 from Taunton Deane and 100 from West Somerset. This is significant for the retention of a young and future working age population.

Table 9.19: Internal Migration Flows: Immediate Districts, 2008-2009

Area	Migration into District	Migration out of District	Migration Net Flow
Sedgemoor	4,700	4,400	+ 300
Taunton Deane	5,200	4,600	+ 600
West Somerset	2,000	1,900	+ 100
South Somerset	6,400	6,000	+ 400
Mendip	5,100	4,800	+ 300

Source: ONS, annual estimates of internal migration flows for local authority areas. Totals may not sum exactly due to rounding.

9.5.14 This population is relatively dynamic and mobile. Every year just under 7% of households move either within, to or from the area. The table above shows significant population flows in and out of the Districts each year.

9.5.15 National Insurance Number (NINO) registrations for foreign national adults in the three districts covered by the HPC assessments rose significantly from around 350 in total in 2002 to around 2,100 in 2007(Ref. 9.59). They have since fallen back to around 1,500 in 2009, but still above previous levels. These numbers do not track whether migrants become permanent residents or the duration of their stay. Many will be temporary seasonal workers. However, in the context of annual migration figures described above they still form a minority of migration to the south west.

v. Baseline Dynamics

9.5.16 A baseline study has been conducted to identify, on a ward-cluster basis, the turnover in population and jobs at a local scale using Census Moving Groups (2001) analysis for population turnover and by applying average job turnover for the UK (OECD, 2010) (Ref. 9.60) to the surveyed jobs (Annual Business Inquiry (ABI)/ Business Register Employment Survey (BRES, 2009) in each ward cluster. The following table outlines this estimate for the twelve ward clusters:

Table 9.20: Population and Jobs Turnover in Ward Clusters

Ward Cluster	% New Residents in 2001	Total New Residents in 2001	Jobs Turnover Estimate @ 15-20% (per year)
Bridgwater	5.5%	2,461	3,200 – 4,200
Burnham and Highbridge	7.0%	2,701	1,700 – 2,200
Cannington	8.1%	556	200 – 300
Cheddar	7.2%	725	500 – 700
Glastonbury	8.2%	2,188	1,600 -2,100
Hinkley Point and Stogursey	6.5%	134	170 – 230
Minehead	8.7%	1,408	900 – 1,300
Somerset South	7.5%	2,009	1,000 – 1,300
Somerset West	8.0%	836	400 – 500
Taunton	8.1%	5,380	6,300 – 8,400
Watchet and Williton	7.0%	757	300 – 400
Weston-super-Mare	5.5%	6,049	6,200 – 8,300

Source: 2001 Census Moving Groups; 2009 ABI/BRES

9.5.17 The population is relatively dynamic and mobile. Every year just under 7% of households move either within, to or from the 60 minute area. These flows are not uniform across housing tenures. Households in owner occupied family housing are much less likely to move (6% each year) compared to households in the Private Rented Sector (PRS) where 20% move. The high level of dynamism could be linked to the strength of tourist and agricultural economies in the area, which rely extensively on a seasonal and migratory workforce.

9.5.18 This dynamism means the local area is able to cope with outages every 15-18 months at the existing Hinkley Point B station. Outages can have a substantial non-home-based workforce of up to 1,000 workers. These are absorbed by the local accommodation market without significant difficulties.

vi. Employment

9.5.19 The latest employment estimates for the immediate districts are for the end of 2009. At that time, there were an estimated 99,700 employee jobs in the three immediate districts, although total employment including self-employed jobs was somewhat higher, at an estimated 125,000. Just over half of these jobs (around 64,000) are located in Taunton Deane district, with most of the remainder (around 45,000) in Sedgemoor. Employment is much smaller in West Somerset district, at an estimated 16,000 jobs in 2009. Employment levels in the CDCZ are estimated at 1,095,734 jobs, which represent just about one half of the South West regional total (2.16 million jobs).

9.5.20 The main concentrations of employment within the immediate districts are located in the main urban centres of Weston-super-Mare (27,800 jobs), Taunton (33,800 employee jobs) and Bridgwater (17,200 employee jobs). Smaller centres of employment are located in Burnham-on-Sea/Highbridge (6,400 jobs), Minehead (3,800) and Wellington (3,600).

Table 9.21: Employment Estimates: Immediate Districts, 2009

Area	Employee Jobs (ABI estimate)	Total Jobs (including self-employed jobs)
Districts		
Sedgemoor	37,600	45,000
Taunton Deane	51,500	64,000
West Somerset	10,500	16,000
Study Areas		
CDCZ	1,095,734	1,282,000
60-Minute Travel Distance	145,300	N/A
Urban Areas		
Bridgwater	17,200	N/A
Taunton	33,800	N/A
Weston-super-Mare	27,800	N/A
Watchet/Williton	1,600	N/A
Minehead	3,800	N/A
Burnham-on-Sea/Highbridge	6,400	N/A
Wellington	3,600	N/A
Cheddar	2,700	N/A
Wider Scales		
Somerset	201,400	256,000
South West	2,166,300	2,717,000
England	21,630,000	26,246,000

Source: Annual Business Inquiry/BRES (2009, NOMIS) and annual estimates of jobs density and total jobs. ABI estimates include only employee jobs. Estimates of total jobs include employee jobs, self employed jobs, HM Forces and government-supported trainees.

9.5.21 ABI-based estimates indicate relatively strong recent employee job growth in the three immediate districts. The number of employee jobs in the immediate districts increased by an estimated 9,800 or 10.1% between 2001 and 2008. The table below shows the change in employment levels between 2001 and 2008, as changes in the sectoral classification in most recent (2009) data prevents transparent comparison of industrial sectors. This compares with increases of 6.8% in the South West region and only 4.4% in England. The rate of job growth has been particularly strong in Sedgemoor District (an increase of 13.5%) and to a lesser extent in Taunton Deane (9.5%). Much slower growth has been experienced in West Somerset (only 2.5% between 2001 and 2008). Recent employee job growth in the wider 90 minute commuting zone (7.5% between 2001 and 2008) has been slightly below the regional average (6.8%).

Table 9.22: Estimated Employee Job Growth, 2001-2008

Area	Employee Jobs, Dec 2001	Employee Jobs, Dec 2008	% Growth, 2001-2008
Districts			
Sedgemoor	35,600	40,400	13.5%
Taunton Deane	50,200	55,000	9.5%
West Somerset	11,100	11,400	2.5%
Sub Total	*96,900*	*106,700*	*10.1%*
Study Areas			
60-Minute Travel Distance	140,317	149,377	6.5%
CDCZ	1,012,868	1,088,696	7.5%
Urban Areas			
Bridgwater	18,600	17,500	-5.9%
Taunton	33,700	35,800	6.4%
Weston-super-Mare	28,200	29,300	3.6%
Watchet/Williton	1,900	1,700	-8.1%
Minehead	3,300	3,800	16.6%
Burnham-on-Sea/Highbridge	6,000	7,400	23.0%
Wellington	3,900	3,800	-2.0%
Cheddar	2,200	2,700	19.2%
Wider Scales			
Somerset	196,300	215,600	9.8%
South West	2,098,600	2,240,600	6.8%
England	22,100,900	23,073,700	4.4%

Source: Annual Business Inquiry (NOMIS). Figures exclude self employed jobs.

9.5.22 **Table 9.23** provides a more detailed breakdown of recent employment change in the immediate districts by broad industry sector. The figures include only employee jobs and exclude self-employed workers. Employment growth during the period 2001-2008 occurred mainly in financial, IT and other business services (net growth of

3,900 jobs) and education and health services (net growth of 4,300 jobs). Significant job growth also took place in the construction sector (1,700 jobs) and wholesale and retail distribution (1,600 jobs). Employment losses were experienced in the manufacturing sector (almost 1,900 net job losses) and mining/quarrying and electricity, gas and water supply (almost 600 net job losses in these combined sectors). Small employment losses were also recorded in the hotels/restaurants sector (200 jobs) and transport, storage and communications (200 jobs):

Table 9.23: Employment Change by Industry Sector: Immediate Districts (Sedgemoor, Taunton Deane and West Somerset) 2001-2008

Sector	2001	2008	Change
Agriculture, Forestry and Fishing; Mining and Quarrying, Utilities	4,075	3,682	-393
Manufacturing	11,903	10,036	-1,867
Construction	2,805	4,554	+ 1,749
Wholesale and Retail Distribution	19,136	20,712	+ 1,576
Hotels and Restaurants	9,784	9,542	-242
Transport, Storage and Communication	4,566	4,321	-245
Financial, IT and Other Business Services	11,102	15,034	+ 3,932
Public Admin/Defence	6,157	6,809	+ 652
Education and Health	22,780	27,063	+ 4,283
Other Service Activities	4,602	4,988	+ 386
Total: All Industries	96,910	106,741	+ 9,831
Tourism-related Sectors	10,919	10,774	-145

Source: Office for National Statistics, Annual Business Inquiry (NOMIS). Employment figures exclude the self employed, government-supported trainees and HM Forces. Tourism-related sectors are defined as the following 2003 SIC categories: 55.1 to 55.4 (hotels; camping sites and other short-stay accommodation; restaurants; bars), 63.3 (travel agencies and tour operators; tourist assistance activities) and 92.5 to 92.7 (library, archives, museums and other cultural activities; sporting activities; other recreational activities)

9.5.23 **Table 9.24** provides a breakdown of employment by broad industry sector for the three immediate districts. Separate breakdowns for each of the three districts are provided in **Table 9.25**.

Table 9.24: Employment by Industry Sector: Immediate Districts (Sedgemoor, Taunton Deane and West Somerset), 2008

Sector	Employee Jobs	% of Total	England %
Agriculture, Forestry and Fishing; Mining and Quarrying, Utilities	3,682	3.4%	1.4%
Manufacturing	10,036	9.4%	10.1%
Construction	4,554	4.3%	4.6%
Wholesale and Retail Distribution	20,712	19.4%	16.8%
Hotels and Restaurants	9,542	8.9%	6.7%
Transport, Storage and Communication	4,321	4.0%	6.0%
Financial, IT and Other Business Services	15,034	14.1%	22.7%
Public Admin/Defence	6,809	6.4%	5.2%
Education and Health	27,063	25.4%	21.2%
Other Service Activities	4,988	4.7%	5.3%

Sector	Employee Jobs	% of Total	England %
Total: All Industries	106,741	100.0%	100.0%
Tourism-related Sectors	10,774	10.1%	8.1%

Source: Office for National Statistics, Annual Business Inquiry (NOMIS). Employment figures exclude the self employed, government-supported trainees and HM Forces. Tourism-related sectors are defined as the following 2003 SIC categories: 55.1 to 55.4 (hotels; camping sites and other short-stay accommodation; restaurants; bars), 63.3 (travel agencies and tour operators; tourist assistance activities) and 92.5 to 92.7 (library, archives, museums and other cultural activities; sporting activities; other recreational activities)

Table 9.25: Employment by Industry Sector: Immediate Districts (Sedgemoor, Taunton Deane and West Somerset), 2008

Sector	Sedgemoor	Taunton Deane	West Somerset
Agriculture, Forestry and Fishing; Mining and Quarrying, Utilities	3.0%	2.3%	10.8%
Manufacturing	14.0%	6.4%	7.6%
Construction	4.6%	4.1%	3.6%
Wholesale and Retail Distribution	19.3%	20.1%	16.6%
Hotels and Restaurants	9.5%	5.9%	21.8%
Transport, Storage and Communication	6.5%	2.6%	2.3%
Financial, IT and Other Business Services	14.8%	14.9%	7.3%
Public Admin/Defence	2.3%	10.2%	2.2%
Education and Health	21.9%	28.6%	21.9%
Other Service Activities	4.2%	4.8%	5.9%
Tourism-related Sectors	9.8%	7.2%	25.0%

Source: Office for National Statistics, Annual Business Inquiry (NOMIS). Employment figures exclude the self-employed, government-supported trainees and HM Forces. Tourism-related sectors are defined as the following 2003 SIC categories: 55.1 to 55.4 (hotels; camping sites and other short-stay accommodation; restaurants; bars), 63.3 (travel agencies and tour operators; tourist assistance activities) and 92.5 to 92.7 (library, archives, museums and other cultural activities; sporting activities; other recreational activities)

9.5.24 The structure of employment in the immediate districts differs in a number of respects from the national average, with low representation in financial, IT and other business service activities and a greater dependence on employment in public sector services such as education and health. Compared with the national average, the immediate districts have an above average share of employment in the following broad activities:

- Agriculture, forestry and fishing, mining and quarrying, and electricity, gas and water supply – these combined sectors account for 3.4% of employee jobs in the immediate districts, compared with only 1.4% nationally;
- Wholesale and retail distribution – accounts for 19.4% of employee jobs, compared with 16.8% nationally;
- Hotels and restaurants – accounts for 8.9% of employee jobs, compared with 6.7% nationally; and,

- Public administration, defence, education, health and social services – these combined sectors, which primarily comprise public sector services, account for almost one third (31.8%) of employee jobs in the three districts, compared with 26.4% nationally.

9.5.25 Employment sectors under-represented in the local economy include transport, storage and communications (accounting for 4.0% of employee jobs, compared with 6.0% nationally), and financial, IT and other business services (which account for only 14.1% of employee jobs, compared with a national average of 22.7%). Employment levels in manufacturing, construction and other service activities are broadly similar to the national average.

9.5.26 Tourism-related sectors account for an estimated 10,800 employee jobs in the immediate districts, representing 10.1% of total employment. This compares with a national average of 8.1% (**Table 9.24** and **Table 9.25**). The significance of employment in tourism-related sectors shows wide variations across the immediate districts. Tourism-related employment is particularly important to the West Somerset economy, accounting for an estimated 25.0% of employee jobs in the district. The figures for Sedgemoor (9.8%) and Taunton Deane (7.2%) are much lower (**Table** 9.25).

9.5.27 Within this overall picture, there are detailed differences in the importance of specific sectors between the three immediate districts. Sedgemoor has much higher shares of employment in manufacturing and transport, storage and communications than the other two districts. Taunton Deane‘s employment base is particularly dependent on public sector services, including education and health, whilst the West Somerset economy is much more dependent on agriculture, forestry and fishing, electricity, gas and water supply, and hotels and catering. The proportion of employment in financial, IT and other business service activities is particularly low in West Somerset.

9.5.28 There are around 832 jobs in the three district area in the 20 highest-GVA-per-worker 4-digit SIC industrial sectors in the UK, which includes 563 jobs in ‘electric power generation, transmission’ which are likely to be attributed to the existing facilities at Hinkley Point.

9.5.29 There were around 4,500 employee jobs in the construction sector in the immediate districts at the end of 2008, plus a further 2,100 employee jobs in the related activities of architecture, engineering and technical consultancy. These employment estimates pre-date the more recent slowdown in the construction industry, although they exclude self-employed jobs. In the immediate districts and the CDCZ, around half of construction sector jobs are in the civil engineering sector. The breakdown of employment in construction and related activities (civil engineering and related technical activities) is presented in the following table.

Table 9.26: Employment in Construction and Related Activities, 2008

Sector	Construction Sector (SIC 45)	Of which: Civil Engineering (SIC 45.1)	Related Technical Services (SIC 74.2)
Districts			
Sedgemoor	1,870	947	479
Taunton Deane	2,279	1,366	1,546
West Somerset	405	207	54
Sub-Total	*4,554*	*2,520*	*2,079*
Wider Scales			
Somerset	9,366	4,967	3,435
CDCZ	47,996	24,406	20,510
South West	98,835	49,627	36,473

Source: Office for National Statistics, Annual Business Inquiry (NOMIS). Employment figures exclude self employed workers.

9.5.30 Compared with the national average, the three immediate districts have a lower proportion of residents in senior managerial and professional occupations (29% compared with a national average of 30%) and in associate professional and technical occupations (14% compared with 15% nationally). However, the proportion of residents in skilled manual trades (12%) is slightly above the national average (10%). Numbers employed in personal service, sales and customer service occupations (18%) are higher than the national average (16%).

Table 9.27: Residents in Employment by Occupation, 2010

Occupational Group	Sedgemoor, West Somerset and Taunton Deane	CDCZ	National (England)
Managers/senior officials and professional	29.4%	29.9%	30.2%
Associate professional and technical	13.7%	14.8%	14.8%
Administrative/secretarial	7.1%	10.3%	10.8%
Skilled trades	11.6%	11.3%	10.1%
Of which: metal and electrical skilled trades	*1.4%*	*4.1%*	*3.7%*
Of which: construction and building skilled trades	*3.3%*	*3.2%*	*3.5%*
Personal service; sales and customer service	17.8%	16.4%	16.1%
Process, plant and machine operatives	6.5%	5.9%	6.5%
Elementary (unskilled) occupations	11.9%	10.8%	11.1%

Source: Office for National Statistics, Annual Population Survey (based on survey data for the January to December 2009 period)

vii. Labour Supply and Profile

Construction Labour Supply

9.5.31 **Technical Note 1: Workforce Profile** (**Appendix 9A**), and the central case assessment described above, splits the construction labour force into two broad groups. Those who already live in the area and will travel to work on a daily basis from their existing home – home based workers – and those who will move into the area temporarily to work on the construction project – non-home based workers.

9.5.32 The area in which home based workers is likely to be recruited is the Construction Daily Commuting Zone (CDCZ) area involves consideration of a number of factors which affect workers willingness to commute daily to the site. EDF Energy's analysis of these factors includes travel allowances for construction workers, general studies of construction workforce mobility and monitoring of previous projects.

9.5.33 The Construction Industry Joint Council (CIJC) Working Rule Agreement (Ref. 9.61) sets out national standards for pay and conditions for workers on major building and infrastructure projects in the UK. The current agreement, which took effect in June 2008, sets out rates for daily travel and fare allowances. These are currently payable on a sliding scale based on the distance travelled, up to a maximum of 75 kilometres (c.47 miles).

9.5.34 A study for the UK Department of Trade and Industry (DTI) and Engineering Construction Industry Training Board (ECITB) (IFF and University of Warwick, 2005) (Ref. 9.62) shows that a proportion of UK and South West Region construction workers are willing to travel over 50 miles to work on a daily basis. Indeed, it is estimated that 11% of South West construction workers travel more than this distance to work daily.

9.5.35 Monitoring studies of the construction of Sizewell B also show actual local recruitment extending to a 50 mile/90 minute commute (Glasson and Chadwick, 1995) (Ref. 9.63). A 90-minute commute zone (Construction Daily Commuting Zone - CDCZ) was also agreed for the assessment in the late 1980s of the previous proposal for Hinkley Point.

9.5.36 Discussions with stakeholders at the socio-economic workshops in 2009 and 2010 reinforced these conclusions with local knowledge and experience and it was agreed that the 90-minute commuting area remained a reasonable assumption.

9.5.37 It is assumed that the workers living within this CDCZ will commute daily to HPC. Workers not resident in this area will move, mainly on a temporary basis, to work on the construction programme. It is assumed that workers who move into the area are likely to live nearer to the site so a 60 minute travel distance has been adopted for these non-home-based workers for assessments of accommodation capacity and local impacts.

9.5.38 Local (Somerset) labour supplies in the construction sector are in similar proportions to national and regional supplies. It is important to distinguish between data which includes self-employment and that which does not because self-employment is very important in the construction sector due to contractors and sub-contractors not employing people directly.

Table 9.28: Employment in Construction and Related Activities, 2008

Area	Construction Sector (SIC45)	Of which: Civil Engineering (SIC45.2)	Related Technical Services (SIC74.2)
Districts			
Sedgemoor	1,870	947	479
Taunton Deane	2,279	1,366	1,546
West Somerset	405	207	54
Sub-Total	*4,554*	*2,520*	*2,079*
Wider Scales			
Somerset	9,366	4,967	3,435
CDCZ	47,996	24,406	20,510
South West	98,835	49,627	36,473

Source: ONS, Annual Business Inquiry (NOMIS). Employment Figures exclude self-employed workers

Table 9.29: Occupations Sought by Unemployed Claimants: Construction-related Occupations, July 2011

Occupations Sought (selected occupations)	Sedgemoor, Taunton Deane and West Somerset	Somerset	CDCZ
Engineering professionals: science and engineering technicians	35	85	520
Skilled mechanical and electrical trades	55	110	570
Skilled construction and building trades	165	300	1,555
Construction operatives (semi-skilled)	15	35	200
Elementary construction occupations (unskilled)	125	245	1,380
TOTAL	**405**	**770**	**4,225**

Source: Office for National Statistics, monthly claimant count data. Figures are based on the following SOC 2000 occupational categories which are regarded as relevant to the construction phase of Hinkley Point development: 21.2 – engineering professionals;31.1 – science and engineering technicians; 52.1 – metal forming, welding and related trades; 52.2 – metal machining, fitting and instrument making; 52.4 – electrical trades; 53.1 – construction trades; 53.2building trades; 81.4 – construction operatives; 91.2 – elementary construction occupations.

Age

9.5.39 The 2001 Census gives a comprehensive overview of the age and gender structure of the UK construction industry. The construction workforce is overwhelmingly male and in the 20 to 49 age range.

9.5.40 More recent data from the Annual Population Survey (2009/10) confirms that these proportions have not changed in the intervening decade. While women make up the majority of the workforce in administrative and secretarial occupations (of which there will be a number at HPC (see **Technical Note 2**) and between 10 and 20% of professional and managerial positions, the on-site operative occupations (skilled trades, elementary and operatives) are male dominated. As these dominate the sector as a whole, just fewer than 9 out of 10 workers in the construction sector are men.

9.5.41 The recent Gibson Report, reviewing productivity and skills in the UK Engineering Construction Industry (DBIS, Dec 2009)(Ref. 9.64), notes the predominantly male workforce, and the ageing of the UK engineering construction workforce – with about 65% of the current workforce over the age of 40. This covers the more skilled roles involved in designing, engineering, constructing and maintaining process plant.

Disability

9.5.42 The Labour Force Survey (now the Annual Population Survey) used the definition from the Disability Discrimination Act (Ref. 9.65) and asked whether people have a health problem or disability that limited their day to day activities or the paid work they could do. The most recent (2004) data identifies 13.7% of the construction workforce having a disability, and 16.5% in the South West. Other sources have identified lower proportions, ranging from 1.2% (ODA, 2010) (Ref. 9.66) to 15% (CIC, 2009) (Ref. 9.67).

Race, Nationality and Ethnicity

9.5.43 A report commissioned by the ODA in October 2010 for the London 2012 Olympics entitled ‘Jobs, Skills, Futures’ highlights that the construction workforce of the UK as a whole is 95% white, rising to 99% in the South West.

9.5.44 This pre-dominantly white workforce contains within it a range of nationalities. Research conducted by CSN/BRMB shows the proportion of the construction workforce that was non-migrant (i.e. UK nationals) and migrant (foreign nationals) in 2008(Ref. 9.68). This shows that the workforce was predominantly British nationals, standing at 92% of the overall workforce, rising to 99% in the south-west. Of the “migrant” workers around two-thirds are from what is described as the A8 Accession countries, the central and eastern European countries that joined the EU in 2004.

Families

9.5.45 Previous studies of the construction of Sizewell B Power Station in the 1990s, suggest that around 25% of construction staff (i.e. professional and managerial), around 4% of operatives and around 80% of operational staff, are likely to be “family type” households (i.e. with dependents/non-single households).Data from the Worker Registration Scheme (2004-2007) shows an average for the South-West of 4.2% of migrant workers having dependent children and 5.7% for the UK as a whole.

Operational Workforce at Hinkley Point B

9.5.46 Hinkley Point B has been in operation since 1976, and currently employs 538 full time staff and 17 apprentices. There are also approximately 210 contract personnel based at the power station. Approximately 70% of current Hinkley Point B employees live in Sedgemoor, and 94.5% live in the three districts of Sedgemoor, West Somerset and Taunton Deane.

Table 9.30: Residence of Employees at Hinkley B

Area	Residents in Employment
Sedgemoor	69.9%
Taunton Deane	11.2%
West Somerset	13.4%
Sub Total	*94.5%*
Mendip and South Somerset	1.7%
South Gloucestershire and North Somerset	2.3%
Devon, Dorset, Gloucestershire, Wiltshire	1.3%
Other UK	0.2%

Source: EDF Energy

viii. Business and Enterprise

9.5.47 There were around 10,200 active businesses in Sedgemoor, Taunton Deane and West Somerset in 2008. This figure includes both VAT-registered and PAYE-based enterprises. Business density, at 48.2 businesses per 1,000 adult residents, is similar to the national average (48.4). Recent growth in the number of businesses in the immediate districts has been relatively slow. The number of active businesses increased by only about 140, or 1.4%, between 2004 and 2008. This compares with an increase of 5.2% in the South West region and 7.4% in England. Growth in the business stock over this period was strongest in Sedgemoor (3.2%), whilst West Somerset experienced a small reduction in the number of businesses.

9.5.48 There were 1,000 new business registrations in the immediate district during 2008. This represents an annual rate of 47.4 new registrations per 10,000 adults, which is below the national average (57.2). The relatively low rate of new business registrations in West Somerset district (32.8 per 10,000 adults) is particularly evident. The latest data on business survival rates in the immediate districts shows that the proportion of new businesses surviving for at least three years is slightly below the South West average but above the national average. This is outlined in more detail the following table.

Table 9.31: Business Stock, Density and Growth

Area	Active VAT Enterprises	Enterprises per 1,000 Adults	Growth in Enterprises 2004-2008	VAT Registrations per 10,000 Adults
Districts				
Sedgemoor	4,415	48.1	3.2%	49.6
Taunton Deane	4,280	48.4	0.8%	50.3
West Somerset	1,470	48.2	-2.0%	32.8
Sub Total	10,165	48.2	1.4%	47.4

Area	Active VAT Enterprises	Enterprises per 1,000 Adults	Growth in Enterprises 2004-2008	VAT Registrations per 10,000 Adults
Wider Scales				
Somerset	21,210	51.2	3.4%	52.3
South West	196,850	48.3	5.2%	49.0
England	1,885,265	48.4	7.4%	57.2

Source: Office for National Statistics, business demography statistics and mid-year population estimates.

ix. Economic Activity, Unemployment and Worklessness

9.5.49 Employment rates for working age residents in the immediate districts appear to be slightly below the South West average but slightly above the national average. Estimates for the 2009 calendar year indicate that, at that time, an estimated 69.1% of working age residents (aged 16-64) in the three immediate districts were in employment. This compares with a South West average of 73.6% and English average of 70.4%. There is some apparent variation in working age employment rates between the three immediate districts, ranging from an estimated 63.5% in Sedgemoor and 69.8% in Taunton Deane to 87% in West Somerset district. However, these district-level figures are based on relatively small samples and should be treated with caution.

Table 9.32: Working Age Employment Rates (16-64), 2010

Area	Residents in Employment	Working Age Residents	Employment Rate
Districts			
Sedgemoor	44,100	69,500	63.5%
Taunton Deane	46,400	66,400	69.8%
West Somerset	16,800	19,300	87.0%
Sub Total	*107,300*	*155,200*	*69.1%*
Wider Scales			
Somerset	230,600	314,700	73.3%
CDCZ	1,116,900	1,506,900	74.1%
South West	2,400,600	3,262,200	73.6%
England	23,638,100	33,561,200	70.4%

Source: Office for National Statistics, Annual Population Survey (based on survey data for the January to December 2010 period). Figures are sample-based estimates subject to a margin of error and should be treated with caution. Working age population is defined as the population aged 16-64 years.

9.5.50 The average claimant unemployment rate for the three immediate districts was 2.4% in July 2011 (expressed as a proportion of working age residents, defined as those aged 16-64 years). This is similar to the South West average (2.5%) and lower than the national average (3.7%). Unemployment rates are currently highest in Sedgemoor (2.7%) and lowest in West Somerset (1.8%) and Taunton Deane (2.3%), although West Somerset in particular may be affected by a greater degree of seasonality in unemployment. Although average levels of unemployment in the immediate districts are below the national average, there are wide variations in unemployment rates at sub-district level. For example, Bridgwater has a higher claimant count of 4.5% of working age residents, compared to 1.2% in Cheddar. The number of unemployed claimants in the immediate districts currently amounts to 3,728 persons (including only job seekers allowance claimants). Within the wider 60-minute travel area, the average unemployment rate is similar to the regional average (2.5%). There are currently almost 5,800 unemployed claimants in this wider commuting area, and 39,400 in the CDCZ.

Table 9.33: Claimant Unemployment Rates, July 2011

Area	Unemployed Claimants	As % of Working Age Residents
Districts		
Sedgemoor	1,845	2.7%
Taunton Deane	1,533	2.3%
West Somerset	350	1.8%
Urban Areas		
Bridgwater	1,044	4.5%
Taunton	1,002	3.0%
Weston-super-Mare	1,794	3.6%
Watchet/Williton	88	2.3%
Minehead	113	2.1%
Burnham-on-Sea/Highbridge	292	2.7%
Wellington	158	2.0%
Cheddar	47	1.2%
Study Areas		
60-minute Travel Distance	5,772	2.5%
CDCZ	39,385	2.6%
Wider Scales		
Somerset	6,785	2.1%
South West	82,901	2.5%
England	1,259,484	3.7%

Source: Office for National Statistics, monthly claimant count data. Percentage rates show the proportion of working age residents who are out of work and claiming Job Seekers Allowance (claimant unemployed). Percentage rates are calculated using mid-2010 resident working age population.

9.5.51 A wider measure of unemployment is provided by the number of working age people claiming ‘out of work’ benefits, including job seekers allowance and incapacity and other related benefits. Data for Q1 2011 shows that 10.6% of working age residents (aged 16-64) in the three immediate districts were claiming out of work benefits. This is slightly below the South West average (10.1%), but above the national average (11.9%).

9.5.52 There are significant variations in the level of out-of-work benefit claimants in areas within the 60-minute travel area, for example 16.4% of working age people in Bridgwater compared to 6.2% in Cheddar, outlined in the following table.

Table 9.34: Out-of-Work Benefit Claimants, Quarter 1 2011

Area	Unemployed Claimants	As % of Working Age Residents
Districts		
Sedgemoor	7,880	11.5%
Taunton Deane	6,525	9.8%
West Somerset	2,075	10.4%
Sub Total	*16,480*	*10.6%*
Urban Areas		
Bridgwater	3,810	16.4%
Taunton	4,090	12.1%
Weston-super-Mare	7,865	15.9%
Watchet/Williton	570	15.0%
Minehead	630	11.7%
Burnham-on-Sea/Highbridge	1,580	14.4%
Wellington	875	11.1%
Cheddar	250	6.2%
Study Areas		
60-minute Travel Distance	25,875	11.4%
CDCZ	153,800	10.1%
Wider Scales		
Somerset	30,900	9.7%
South West	333,010	10.1%
England	4,027,950	11.9%

Source: Department for Work and Pensions, working age client group data set.

9.5.53 Amongst the immediate districts, the proportion of out of work benefit claimants is highest in Sedgemoor (11.5%). There are several areas in the immediate districts with proportions of out of work benefit claimants significantly above the national average. These wards include Bridgwater, Weston-super-Mare and Watchet/Williton.

9.5.54 Around 6.4% of unemployed claimants in the immediate districts are seeking employment in managerial, professional or technical occupations, and a further 10.1% are seeking jobs in skilled manual trades. Within the wider 60-minute Travel Distance, a higher percentage of claimants (7.9%) are seeking managerial, professional and technical employment, and the proportion seeking skilled manual jobs is similar (10.3%). There are large numbers of claimants who are looking for employment in semi-skilled operative and elementary occupations. These groups account for a similar proportion of claimants (35.7-37.6%) in the immediate districts and the wider 60-minute Travel Distance (34.8%).

Table 9.35: Occupations Sought by Unemployed Claimants, July 2011

Occupation Sought (SOC 2000 Category	Sedgemoor, Taunton Deane and West Somerset	Somerset	CDCZ
Managers and senior officials	125	270	1,750
Professional	60	220	1,335
Associate professional and technical	170	385	2,300
Administrative and secretarial	380	695	3,605
Skilled trades	365	745	3,680
Personal service	220	420	2,365
Sales and customer service	880	1,570	9,950
Process, plant and machine operative	350	645	3,085
Elementary occupations	945	1,710	10,500
Occupation unknown	30	105	715
TOTAL	**3,525**	**6,765**	**39,285**

Source: Office for National Statistics, monthly claimant count data.

9.5.55 Within the CDCZ, around 520 unemployed claimants are seeking employment as engineering professionals or science and engineering technicians. A further 2,125 claimants are seeking employment in skilled mechanical, electrical, construction and building trades, and 1,580 are looking for other construction employment (in semi-skilled or elementary occupations). This is outlined in more detail in the following table:

Table 9.36: Occupations Sought by Unemployed Claimants: More Detailed Breakdown for Selected Occupations, July 2011

Occupation Sought (SOC 2000 Category	Sedgemoor, Taunton Deane and West Somerset	Somerset	CDCZ
Engineering professionals; Science and engineering technicians	35	85	520
Skilled mechanical and electrical trades	55	110	570
Skilled construction and building trades	165	300	1,555
Construction operatives (semi-skilled)	15	35	200
Elementary construction occupations (unskilled)	125	245	1,380

Source: Office of National Statistics, monthly claimant count data. Figures are based on the following SOC 2000 occupational categories which are regarded as particularly relevant to the construction phase of the Hinkley Point development: 21.2, engineering professionals; 31.1, science and engineering technicians; 52.1, metal forming, welding and related trades; 52.2, metal machining, fitting and instrument making trades; 52.4, electrical trades; 53.1, construction trades; 53.2, building trades; 81.4, construction operatives; 91.2, elementary construction occupations.

x. Income

9.5.56 In 2010, average workplace earnings in Sedgemoor and Taunton Deane districts were lower than the national average, and regional average. In contrast, gross weekly earnings for workers in West Somerset were significantly higher. The average earnings of residents living in Sedgemoor and Taunton Deane were higher than average workplace earnings, reflecting the higher average wages of those who commute out of the districts to work.

Table 9.37: Average Gross Mean Weekly Earnings, 2010

Area	Mean Weekly Earnings, Workplace-based	Mean Weekly Earnings, Residence-based
Districts		
Sedgemoor	£447.9	£550.2
Taunton Deane	£536.2	£552.5
West Somerset	£641.1	£523.0
Wider Scale		
Somerset	£520.3	£553.0
South West	£544.2	£554.9
England	£608.6	£609.5

Source: ONS 2010 Annual Survey of Hours and Earnings

xi. Skills and Qualifications

9.5.57 The proportion of working age residents in the immediate districts with at least Level 2 qualifications (69.4%) is slightly above the national average (67.0%), but below the Somerset and regional average (70.5%; 71.0%%). There appear to be wide variations across the immediate districts, with a relatively low proportion of residents with Level 2 qualifications in Sedgemoor (61.7%) and higher proportions in Taunton Deane (76.3%) and West Somerset (73.3%).

9.5.58 The proportion of working age residents in the immediate districts with at least Level 3 qualifications appears to be similar to the national average (both around 50%). However, this proportion is again slightly below the South West regional average (53.3%). There are relatively minor differences in the proportions with Level 3 qualifications between West Somerset and Taunton Deane districts, although Sedgemoor has a lower rate.

9.5.59 The proportion of working age residents with at least Level 4 (degree level or equivalent) qualifications (30.9%) in the immediate districts is also slightly below the regional (31.5%) and national averages (31.1%).

Table 9.38: Qualifications of Working Age Residents (16-64), 2009

Area	% Qualified at Level 2+	% Qualified at Level 3+	% Qualified at Level 4+
Districts			
Sedgemoor	61.7%	46.8%	28.1%
Taunton Deane	76.3%	53.7%	34.7%
West Somerset	73.3%	53.4%	28.8%
Sub Total	69.4%	50.6%	30.9%
Wider Scales			
Somerset	70.5%	51.1%	29.8%
South West	71.0%	53.3%	31.5%
England	67.0%	50.7%	31.1%

Source: Office for National Statistics, Annual Population Survey (based on survey data for the January to December 2010 period). All figures are sample-based estimates and are subject to a margin of error. Estimates for the immediate districts are based on a relatively small sample and should therefore be treated with caution.

Note: According to the London School of Economics definition, the NVQ equivalents are NVQ 2 = five GCSEs at grades A-C, BTEC first diploma; NVQ 3 = two or more A levels, BTEC Ordinary National Diploma (OND), City and Guilds Advanced Craft; NVQ 4 = BTEC Higher National Certificate (HNC) or Higher National Diploma (HND), or City and Guilds Full Technological Certificate/Diploma /or first Degree*

9.5.60 Data on GCSE exam attainment for the 2008/09 academic year is based on the residential location of pupils rather than the location of schools. The latest results show that attainment levels for pupils living in Sedgemoor and West Somerset, and in Somerset as a whole, are below the regional and national averages. In 2009 the proportion of pupils gaining at least 5 GCSE passes at A*-C was 61.8% in Sedgemoor and 59.1% in West Somerset, compared with a South West average of 67.9% and English average of 69.8%. The figure for Somerset as a whole was relatively low, at 63.5%. Attainment levels were higher in Taunton Deane, with 67.2% of pupils gaining 5 or more A*-C passes in 2009.

Table 9.39: GCSE Exam Attainment Levels in the Immediate Districts, by Location of Pupil Residence, 2009

Area	% 5+ GCSEs at A*-C	% 5+ GCSEs at A*-C including English and Maths	% 2+ GCSEs at A*-C in Science Subjects
Districts			
Sedgemoor	61.8%	50.3%	50.8%
Taunton Deane	67.2%	49.4%	47.1%
West Somerset	59.1%	42.6%	42.0%
Sub Total	63.7%	49.0%	48.2%

Area	% 5+ GCSEs at A*-C	% 5+ GCSEs at A*-C including English and Maths	% 2+ GCSEs at A*-C in Science Subjects
Wider Scales			
Somerset	63.5%	49.4%	49.1%
South West	67.9%	51.8%	54.3%
England	69.8%	50.7%	54.0%

Source: Department for Children, Schools and Families (Neighbourhood Statistics), GCSE and Equivalent Results for Young People by Gender in England (Referenced by Location of Pupil Residence), 2009.

xii. Deprivation

9.5.61 Evidence from the national indices of deprivation 2010 highlights that average levels of deprivation across each of the immediate districts are indicated by their rank position relative to all other English local authority districts. On the overall Index of Multiple Deprivation (IMD 2010), West Somerset is ranked 90th out of the 354 local authority districts in England (where a rank of 1 indicates the most deprived district nationally and a rank of 354 the least deprived). Average levels of deprivation are lower in Sedgemoor (ranked 152nd) and Taunton Deane (ranked 181st). The proportions of income deprived and employment deprived residents are above the South West average in both Sedgemoor and West Somerset districts. An image highlighting the spatial areas of deprivation is included at **Figure 9.3**.

9.5.62 Only 6% of the lower-level super output areas (LSOAs) in Sedgemoor, Taunton Deane and West Somerset are ranked in the most deprived 20% nationally on the overall IMD 2010, and 3% are in the 10% most deprived LSOAs. However, a more detailed analysis of the individual domains and sub-domains of ID 2010, which explores different aspects of deprivation, reveals a more complicated overall pattern of deprivation:

- There are particular issues in relation to barriers to housing and services, particularly in West Somerset district. This largely reflects the geographical remoteness of certain rural communities, but it also reflects affordability issues in relation to access to housing;
- A relatively high proportion of SOAs in the immediate districts are also ranked amongst the most deprived nationally in relation to their indoor living environment, reflecting poor housing quality and lack of basic amenities; and
- Levels of income deprivation are generally low. However, levels of employment deprivation are higher.

xiii. Future Growth Prospects

9.5.63 The most recent set of employment forecasts for the region were prepared by Oxford Economics on behalf of the South West Regional Development Agency and South West Councils (previously the Regional Assembly), and were published in June 2010. These forecasts explore alternative growth scenarios for the region, providing job growth forecasts to 2030 (although the focus in this section is on the 2008-2018 period, which is considered to be more relevant to the timescale of the proposed HPC development). Three main growth scenarios are considered, including a —central growth forecast and alternative —weak growth and —strong growth scenarios. Key results for Somerset and the wider sub-region are summarized in **Table 9.40** and **Table 9.41**, for all sectors and the construction industry:

Table 9.40: Forecast Employment Growth, 2008-2018 (Oxford Economics, South West Growth Scenarios, June 2010)

Area	2008 (Baseline)	2018 (Weaker Growth)	2018 (Central Growth)	2018 (Stronger Growth)
Somerset	268,400	278,200	281,300	291,600
West of England	590,500	618,500	625,200	650,600
Exeter and Devon	474,700	495,600	500,700	520,500
South West	2,703,500	2,798,300	2,829,000	2,936,600
United Kingdom	31,602,300	32,285,500	32,742,300	34,004,200

Source: Oxford Economics, South West Growth Scenarios: Final Report, June 2010. West of England area includes Bath and North East Somerset, City of Bristol, North Somerset and South Gloucestershire.

9.5.64 The alternative scenarios suggest overall employment growth of between 9,800 and 23,200 jobs in Somerset during the 2008-2018 period, with a central growth forecast of 12,900 additional jobs. This amounts to job growth of between 3.7% and 8.6%, with a central forecast of 4.8%. This is similar to forecast job growth in the South West region as a whole (3.5% to 8.6%, with a central growth forecast of 4.6%), and higher than average forecast growth in the UK (2.2% to 7.6%, with a central forecast of 3.6%). Within the wider sub-region, comprising Somerset, Devon and the West of England, employment growth is forecast at between 58,700 and 129,100 jobs, with a central growth forecast of 73,600 additional jobs. This represents overall job growth of 4.4% and 9.7%, with a central forecast of 5.5%.

Table 9.41: Forecast Construction Sector Employment Growth, 2008-2018 (Oxford Economics, South West Growth Scenarios, June 2010)

Area	2008 (Baseline)	2018 (Weaker Growth)	2018 (Central Growth)	2018 (Stronger Growth)
Somerset	20,785	19,669	20,107	20,671
West of England	39,684	38,161	39,016	40,115
Exeter and Devon	41,499	38,846	39,712	40,827
South West	203,774	191,995	196,278	201,793
United Kingdom	2,212,663	2,128,278	2,179,892	2,240,959

Source: Oxford Economics, South West Growth Scenarios: Final Report, June 2010. West of England area includes Bath and North East Somerset, City of Bristol, North Somerset and South Gloucestershire.

9.5.65 Employment forecasts for the construction sector indicate a net decline in employment levels between 2008 and 2018 in all three scenarios for Somerset, the wider sub-region and the South West as a whole. Within Somerset, a net decline of between 100 and 1,100 construction sector jobs is forecast, with a central estimate of 700 fewer jobs. This represents a reduction of between 0.5% and 5.4%, with a central forecast reduction of 3.3%. Forecasts for the wider sub-region indicate a broadly similar reduction in employment levels of between 0.3% and 5.2%, with a central forecast of 3.1%. A slightly larger reduction in employment is expected in the

South West region as a whole, of between 1.0% and 5.8%, with a central forecast of 3.7%.

xiv. Land Use and Agricultural Economy

9.5.66 The site is generally in agricultural use (mixed pasture and arable). Land immediately adjacent to and within 100 metres of the site is also primarily in agricultural use, comprising pasture, arable land and small tracts of woodland.

9.5.67 Within the HPC Development Site are four farm units, covering 22 fields and including three derelict farm buildings. A total of 141.2 hectares of agricultural land would be required for the proposed development, of which 14% is considered 'Best and Most Valuable Land' (BMVL)' and 73% is of 'moderate' quality, as assessed in **Chapter 13** of this Volume of the ES (Soils and Land Use).

9.5.68 Agricultural land accounts for a total of 331,233ha in Somerset, and an estimated 1,738 jobs (ABI, 2008), based on an average of 1.5 self-employment jobs to every employee job in this sector across the South West.

xv. Accommodation

9.5.69 The following section examines in detail accommodation capacity. This has involved careful consideration of the potential scale of accommodation available in four sectors:

- Tourist accommodation;
- Private Rented Sector (PRS);
- Owner Occupied Sector (OOS); and,
- Latent accommodation – i.e. accommodation that is either new or not currently included in records of tourist or private rented accommodation because it has been out of use or has not sought registration.

9.5.70 The following main data sources have been used for this analysis:

- Tourist: South West Tourist Board's Accommodation Database and a survey undertaken by Arup on behalf of the local authorities.
- Private rented: Census (for ward level data), estate agents, and local authority data including the Strategic Housing Market Assessment and Housing Strategy Statistical Appendix (HSSA) returns.
- Owner occupied: Census (for ward level data), and local authority data including the Strategic Housing Market Assessment and Housing Strategy Statistical Appendix (HSSA) returns.
- Latent: Advertisements were placed in newspapers in 2009 and 2010 inviting potential accommodation providers to provide details of property that could be available for construction workers, EDF Energy's office in Bridgwater has created a database that captures these responses and further responses since the surveys were undertaken.

9.5.71 At the Stage 2 Consultation, it was assumed that non-home-based power station construction workers will move closer to the Hinkley Point site for accommodation than the 90 minutes CDCZ, and a 60 minutes zone was therefore calculated and used. It covers all of Sedgemoor, significant parts of West Somerset, Taunton Deane and North Somerset, and a small part of Mendip.

9.5.72 The 60 minute zone represents the zone within which construction workers moving into the local area to work on the Project would be expected to seek accommodation. This is smaller than the CDCZ because it is assumed that non-home-based workers will move to areas closer to the site than people who commute from home. .

General Housing Data

9.5.73 The housing stock in the districts of Sedgemoor, Taunton Deane and West Somerset is currently estimated at just over 117,000 dwellings (April 2009 estimate). The housing stock in these immediate districts increased by an estimated 11,000 dwellings between 2001 and 2009 (equivalent to an additional 1,380 dwellings per annum). This represents a 10.4% increase in the area's housing stock over this eight year period, which is significantly above the national average increase (5.6%) and also slightly higher than the average rate of housing growth in the South West region:

Table 9.42: Growth in Housing Stock in Immediate Districts, 2001-2009

Area	Dwelling Stock, April 2001	Dwelling Stock, April 2009	% Growth, 2001-2009
Districts			
Sedgemoor	45,336	50,046	10.4%
Taunton Deane	44,530	48,893	9.8%
West Somerset	16,273	18,226	12.0%
Sub-Total	*106,139*	*117,165*	*10.4%*
Wider Scales			
Somerset	216,273	237,191	9.7%
South West	2,173,221	2,367,565	8.9%
England	21,360,647	22,564,243	5.6%

Source: Department for Communities and Local Government, annual estimates of dwelling stock by tenure and condition (Neighbourhood Statistics).

9.5.74 Within the wards in the immediate vicinity of the site, there were approximately 24,000 dwellings in March 2009, of which around 16,300 are in Bridgwater. The housing stock in this immediate area has increased at a broadly similar rate in recent years as the average for the immediate districts (an additional 2,050 dwellings between 2001 and 2009, representing growth of 9.3%). Most of this local housing growth has taken place in Bridgwater and in the adjacent Sandford ward.

9.5.75 Information on the tenure of the local housing stock is available from the Taunton and South Somerset Strategic Housing Market Assessment (Fordham Research, August 2008) (Ref. 9.69). This information, derived from household surveys undertaken in each of the immediate districts results in estimates that suggest that owner occupied properties account for around 75% of the current housing stock in the immediate districts. Social rented housing accounts for an estimated 14% of the stock, and the private rented sector for the remaining 11%.

9.5.76 It is estimated that almost 12,400 households are currently in private rented housing in the immediate districts. This includes around 4,700 households in Sedgemoor, 5,500 in Taunton Deane and 2,100 in West Somerset.

Table 9.43: Estimated Tenure of Households in Immediate Districts

Area	Owner Occupied	Social Rented	Private Rented
Sedgemoor	37,500	5,900	4,700
Taunton Deane	36,200	7,900	5,500
West Somerset	12,000	2,300	2,100
TOTAL	**85,600**	**16,100**	**12,400**
Sedgemoor	77.9%	12.4%	9.7%
Taunton Deane	72.9%	16.0%	11.1%
West Somerset	73.2%	13.7%	13.1%
TOTAL	**75.1%**	**14.1%**	**10.8%**

Source: Fordham Research, Taunton and South Somerset Strategic Housing Market Assessment (August 2008), estimates based on household survey data.

Tourist Sector

9.5.77 There is a substantial local supply of tourist accommodation in the Somerset area, and in the area where non-home-based workers are expected to live. There are approximately 50,000 tourism bed spaces within the 60 minute zone, or 35,000 excluding holiday villages based on South West Tourist Board's 2009 database. This is an underestimate of the total tourist accommodation in the area because it only includes accredited or "rated" accommodation, which has undergone an independent quality assurance process, and there are many businesses that are not rated and therefore do not appear on the SWTB database.

9.5.78 Data from the SWTB indicates the following break-down by type in the 60-minute travel area:

Table 9.44: Tourist Accommodation in the 60-minute Travel Area (SWT, 2009)

	Serviced	Self-Catering	Holiday Village	Caravan/ Camping	Campus/~ Hostel	TOTAL
2009	8,657	2,818	14,632	22,264	1,448	49,819

Private Rented Sector

9.5.79 There is a substantial private rented sector (PRS) within the 60-minute travel area. The following table shows the number of private rental sector (PRS) units at the time of the 2001 Census and at the time of the 2008 update included in the Housing Needs Survey (HNS) that was undertaken as part of the local authorities' Strategic Housing Market Assessment:

Table 9.45: Private Rented Accommodation in the 60-minute Zone

District	PRS Units 2001	PRS Units 2008
Sedgemoor	3,199	4,689
Taunton Deane	3,598	5,522
West Somerset	1,347	1,870
South Somerset	335	518
North Somerset	6,457	8,069
Mendip	1,022	1,151
TOTAL	**15,958**	**21,819**

9.5.80 There are around 21,800 PRS units in the 60 minute zone. It should be noted that these are PRS units rather than bed spaces. The vast majority of units have more than one bedspace. Data used in the **Transport Assessment** identifies an average of 2.29 bedspaces per PRS unit in Sedgemoor, 2.49 in Taunton Deane, 2.30 in West Somerset, and an average of 2.26 per unit in other local authorities with wards in the 60-minute zone. This produces a total of 50,796 bedspaces across the 60 minute travel zone.

Latent Accommodation Sector

9.5.81 EDF Energy placed newspaper adverts on two separate occasions inviting potential landlords to register their property if they wished to offer accommodation to the HPC construction workforce. The initial response to these provided 750, of which over 450 were genuinely “additional” to existing supply (i.e. they had not been offered for rent before). This additional accommodation can be used without any risk of displacing existing residents.

xvi. Education

9.5.82 This section discusses primary and secondary education services. Information is included on current pupil numbers in local schools and the numbers of surplus school places. The implications of the latest school roll forecasts to 2014 in Somerset are also considered where applicable. Baseline data on these issues is provided for all LEA maintained schools within an approximate 60 minute travel time of the HPC site.

9.5.83 Brief information is also included at the end of the section on other education provision, including pre-school and nursery provision and post-16 education.

Primary Education

9.5.84 **Table 9.46** provides data on pupil numbers and school capacity for all LEA maintained primary schools within 60 minutes travel-time of the HPC Site. Pupil numbers in these schools totalled 26,781 in January 2010. Around half of these pupils are located in the primary schools in urban areas of Bridgwater, Taunton, Weston-super-Mare and Highbridge with the remainder in the more rural primary schools elsewhere in the area and in smaller settlements. There are some relatively small primary schools in the more rural parts of the area. For example, 36 schools, including Combwich, Crocombe, Spaxton, Stogumber and Stogursey each have fewer than 100 pupils. Total primary school capacity in the area is 30,884 places (based on the position as at 2011/12 entry). There were therefore around 4,103 surplus primary places in the area, representing13% of existing primary school capacity. The location of these schools is mapped in the **Figure 9.4**.

9.5.85 The proportion of surplus places varies across the defined ward clusters in the area, as follows:

Table 9.46: Local Primary School Capacity and Pupil Numbers

	Net Capacity (For 2011/12)*	Pupils on Roll (January 2010)*	Surplus Places	% Surplus Capacity
Bridgwater	3,831	3,646	185	5%
Burnham and Highbridge	2,995	2,818	177	6%
Cannington	630	597	33	5%
Cheddar	822	668	154	19%
Glastonbury	2,708	2,173	535	20%
Hinkley Point	84	63	21	25%
Minehead	1,032	662	370	36%
Somerset South	2,415	1,867	548	23%
Somerset West	644	545	99	15%
Taunton	5,551	5,179	372	7%
Watchet and Williton	627	421	206	33%
Weston-super-Mare	9,545	8,142	1,403	15%
60-Minute Travel Area	30,884	26,781	4,103	13%

**Annual Schools Census 2010; **Somerset County Council, School Organization Plan 2010-2014, published 13 July 2010.*

9.5.86 Surplus places are currently unevenly distributed across local primary schools. As a result, although some schools have significant numbers of surplus places, other local schools are operating close to or above their current capacity.

9.5.87 Forecasts of pupil numbers for the local primary schools have been obtained from the latest version of Somerset County Council's School Organization Plan Tables, published in July 2010 (SCC, School Organisation Plan 2010-2014) (Ref. 9.70). Overall, an increase in rolls for the primary schools in the Bridgwater area of 10.3% is forecast between 2009 and 2014. This represents an additional 301 primary pupils in the area over this five year period. Assuming no changes in school capacity, the effect of this increase would be to exceed the capacity in local primary schools by 2014. This represents a reduction in the proportion of surplus primary places from 8% of current capacity to 'at capacity' by 2014.

9.5.88 Based on existing levels of capacity, the following broad changes to numbers of surplus places can be expected in Burnham/Highbridge and Taunton. Note that these figures differ from those in **Table 9.46** as the Council uses slightly different clusters of schools than those shown:

- Burnham/Highbridge: Increase in the number of children on roll of 33 by 2014, with surplus capacity reducing from 7% to 4%.

- Taunton: Increase in the number of children on roll of 692 by 2014, with surplus capacity reducing from 11% to no capacity by 2014.

Secondary Education

9.5.89 There are 25 secondary-level schools within the 60-minute travel area from HPC. Of these, four are middle schools (age 9-13), based on the three-tier system used in West Somerset.

9.5.90 Total capacity in the secondary schools is currently 24,610 places (based on Somerset County Council School Organisation Plan and North Somerset Council's School Admission Documents). Pupil numbers in these schools totalled 23,134in January 2010 based on Annual Schools Census data. There are therefore 1,476 surplus secondary places in the area at this time, representing around 6% of existing capacity.

9.5.91 The Somerset County Council School Organisation Plan groups the schools into geographical areas for planning purposes, which can be broadly correlated to the ward clusters identified in the Methodology section of this chapter, as outlined in **Figure 9.1** with key areas of population being Taunton, Bridgwater and Weston-super-Mare.

9.5.92 There are four secondary schools serving Bridgwater and the surrounding rural catchment area. These schools cater for 11-16 year olds. In addition, Brymore School in Cannington is a secondary technical school for boys, specializing in rural technology, although this school has a wider than local catchment area. Current rolls and capacity for these schools is summarized in **Table 9.47**.

9.5.93 There are three secondary schools serving the urban area of Taunton, all catering for pupils aged 11-16. Two of these schools also have 6th Form provision. Current rolls and capacity for these schools is summarized in **Table 9.47**. In addition, there is a private school (Taunton International Academy) here.

9.5.94 There are four secondary schools in the urban area of Weston-super-Mare, catering for 11-16 year old pupils. These combined schools currently have 335 surplus places, equivalent to a surplus capacity of around 7%. **Figure 9.5** maps the location of secondary schools.

9.5.95 The following table outlines the capacity, number on roll and surplus capacity of these schools.

Table 9.47: Local Secondary School Capacity and Pupil Numbers

School	Net Capacity (January 2011)*	Pupils on Roll (January 2010)*	Surplus Places	% Surplus Capacity
Robert Blake Science College	700	648	52	7%
Chilton Trinity Technology College	1000	944	56	6%
Haygrove School	1070	1107	-37	-3%
East Bridgwater Community School	870	804	66	8%
The King Alfred School	1380	1368	12	1%

School	Net Capacity (January 2011)*	Pupils on Roll (January 2010)*	Surplus Places	% Surplus Capacity
Hugh Sexey Middle School	600	661	-61	-10%
Brymore School	316	162	154	49%
The Kings of Wessex School	1246	1191	55	4%
Fairlands Middle School	508	505	3	1%
Crispin School	1090	1098	-8	-1%
Minehead Middle School	648	609	39	6%
West Somerset Community College	1554	1301	253	16%
Court Fields Community School	860	822	38	4%
Kingsmead Community School	725	780	-55	-8%
The Castle School	1150	1201	-51	-4%
Heathffield Community School	1159	1199	-40	-3%
Bishop Fox's School	915	823	92	10%
The Taunton Academy	1050	1020	30	3%
Danesfield Community Middle School	464	396	68	15%
Worle Community School	1500	1350	150	10%
Broadoak Mathematics and Computing College	900	897	3	0%
Clevedon School	1200	1016	184	15%
Hans Price Academy	1200	761	439	37%
Churchill Community Foundation School and Sixth Form Centre	1305	1277	28	2%
Priory Community School	1200	1194	6	1%

Source: Annual Schools Census 2010; and Somerset CC School Organisation Plan 2010-2014; and North Somerset County Schools Admissions Document 2011-12

* *Taunton Academy opened in Jan 2010 as an amalgamation of Ladymead Community School and St Augustine of Canterbury School. The numbers represented are pupils registered at these schools that it is assumed would transfer to the Academy.*

* *Hans Price Academy opened in 2009, as a conversion from the previous Wyvern Community School. The numbers represented are pupils registered at this school that it is assumed transferred to the Academy.*

Forecast Pupil Rolls

9.5.96 Forecasts of pupil numbers for the local secondary schools are taken from the latest version of Somerset County Council's School Organization Plan for 2010-2014. Overall, the latest forecasts indicate a decline in secondary pupil numbers in the area. Local secondary school rolls are expected to decline between 2009 and 2014. This represents a reduction of pupil numbers over this five year period. Assuming no changes in school capacity, the effect of this decline will be to increase the number of surplus places locally by 2014, although this will not be uniform across the area. There would be an increase in surplus capacity from 5% (174 places) to 8%

(306 places) in schools in Bridgwater, although schools in Taunton would be operating at capacity.

Future Development

9.5.97 In 2007, Somerset County Council secured £450 million in funding for the Somerset Building Schools for the Future (BSF) programme. The BSF programme in Somerset was planned to start in Bridgwater with the rebuilding of all four of the town's secondary schools plus two special schools. The original plans envisaged the following new secondary provision in Bridgwater (SCC, Building Schools for the Future: Outline Business Case, April 2008) (Ref. 9.71):

- 1,050 place 11-16 Chilton Trinity Technology College, to be rebuilt on its current site (current capacity is 1,000 places);
- 900 place 11-16 East Bridgwater Community College, to be rebuilt on its current site (current capacity is 870 places; the plans incorporate the potential to increase the school's capacity to 1,050 places in the future if required);
- 1,050 place 11-16 Haygrove School, to be rebuilt on a new greenfield site at Queenswood Farm (current capacity is 1,070; the plans incorporate the potential to increase the school's capacity to 1,200 in the future if required); and
- 900 place 11-16 Robert Blake Science College, to be rebuilt on its current site (current capacity is 700 places; the planned additional new capacity allows for a projected increase in roll numbers due to significant residential development close to the school).

9.5.98 Completion of the rebuilding projects was scheduled for autumn 2012. The plans also included co-location of specialist provision at Haygrove School (50 places) and Robert Blake Science College (60 places). Significant changes to the original proposals have occurred following the government's announcement in July 2010 of the withdrawal of funding for all future BSF construction projects. In Bridgwater, the rebuilding of Chilton Trinity and Robert Blake is to proceed as planned (with completion by November 2012), but the BSF funding for the rebuilding of East Bridgwater and Haygrove Schools has been withdrawn. Rebuilding of Chilton Trinity and Robert Blake secondary schools will result in an additional 250 secondary places in Bridgwater from late 2012 onwards.

Pre-School Provision

9.5.99 Data on existing local childcare provision for 0-5 year olds has been obtained from the Somerset Family Information Service (FIS). A total of 13 day nurseries or pre-school playgroups are listed in Bridgwater and a further 10 groups are listed in the surrounding rural area. The total number of registered childcare places for 0-5 year olds currently listed by the Somerset FIS is as follows (excluding places with individual childminders):

- *Urban Bridgwater area*: 455 registered places, excluding nursery classes at Hamp and Sedgemoor Manor Infants Schools.
- *Rural Bridgwater area*: 150 registered places, mainly in Cannington (65) and North Petherton (65).

- *West Somerset area*: 100 registered places, excluding nursery classes at Old Cleeve First School. These places are located mainly in Watchet (50) and Williton (30).
- *Other local*: 50 registered places.

9.5.100 Somerset County Council's *Childcare Sufficiency Assessment*, published in March 2011 (Ref. 9.72) highlights that:

- As a whole the county has sufficient childcare and EYE places for children aged 3-4, with some local gaps in primarily rural areas.
- There are insufficient childcare places for children aged 0-2, based on average national demand, but sufficient EYE places for 2-year olds.
- Despite the new and extended provisions created through Sure Start capital funding, further childcare provisions are required in the near future. District councils have identified sites for up to 36,892 new houses across Somerset up to 2026. It is possible that not all of these houses will be built, but the allocation does indicate that a substantial growth in population is anticipated over this period. The current levels of childcare provision are not sufficient to meet this expanded need, so new childcare provisions will be required as new housing, and the corresponding population rises develop.

The following table highlights the current provision and demand for places for different kinds of childcare in Sedgemoor, Taunton Deane and West Somerset based on national average indicators of the proportion of children in each type of childcare, applied to the number of children, by age group, in each district.

Table 9.48: Local Preschool Provision and Pupil Numbers

	Sedgemoor	Taunton Deane	West Somerset
Childminder (age 0-4)	Sufficient	Sufficient	Insufficient* (-5)
Pre-School (age 0-2)	Insufficient (-329)	Insufficient (-264)	Insufficient (-40)
Pre-School (age 3-4)	Sufficient	Insufficient (-34)	Sufficient
Early Education Entitlement (EEE)	Sufficient	Sufficient	Sufficient
Out of School	Insufficient (-333)	Insufficient (-333)	Broadly Sufficient (-4)

**Exacerbated by rural nature*

9.5.101 In Sedgemoor, there are sub-district shortages of places, particularly in urban areas of Bridgwater, Highbridge (pre-school and EEE) and rural areas of Spaxton and Nether Stowey, and Wedmore and Mark (childminder).

9.5.102 In Taunton Deane, there are sub-district shortages of places, particularly in the most sparsely populated areas south of Taunton and south of Wiveliscombe/east of Wellington in terms of childminder provision, with only marginal sufficiency in Taunton. There are sufficient 3-4 group childcare places in most areas, with the exceptions of Bishop's Lydeard (also insufficient in EEE provision) and some rural villages, though there are sufficient places in the wider area.

9.5.103 There are shortages of childminder places in very large rural areas of West Somerset, though these areas were very sparsely populated with the exception of

Dulverton. There are insufficient 0-2 group childcare places, based on average national demand, in every part of West Somerset, except Watchet. There are sufficient 3-4 group childcare places in most areas, with the exceptions of Porlock and some rural villages, though overall there is an insufficiency. Here are shortages of Early Years Entitlement places in the west of the District (Kilve, Stringston, Stogursey) but sufficient places nearby, including provisions in Sedgemoor. There are shortages of before school care places in rural parts of West Somerset. All urban areas had sufficient before and after school places.

Post-16 Provision

9.5.104 Post-16 education and training in Sedgemoor is mainly provided by Bridgwater College. The College has two campuses, in central Bridgwater and Cannington. There are currently around 3,000 students aged 16-18 years, including over 800 following AS/A level studies. There are also around 600 students following higher education courses.

9.5.105 In West Somerset the main provider is West Somerset Community College, which, in addition to the provision for secondary school aged children described above also provides a range of post 16 provision with a strong focus on vocational and technical education.

9.5.106 In addition, post-16 education is also provided at Richard Huish College and Somerset College of Arts and Technology, both in Taunton, and Weston College in Weston-super-Mare.

xvii. Primary Healthcare

9.5.107 See also separate **Health Impact Assessment** prepared by RPS (2011) for the HPC Environmental Statement.

Health Indicators

9.5.108 On many health indicators Somerset, and Sedgemoor and West Somerset, perform very well. The Indices of Deprivation (2010), Health, Deprivation and Disability Domain provide a measure of illness and disability, mental health problems and hospital admissions. Somerset County performs better on overall health indicators than the England average. Life expectancy for both men and women exceeds the England average by 1-2 years; levels of physical activity are high (Somerset); early deaths due to cancer, heart disease and strokes are lower than the England average and have fallen over the last 10 years. On the other hand, the rate of road injury and death is high compared to England averages; around 340 people are killed or seriously injured on the roads in Somerset each year. The proportion of women who smoke during pregnancy is higher than for both the region and England. The Socio-Economic Workshop also noted that the high level of incapacity benefits/issues needs to be recognised and responded to in relation to skills development /employment opportunities; this is currently a barrier in developing the skills base of the area. There are also particular problem pockets across the county, mainly in towns but also in rural West Somerset. The Somerset Local Area Agreement (LAA) prioritises: healthy life expectancy, teenage pregnancy, early deaths from circulatory disease, childhood obesity, drug and alcohol abuse, road injuries and Child and Adolescent Mental Health Services.

Local Healthcare Facilities

9.5.109 There are currently 62 GP practices based within 60 minutes travel time of the Hinkley Point site. The closest practices to the site, serving the immediate area, are the Cannington Health Centre (which includes branch surgeries in Combwich, Spaxton and Stogursey) and the Quantock Medical Centre in Nether Stowey. There are six GP practices in Bridgwater, plus an additional practice in North Petherton, to the immediate south of Bridgwater. A single practice (West Somerset Healthcare) serves the area to the west of the site, with surgeries located in both Watchet and Williton. There is also a small practice located near Washford in West Somerset (Brendon Hills Surgery). **Figure 9.6** maps the location of these GP surgeries.

9.5.110 There are currently around 457,343 patients on the lists of those practices within a 60-minute travel distance of the site. These local practices have a total of 393 whole-time equivalent general practitioners (excluding registrars). The local practices vary widely in size, from only 600 to 14,000 registered patients. Average list sizes per GP in the study area and major urban areas are shown in **Table 9.49**. Across all the local practices, there is an average of 1,164 patients per whole-time equivalent GP (excluding registrars). This is below the average for all Somerset GP practices (1,725). The average list size is higher for the Bridgwater practices (1,239 per whole-time equivalent GP) than for the more rural practices. By national standards these are relatively low numbers suggesting reasonable GP capacity in the area.

Table 9.49: List Sizes and Practitioner Numbers in Local GP Practices

Practice	List Size	GPs	Patients per GP
Urban Areas			
Bridgwater	49,570	40	1,239
Taunton	75,976	65	1,169
Weston-super-Mare	92,486	73	1,267
Watchet/Williton	10,044	8	1,256
Minehead	13,898	14	993
Burnham-on-Sea/Highbridge	28,919	21	1,377
Wellington	19,514	19	1,027
Cheddar	7,438	6	1,240
Study Area			
60-minute Travel Distance	457,343	393	1,164

Source: NHS Business Services, 2011

9.5.111 These overall averages conceal some significant variations between individual local practices. List sizes per whole-time equivalent GP in individual practices range from only 800 to almost 4,700. List sizes are above the Somerset average of 1,725 per GP in four of the practices.

9.5.112 A development framework was approved by NHS Somerset in September 2008, following the review of primary care infrastructure. The framework covers the period to 2015 and includes recommendations to replace or extend some existing surgery premises in the area. This includes the replacement of Brent House Surgery in Bridgwater (by 2011) and North Petherton Surgery (by 2012/13). The framework also includes the provision of capital grants to enable the extension of existing premises at Redgate Medical Centre and Taunton Road Medical Centre, both in Bridgwater. Proposals for a new surgery in south Bridgwater were not supported as part of NHS Somerset's current development framework, as existing primary care capacity in Bridgwater was considered to be sufficient.

9.5.113 The nearest accident and emergency facilities are located at Musgrove Park Hospital in Taunton. The hospital is located about 18 miles by road from the Hinkley Point site, with an estimated journey time of just over 40 minutes.

9.5.114 There are two community hospitals within a 30 minute drive of the Hinkley Point site, located in Bridgwater and Williton, with another slightly further away in Minehead. These hospitals are operated by NHS Somerset. The services currently provided by these hospitals are summarized below.

- Bridgwater Hospital – the hospital has 50 beds for consultant and GP patients, plus a maternity unit with 8 beds. Services provided include outpatients, the rehabilitation unit, X-ray, physiotherapy and occupational therapy. There is a Minor Injuries Unit which operates from 7.00 to 23.00, seven days a week.
- Williton and District Hospital – the hospital has 45 inpatient beds. Services include the rehabilitation unit, palliative care, physiotherapy and occupational therapy.

9.5.115 Elsewhere in the 60-minute Travel Distance are:

- Musgrove Park Hospital (Taunton) – this is the largest general hospital in Somerset, and includes 700+ beds, 15 operating theatres, an intensive care and high dependency unit, a medical admissions unit, a fully equipped Diagnostic Imaging Department and a specialised Children's Department including a Paediatric High Dependency Bay. Musgrove Park also provides Neonatal Intensive Care for all of Somerset and has an Accident and Emergency facility.
- Burnham-on-Sea War Memorial Hospital (Burnham-on-Sea) – this hospital has 22 beds where patients can be admitted under the care of local GPs. A rehabilitation team of doctors, nurses, physiotherapists and occupational therapists support patients during their hospital stay. Patients often return to Burnham Hospital following treatment at Musgrove Park Hospital or Weston General Hospital so they can be close to their home and families. The Minor Injuries Unit operates a Nurse Led Treatment Centre seven days a week 10.00 - 18.00 hrs, April to October and 11.00 - 15.00 hrs, November to March.
- Weston General Hospital (Weston-super-Mare–run by the Weston Area NHS Trust) – Among the key services is the 24-hourEmergency Department (Urgent Care Centre) and Intensive Care Unit for patients with serious injury or illness.

9.5.116 Other primary care facilities within 60-minutes travel distance of HPC include 63 dentists, 76 pharmacies and 39 opticians. **Table 9.50** and **Figure 9.7** outline the spatial location of these facilities:

Table 9.50: Pharmacies, Dentists and Opticians

	Facilities		
	Opticians	Pharmacies	Dentists
Bridgwater	5	7	8
Taunton	7	13	10
Weston-super-Mare	4	18	10
Watchet/Williton	1	2	1
Minehead	2	4	3
Burnham-on-Sea/Highbridge	3	5	4
Wellington	1	4	4
Cheddar	1	1	1
Glastonbury	4	3	1
60-minute Travel Distance Area	39	76	63

Source: Somerset County Council, North Somerset Council 2011

xviii. Sport and Leisure Facilities

9.5.117 **Technical Note 5: Leisure Audit and Estimated Demand** (**Appendix 9E**) sets out the existing provision of sports facilities in Sedgemoor, West Somerset and Taunton Deane districts. The approach taken to the assessment of the existing provision of sports facilities is based on two sources of information:

- A survey undertaken by ARUP in 2010 which highlights the location and type of a range of sports and leisure facilities in West Somerset and Sedgemoor.
- Sport England's Active Places database, which includes a list of facilities by type and size/capacity for all areas.

9.5.118 In terms of wider sports needs, most areas have existing provision that is adequate, the exception to this being the lack of a publicly accessible indoor swimming pool in a number of areas, including Minehead and Bridgwater. Minehead has an outdoor pool at Hoburne Blue Anchor Holiday Park and an indoor leisure pool at Butlins, although these may not be accessible for HPC workers. The proposed refurbishment of Chilton Trinity School in Bridgwater includes the provision of a new swimming pool. Elsewhere in the 60-minute Travel Distance Area, there is an indoor swimming pool in Burnham-on-Sea and public pools in Taunton, Weston-super-Mare, Glastonbury, Cheddar and Wellington.

9.5.119 Somerset County Council operates a network of Leisure Centres across the County. These are all school-based and operate on a dual-use model, combining school and community access.

9.5.120 Specifically in terms of Bridgwater, SCC operated Leisure Centres include the Chilton Trinity Sports and Leisure Centre and the East Bridgwater Sports Centre. Details of the facilities at the centres in Bridgwater are shown below:

- Chilton Trinity Sports and Leisure Centre – the centre is based at Chilton Trinity Technology College and was constructed in the late 1980's. The centre is open seven days a week and offers the following range of facilities:
  - Squash court;
  - Two fitness studios;
  - Floodlit artificial turf pitch;
  - Children's indoor activity play area;
  - Four court sports hall; and
  - Public bar area and party room.
- East Bridgwater Sports Centre – this centre is based at East Bridgwater Community School and was constructed in the 1970s. The centre is open seven days a week and provides the following facilities:
  - Four badminton courts;
  - Four squash courts;
  - Outdoor football pitches;
  - Floodlit court; and
  - Public bar.

9.5.121 Under the BSF programme in Somerset, it is currently envisaged that both Chilton Trinity and East Bridgwater secondary schools will be rebuilt on their existing sites by 2012. The current plans also include the rebuilding of both leisure centres, with dual school-community use of facilities retained. The proposals include provision of a new dual-use swimming pool as part of the rebuilding of Chilton Trinity.

9.5.122 Provision of indoor sport facilities is relatively limited in West Somerset. There is only one sports hall in the district, no public swimming pool, no indoor tennis courts and relatively limited per capita provision of health and fitness facilities. The exception is facilities for indoor bowls, where per capita provision is above that in Taunton Deane. Provision of indoor facilities in Sedgemoor includes nine sports halls and one public swimming pool. There is currently no provision for indoor tennis.

9.5.123 Per capita levels of provision for outdoor sport in Sedgemoor appear to be relatively favourable for outdoor bowls and grass playing pitches (for football, cricket and rugby). However, provision is less extensive in relation to synthetic turf pitches and multi- use games areas.

xix. Other Community Facilities

9.5.124 Within 60-minutes Travel Distance of Hinkley Point, there are28 libraries operated by Somerset County Council, North Somerset Council in urban areas including Bridgwater (1), Weston-super-Mare (3), and Taunton (4).

9.5.125 Closer to the Site, there are also libraries in Bishops Lydeard, Nether Stowey, North Petherton, Watchet and Williton. There are also mobile library services based in Bridgwater and Minehead which serve the more rural settlements in these areas.

9.5.126 **Table 9.51** and **Figure 9.8** highlight the spatial distribution of libraries and community centres within the 60-minute Travel Distance Area:

Table 9.51: Other Community Facilities

	Community Facilities	
	Libraries	Community Centres
Bridgwater	1	6
Taunton	4	6
Weston-super-Mare	3	8
Watchet/Williton	2	1
Minehead	1	3
Burnham-on-Sea/Highbridge	2	0
Wellington	1	0
Cheddar	1	0
Glastonbury	2	3
60-minute Travel Distance Area	28	34

Source: Somerset County Council, North Somerset Council 2011

xx. Crime and Community Safety

9.5.127 Somerset experiences relatively low levels of crime and disorder compared to the national average. Levels of crime and fear of crime are highest in the larger centres within the county and typically coincide with areas of relative deprivation. Improving economic opportunities in these deprived communities will continue to contribute to addressing the incidence and fear of crime (Somerset Strategic Partnership, 2007) (Ref. 9.73).

9.5.128 Home Office statistics on numbers of recorded offences in the immediate districts are presented for Local Authority and wider scales, based on the number of recorded offences during the 12 month period to December 2010.

9.5.129 There were 14,353 recorded offences in the immediate districts during the 12 months to December 2010. Adjusting for the districts' resident population, this represents an annual crime rate of 56.0 offences per 1,000 population. This is below the South West average of 57.9 offences. Recorded crime rates are particularly low in West Somerset district (44.4 offences per 1,000 population), but are higher in Sedgemoor (56.8) and Taunton Deane (59.0).

9.5.130 Data is available on a neighbourhood-level for smaller areas which identifies the total recorded offences per month. This data has been equivalised over 12 months to give estimates of comparative crime rates for urban areas in the 60-minute travel distance. This illustrates the higher crime rates in urban areas.

Table 9.52: Recorded Offences 12 Months to December 2010

	Recorded Offences (annual, monthly Dec 2010 for urban areas)	Mid-2009 Population	Offences per 1,000 Population
District			
Sedgemoor	6,363	112,100	56.8
Taunton Deane	6,420	108,700	59.0
West Somerset	1,570	35,400	44.4
Sub-Total	*14,353*	*256,200*	*56.0*
Urban Areas			
Bridgwater	587	36,200	194.6
Taunton	642	54,200	142.1
Weston-super-Mare	872	79,200	132.1
Watchet/Williton	56	6,600	101.8
Minehead	81	10,100	96.2
Burnham and Highbridge	196	19,100	123.1
Wellington	157	13,300	141.7
Cheddar	44	6,800	77.6
Wider Scales			
Somerset	52,837	910,000	58.0
South West	303,330	5,231,200	57.9

Source: Home Office, Crime in England and Wales: Quarterly Update to December 2010, published February 2011; and National Policing Improvement Agency, Local Crime Mapping. Crime rates per 1,000 population are calculated using mid-2009 population estimates (published by the Office for National Statistics on 24 June 2010). Number of recorded offences is for the 12 month period to 30 December 2010.

9.5.131 Data on the number of anti-social behaviour incidents recorded by the police is shown in the following table. This data relates to the 12 month period to June 2010. There were around 13,500 incidents of anti-social behaviour recorded during this period in the three immediate districts. This represents a total of 52.7 incidents per 1,000 population, compared with the regional average of 53.9. Numbers of incidents per 1,000 population are again relatively low in West Somerset (42.1) and somewhat higher in Sedgemoor (52.1) and Taunton Deane (56.7). As with recorded crime, there is a relatively high level of anti-social behaviour in Bridgwater (85.0 incidents per 1,000 population) and much lower levels in the rural wards closer to the site (20.2).

Table 9.53: Anti-Social Behaviour: Immediate Districts, 2009/10

	Recorded ASB Incidents	Mid-2009 Population	Incidents per 1,000 Population
Districts			
Sedgemoor	5,835	112,100	52.1
Taunton Deane	6,163	108,700	56.7
West Somerset	1,492	35,400	42.1
Sub-Total	*13,490*	*256,200*	*52.7*
Wider Scales			
Somerset	26,258	523,500	50.2
South West	281,968	5,231,200	53.9
England	-	51,809,700	-

Source: National Policing Improvement Agency, Local Crime Mapping. Incidents per 1,000 population are calculated using mid-2009 population estimates (published by the Office for National Statistics on 24 June 2010). Number of ASB incidents is for the 12 month period to 30 June 2010.

9.6 Assessment of Construction Phase Impacts

9.6.1 The socio-economic construction impacts of the scheme in the main result from the workforce required to build HPC and the demand from EDF Energy for goods and services to support the development.

9.6.2 Section 9.4 (above) summarises the "central case" in relation to:

- likely workforce profile and timing;
- where workers are likely to be recruited from (home-based and non-home-based recruitment);
- the demographic make-up of the workforce;
- where workers are likely to live, based on accommodation capacity assumptions and EDF Energy's **Accommodation Strategy**, and the "Gravity Model" produced for the **Transport Assessment**; and
- the demographic make-up of the workforce.

9.6.3 This section then assesses the impacts of the proposals against the policy, baseline and significance criteria described above in relation to the following topics:

- Labour market and local economy.
- Accommodation Impacts.
- Population and demographics.
- Public services including:
  - Education.
  - Health.
  - Emergency Services.
  - Leisure and Recreation.

  - Other Services.
- Community Cohesion.
- Specific Locational Impacts.

9.6.4 The spatial spread of impacts and equalities issues are considered as cross cutting themes where relevant.

a) Economic Impacts

9.6.5 The construction of HPC could have a range of economic impacts. In this section the areas of impact will focus on four levels identified in the baseline assessment, the CDCZ (90 minute) area in which the home-based workforce will live, the 60 minute non-home-based workforce accommodation area, the county of Somerset and the three immediate district area (Sedgemoor, West Somerset and Taunton Deane).

9.6.6 The main areas covered are:

- Labour Market:
  - impact on demand for labour; and
  - impact on wider labour supply;
- Impact on Supply Chain and Procurement:
  - The direct demand for goods and services arising from the HPC development;
  - expenditure of workforce (non-home-based);
  - expenditure of workforce (HB); and
  - multipliers and wider effects.
- Impact on Sectors:
  - tourism; and
  - other sectors, including agriculture.

b) Labour Market Impacts

i. Total Workforce

9.6.7 Assumptions about the labour force requirements for the construction of HPC are set out in **Technical Note 1** and in the paragraphs describing the scheme above.

9.6.8 This shows a slow build up over the first 18 months before a step change, with an increase of around 2,000 workers over a year, as the main contracts begin. There is a further increase of 1,500 between years 3 and 4, after which the workforce stays at above 4,000 until year 8, with a peak of 5,600 in year 6.

9.6.9 This “gross” peak employment total of 5,600 equates to less than 1% of jobs in the CDCZ, approximately 3% of jobs in Somerset and the 60 minute area, and approximately 5% of jobs in the three district area.

9.6.10 The build-up of the workforce equates to approximately 1,000 jobs per year for the first six years of the project. This equates to under 1% of total jobs at all levels and is lower than the annual jobs growth in each area from 2001 to 2008.

9.6.11 In relation specifically to construction employees, detailed data is contained in **Technical Note 1: Workforce Profile (Appendix A)** on current and projected construction employment in the CDCZ and Somerset. The 5,600 peak jobs figure equates to around 11% of total construction jobs in the CDCZ and is therefore assessed as an impact of **moderate beneficial** significance at the CDCZ level.

ii. Recruitment by Area

9.6.12 Because of the relatively high levels of labour demand, particularly compared to the immediate three District area, it is projected that a substantial proportion of the workforce will be recruited from outside the CDCZ. This will vary by skill type and timing within the project as described in **Technical Note 1** and set out above.

9.6.13 **Table 9.54** below, shows, for illustrative purposes the likely “central range” estimates of how the workforce could break down, in terms of residence location, over the impact areas in each year. The home based numbers are based on the central point of the assessment in **Technical Note 1**, which vary slightly, but not significantly, from those in the gravity model used in the **Transport Assessment**. The non-home based split is based on the gravity model assumptions. The three district peak home based total represents approximately 1% of total residence based employment in the 3 Districts. This impact is assessed as of **moderate beneficial** significance at the three district level.

Table 9.54: Central Range of Workforce

Year	Home-based Total	Of which			Non home-based Total	Of which		
		3 Districts	Rest of Somerset	Rest of CDCZ		3 Districts	Rest of Somerset	Rest of 60-minute Zone
1	90	50	10	30	90	70	10	10
2	320	160	50	110	380	300	30	60
3	1,350	690	210	460	1,630	1,280	110	240
4	1,900	1,170	220	500	2,520	1,980	170	380
5	1,840	1,055	235	550	2,970	2,330	190	440
6	1,900	970	290	640	3,700	2,900	240	550
7	1,680	860	260	570	3,130	2,460	210	470
8	1,280	650	200	430	2,080	1,630	140	310
9	830	420	130	280	1,080	850	70	160

Source: HDS/IAU Analysis of Construction Workforce Profile

iii. Impacts on the Labour Market

9.6.14 The labour market is dynamic: people move in and out of the labour market and move between jobs regularly. As demand for workers increases, jobs are filled by people currently in employment moving jobs, people who are registered as unemployed, and people who do not form part of the labour market because they are classed as economically inactive.

9.6.15 **Table 9.55**, below, shows claimant unemployment in construction related professions in the relevant impact areas in July 2011. It should be noted that there will also be significant demand for non-construction skills such as administration, security and transport operatives.

Table 9.55: Claimant Unemployment, July 2011

Occupation sought (selected occupations)	Sedgemoor, Taunton Deane and West Somerset	Somerset	90 Minutes CDCZ
Engineering professionals; Science and engineering technicians	35	85	520
Skilled mechanical and electrical trades	55	110	570
Skilled construction and building trades	165	300	1,555
Construction operatives (semi-skilled)	15	35	200
Elementary construction occupations (unskilled)	125	245	1,380
TOTAL	**395**	**775**	**4,225**

Source: Office for National Statistics, monthly claimant count data. Figures are based on the following SOC 2000 occupational categories which are regarded as relevant to the construction phase of Hinkley Point development: 21.2 – engineering professionals; 31.1 – science and engineering technicians; 52.1 – metal forming, welding and related trades; 52.2 – metal machining, fitting and instrument making; 52.4 – electrical trades; 53.1 – construction trades; 53.2 – building trades; 81.4 – construction operatives; 91.2 – elementary construction occupations.

9.6.16 The number of people who are economically inactive but who want to work is significantly greater than the numbers who are registered as unemployment benefit claimants (JSA Claimants). The Government's preferred definition of unemployment – the ILO measure – shows higher numbers of people unemployed than either the JSA measure or the economically inactive who want to work, as the following table shows:

Table 9.56: ILO Unemployment, JSA Unemployment and Economically Inactive who Want to Work

	JSA Claimants (July 2011)	ILO unemployed (Jan 2010-Dec 2010)	Economic inactive, but want to work (Jan 2010-Dec 2010)
Sedgemoor	1,845	6,000	3,800
Taunton Deane	1,533	4,200	4,500*
West Somerset	350	N/A – disclosive sample	N/A – disclosive sample**
Somerset	6,785	20,200	13,600

Source: ONS – Annual Population Survey (2010); DWP – JSA Claimant Count (July 2011)
* *Confidence Error*
** *Previous year = 1,800*

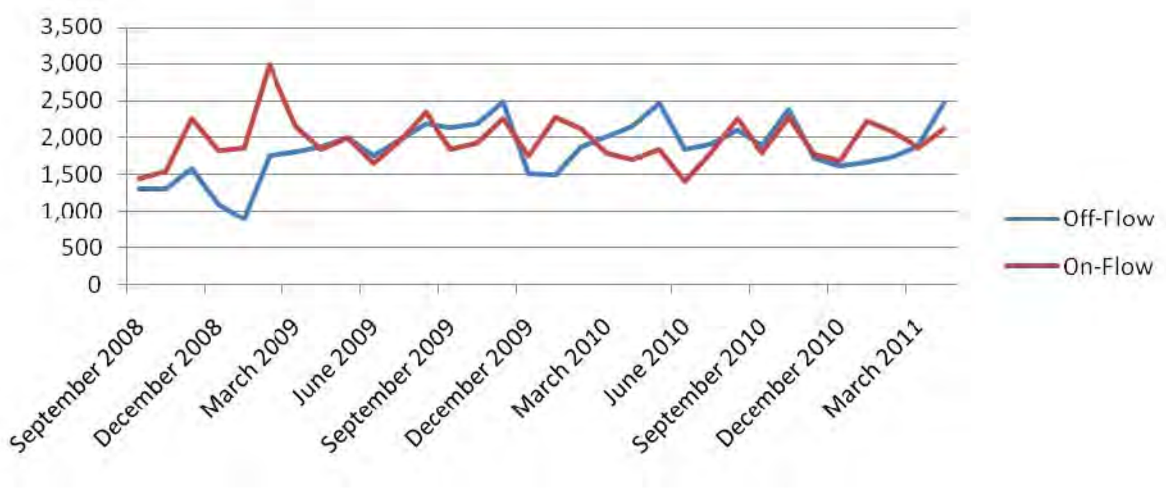
9.6.17 These numbers are volatile and there are significant annual changes in the level of economic inactivity, which is significantly more sensitive to changes in economic output than unemployment. It can therefore be seen that the number of people who are active in the labour market is not fixed – it expands and contracts according to economic environment, so when there are more jobs available, it can be expected that more people will be economically active.

9.6.18 Increases in demand for labour, for example. During the HPC construction phase, are likely to cause an expansion in the labour supply, in part by reducing economic inactivity.

9.6.19 In addition to people moving in and out of the active labour market, there are also significant moves into and out of claimant unemployment.

9.6.20 **Plate 9.1** shows the flows of people on and off Jobseekers' Allowance in Somerset. Since spring 2009 both have stabilised around 2,000 movements in each direction every month.

Plate 9.1: Claimant Unemployment Flows, September 2008 to March 2011



Source: NOMIS

9.6.21 In addition to a large number of people moving in and out of work, there are also regular changes of jobs. There is no single data source for average job tenure, but a number of UK studies have been conducted based on the Labour Force Survey, and the OECD produces an annual dataset. The following table summarises their broad statistics on job tenure.

Table 9.57: Job Tenure

Tenure	Less than one year	1-5 years	5-10 years	10+ years
Percentage	15-20%	30-35%	15-20%	30%

Source: OECD (2010)

9.6.22 The ONS estimates that there are just over 250,000 jobs in Somerset. The application of the OECD data described above would suggest that between 37,500 and 50,000 people in Somerset change jobs every year. The data also show that around half of all workers have job tenure of less than five years, therefore within the

NOT PROTECTIVELY MARKED

construction phase of HPC, most workers would change job twice. By extension, most employers would expect to fill each of their posts twice.

9.6.23 Job tenure is particularly short in construction. A survey for Construction Skills found that in the South West, job tenure was as follows:

Table 9.58: Total Length of Time Expected to Work at a Construction Site in the South West

	2007	2004
< 1 Month	11%	13%
1-3 Months	20%	17%
> 3-6 Months	16%	17%
> 6 Months – 1 year	17%	18%
> 1 Year	20%	9%
Don't Know	17%	25%

Source: Construction Skills (2010) All respondents (2007: 3,877; 2004: 8,436)

9.6.24 Only around two in five workers in the South West (37%) expected to be on site for more than six months and one in five (20%) expected their work on site to last over a year. Looking at variation by occupation, the report states that it tended to be trades whose work is undertaken at specific times in a project who expect the shortest duration on site: Electricians (62%), dry-liners (57%) and roofers (56%) were most likely to expect to be employed at the site for six months or less.

9.6.25 Tenures in key existing sectors in the Somerset economy in particular– tourism and agriculture – are also likely to be very low, because the nature of the work is seasonal.

9.6.26 There are around 47,996 construction sector jobs in the CDCZ, and 9,366 in Somerset. **Table 9.59**, below, shows the proportion of total jobs in the construction sector in Somerset and the CDCZ that the total construction workforce at HPC represents in each year of the project (comparable data is not available for the three districts). Given the relatively high proportions that would be required the assumptions in the central case in relation to the home-based workforce (1,900 of the 5,600 at peak) are significantly lower representing 20% of the Somerset construction workforce and 4% of the CDCZ.

Table 9.59: Construction Jobs

Year	% of Construction Jobs in Somerset	% of Construction Jobs in the CDCZ
1	4%	1%
2	18%	3%
3	34%	7%
4	48%	9%
5	54%	11%
6	60%	12%
7	49%	10%
8	36%	7%
9	17%	3%

9.6.27 There is the potential as part of this process that employees will be recruited from other local employers, thus causing recruitment problems. Experience at Sizewell B was that around 20% of locally recruited employees had previously been unemployed or economically inactive and around 30% (600 of 2,200) recruited in the peak recruitment year had come from other local employers. But a survey of 160 local companies found that less than 10% of the companies thought the power station project made it more difficult to retain or recruit (replacement) staff (Glasson and Chadwick, 1995 (Ref. 9.74)).

9.6.28 If similar proportions were to occur at the peak of the HPC construction programme, this would be around 380 formerly unemployed or previously inactive workers and around 570 workers from existing firms. This would equate to around 96% of unemployed construction workers in the three district area, 49% in Somerset and 9% of the CDCZ. This is assessed as an impact of **moderate beneficial** significance at all spatial levels. In terms of potential “displacement” the 570 workers would account for 6% of the construction workforce in Somerset and 1% in the CDCZ, which would in the context of the overall “churn” within the construction and overall labour market in the area.

iv. Impact on Supply Chain and Procurement

9.6.29 The development of a two UK EPR reactor units at Hinkley Point C will create supply chain opportunities, particularly as it is intended to form the start of a new fleet of nuclear power stations in the UK.

9.6.30 The supply chain will operate on a number of levels:

- There will be around 160 ‘*Tier 1*’ contractors appointed for the construction of the project – national and international companies working independently or through joint ventures who will be responsible for delivering one or more packages of works. A substantial proportion of construction expenditure will be on equipment and materials through this group. There will be a large number of ‘*Tier 2*’ sub-contractors and suppliers working for these contractors – ranging from providing materials, equipment, very specialist skills, through to more general trades.
- EDF Energy and its supply chain will also procure a large range of other (non-construction) services including, for example, professional and design services, facilities management (for campuses and park and rides), transport services, security, events and catering.

9.6.31 The technology suppliers/engineers and equipment and materials contracts will be at the national and international level and will contribute to national policy ambitions to develop the UK’s low carbon manufacturing capacity.

9.6.32 There are however, a number of local and regional firms that may benefit from these contracting opportunities. Over three quarters of the companies registered on the South West Supply Chain portal managed by the Somerset Chamber of Commerce are Somerset based (over 700 firms).

9.6.33 Construction contracts and sub-contracts, and particularly non-construction packages will have a much stronger local and regional element, with a substantial proportion of construction value retained in the local economy through wages to home-based workers and expenditure by non-home-based workers.

9.6.34 Early contracts let by EDF Energy have had a high local component. As of August 2011, contracts worth over £25.8m have been let by EDF Energy to local and regional businesses. The Site Preparation Works contract has been let to Kier/Bam Joint Venture and, in value terms, over 83% of their sub-contracts have been placed with Somerset businesses and organisations with a further 13% going to regional businesses.

9.6.35 Recent information on local contract expenditure for the main civils contractor at Flamanville 3 shows about 2% local expenditure out of Euro 400m total (2007-mid-2009), within 50km of the site, mainly in Cherbourg. At Sizewell B the figure of contracts with local firms in the larger area of Suffolk and Norfolk was a little higher at about 4% (i.e: c £80m out of total contract value of about £2bn).

9.6.36 The total value of the HPC project is estimated at £10bn. This would equate to a total “local” retention of between £100m and £400m over the construction period of the contract, equivalent to up to £45m per year. **This is a moderate beneficial impact** at the CDCZ level**.**

v. Multiplier and Other Local Economic Benefits

9.6.37 In addition to this local supply chain retention, is the “multiplier” income from expenditure by HPC employees in the area. This would include the additional incomes from home-based employees, and the retained expenditure from non-home based employees – i.e. local expenditure on accommodation, goods and services as opposed to that which is saved or remitted to families at home.

9.6.38 The estimated net additional outcome at Sizewell for additional workforce expenditure in the locality (i.e. setting aside some of the expenditure by local recruits which would have been undertaken even if the project had not gone ahead) was around £80 million. Up rating this taking into account the construction costs for HPC would give a total of £400 million.

9.6.39 Annual wages averaged for the whole of the construction period are estimated at £85 million per year, split between £32 million for HB workers and £53 million for non-home-based workers. This is based on the following assumptions of median wages in 2010:

- Site services – all sectors in Somerset
- Civils and M&E operatives – Construction of other civil engineering projects
- Staff and management – Civil engineering
- Associated development – Construction

9.6.40 This produces a total for wages over the construction process of just under £800 million. The amount of this that is captured locally will vary by whether they are home based or not, where non-home-based workers choose to live, and whether they bring their families.

9.6.41 A more detailed analysis would disaggregate the construction workforce expenditure into various expenditure groups. For example, non-home-based employees with families will spend more locally than un-accompanied non-home-based employees. Previous studies for Hinkley Point suggest a multiplier range of 1.3 to 1.5 for those with families, compared with 1.05 to 1.11 for unaccompanied workers, although the latter will still be of most significance in expenditure terms by virtue of the larger workforce numbers involved (Glasson, van Der Wee and Barrett, 1988).

9.6.42 Such an analysis can be used to estimate the wider indirect employment effects generated by the various types of local expenditure. Again the previous studies suggest indirect employment effects in the CDCZ, for example in retailing, plus local suppliers to the main contractors, of up to 50% of the main project employment. For capital projects the Department of Business Innovation and Skills (Ref. 9.75) estimates an average multiplier of 1.4 at the regional level and 1.33 at the sub-regional level.[1] This would mean that for every ten directly employed jobs at the regional level, a further four would be supported in other businesses, three of which would be at the sub-regional level.

9.6.43 This would suggest an additional employment impact of 2,240 for the CDCZ (taken here as the regional level) of which 1,850 would be in the local (taken here as the 60 minute zone) level. It is not appropriate to project multipliers at the very local (district level) as such assessments are very sensitive to small changes in assumptions. These jobs would be mainly outside of the construction sector and therefore not affect the conclusions drawn above, or in the cumulative assessment about construction recruitment. This impact would constitute a **moderate beneficial significance** at the 60 minute zone and CDCZ levels**.**

vi. Impact on Tourism, the Rural Economy and Logistics

9.6.44 In addition to the impact of HPC on other local employers, which is dealt with above, three other issues have been raised in scoping and consultation about impacts on important sectors in the local and sub-regional economy. The main sectors identified have been tourism and agriculture. The potential for HPC to cause traffic congestion in the area has been identified by the local authorities as a possible issue for tourism, agriculture and logistics.

vii. Tourism

9.6.45 In relation to tourism three specific potential effects have been identified:

- Effects on accommodation supply;
- Effects on the 'image' of the area;
- Effect of the Public Information Centre in attracting new visitors; and

9.6.46 Tourist accommodation supply is primarily dealt with in the accommodation section (below). This identifies capacity at peak (August) season and in the off season period (February). Vacancy ranges from around 6,500 places in August in the 60 minute zone, and around 24,500 places in February. On the basis of average worker accommodation allowances and the number of workers likely to be living in tourist accommodation over the lifetime of the construction period, using the central case there would be £15,000,000 expenditure in local tourism accommodation. This is assessed as an impact of **negligible** significance at the 60 Minute Zone level.

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[1] *BIS Occasional Paper No. 1, Research to improve the assessment of additionality, October 2009*

9.6.47 Some concern has been expressed in the consultation process around the potential displacement of tourists who have higher average daily expenditure than workers, and impacts on return visits. In effect however, this will be a commercial decision for accommodation providers, who decide whether to let accommodation to workers – within any planning or other regulatory restrictions with which they must comply. The central case assessment suggests capacity in tourism accommodation even in peak season, and where this is the case expenditure would be additional. Even if there were to be a small level of displacement in the summer in some locations, this would be balanced by the benefits to providers outside of the peak season. This is assessed as an impact of **negligible** significance at all spatial scales.

9.6.48 In relation to the image of the area it has been suggested that there may be an 'image' impact on tourism on the area of the development of a New Nuclear Power Station. Yet there has been a nuclear power station at Hinkley Point since 1965, so this effect, if there was one, would to some extent already be part of the baseline.

9.6.49 Other studies (e.g. Travers Morgan, 1988, on Wylfa) (Ref. 9.76) have found no evidence that such developments deter tourists. A more recent study (Cogent et al, 2008) (Ref. 9.77) similarly found only very limited economic impact on tourism for the, partly analogous, energy developments of wind farms—and most of the concern was related to the early planning period for such developments. In the absence of any evidence to the contrary this impact has a **negligible** significance at all spatial levels.

9.6.50 A new Public Information Centre is proposed as part of HPC development. It is the intention of EDF Energy that this would be open to the public with a mix of local, tourist and educational visitors. The detailed content of the centre is still under development but it will include a reception, cafe and auditorium, high quality modern exhibition galleries. It is anticipated that the centre will open in 2014 and allow visitors to view the progress of the development.

9.6.51 The current intention is for the Centre to be open seven days a week from 10am to 4pm, although Sunday hours may be slightly shorter. As such it is expected to be a popular visitor destination for tourists and local residents alike. EDF Energy intends to have an initial cap of around 250,000 annual visits per year, with capacity for up to 1,000 a day in August peak. If it attracted 250,000 annual visitors it would be the equal most popular visitor attraction in Somerset County Council area alongside the West Somerset Railway (250,000), with nearly twice the total visitors of the next two largest Glastonbury Abbey (125,000) and the Fleet Air Arm (113,000). This impact would be of **major beneficial significance** at the local and county level**.**

c) Impact on Agricultural Land and Farming Activity

Farm Land and Activity

9.6.52 The proposed development would lead to the loss of farming activity, arable land and pasture both temporarily and permanently within site boundary.

9.6.53 Some land take impact will be short term/medium term during the construction period, with land required on a temporary basis to accommodate the construction activities and then restored post-construction. Of the total 171.4 hectares site area, approximately 66.6 hectares of land will be permanently lost. Following the construction phase, 104.8 hectares of land will be restored (as part of the Landscape

Restoration Plan) to arable agricultural land, grassland, woodland and scrub, hedgerow and wetland habitats.

9.6.54 Overall, the area of agricultural land affected within the site (141.2ha) represents approximately 0.04% of the total 331,233ha of agricultural land (Grades 1-5) across Somerset as a whole. As a proportion of the total employment in the agricultural sector in Somerset in 2009, this would equate to an average loss of 0.7 jobs in this sector.

9.6.55 Given the very low proportion of jobs that would be lost, the magnitude of the impacts would be very low (insignificant in terms of the sub-regional economy) and the sub-regional economy as a receptor would have very low sensitivity to the proposed changes, resulting in an impact of **negligible** significance in terms of the sub-regional economy.

Severance/Disruption

9.6.56 No severance is experienced through the construction and operational phases of the Hinkley Point C Development Site due to the natural boundary features and the scale of the area involved. Agricultural access to the surrounding land remains unaffected by EDF Energy's proposals as there remain sufficient linkages between adjoining fields to allow for the continuation of agricultural practices in adjacent farm units, therefore no impact is identified.

Direct Economic Impact

9.6.57 The HPC Project would affect land currently under agri-environment schemes (comprising Entry Level Environmental Stewardship and Countryside Stewardship Agreements). Schemes within the site will cease prior to commencement of the earthworks associated with the construction of Hinkley Point C.

9.6.58 According to Natural England, the total number of agreements and the total area of land in Countryside Stewardship Schemes or entry level Environmental Stewardship Schemes in Somerset (as July 2011) is as follows:

- Total Entry Level Environmental Stewardship Schemes – 1,128 agreements, amounting to 88,406.8 hectares of land.
- Total Countryside Stewardship Scheme – 211 agreements, amounting to 6,113.2 hectares of land.

9.6.59 The amount of land under Entry Level Environmental Stewardship Agreements within the site is therefore approximately 0.09% of the land under such agreements in the whole of Somerset, representing a very low magnitude impact and low sensitivity of the receptor to change as a result of the proposed development. This results in an impact of **negligible** significance in terms of the wider economy.

9.6.60 The loss of the derelict farm buildings on the site has no socio-economic impact due to the structural condition of these structures making them unsuitable for agricultural use.

9.6.61 Land owners will be compensated for any loss of land prior to the start of construction of the proposed development; therefore no impact is identified on individual farm units.

d) Impacts of Transport on Business

9.6.62 The **Transport Assessment** assesses the peak traffic generation for HPC and associated developments on a weekday and identifies that there are no significant delays caused as a result of HPC across the modelled network (which broadly covers an area between junctions 23 and 24 and Cannington), during the peak construction phase of HPC (2016). By 2021, the assessment indicates that there is an improvement to the overall transport network in Bridgwater as a result of the proposed highway improvement measures delivered through the HPC project. The assessment also states that there is very little seasonal variation and that there will be less traffic on Saturdays. Therefore, it can be concluded that there will be no significant additional delays to tourist traffic on routes through Bridgwater arising as a result of the HPC project, and negligible impacts on the delivery of goods or on the agricultural sector. This is assessed as an impact of **negligible** significance at all spatial levels.

e) Financial Benefits (Business Rate Retention)

9.6.63 On 18th July 2011 the Secretary of State made a statement to the House of Commons, drawing attention to the publication of the Government's proposals to enable local retention of business rates, and Tax Increment Financing (Ref. 9.78).

9.6.64 The consultation seeks views on the Government’s proposals to change the way local government is funded by introducing retention of business rates. It also seeks views on options for enabling authorities to carry out Tax Increment Financing within the business rates retention system.

9.6.65 The consultation sets out the Government’s proposed core components for a business rates retention system. In addition, the consultation sets out the proposals for TIF to operate within the business rates retention system as a way of funding infrastructure investment to unlock economic growth. The consultation also outlines how the proposals interact with wider Government initiatives to promote growth, including the existing New Homes Bonus, and considers how they will work alongside the existing architecture of the business rates system which will not be changed – for example rate reliefs and the national business rate multiplier.

9.6.66 While this policy is still in development, and is relatively uncertain, if implemented there could be a potential positive effect at the local scale in relation to the HPC Project.

9.6.67 The Government’s proposals include:

- Setting a baseline business rate in 2013/14 for each local authority;
- Setting a baseline level which local authorities will retain, and a baseline contribution to the national pot (a tariff);
- Identifying an incentive as to what percentage of any business rate increase from the baseline local authorities retain; and
- Introduce a levy for claiming back any “disproportionate” benefit (i.e. an overage component).

9.6.68 For West Somerset Council, there could therefore be a significant benefit generated from retention of business rates as a result of HPC, noting that there are uncertainties over, for example, how gains will be shared with upper-tier authorities, and what proportion could be retained ("windfall"). Without further information it is not possible to assess the magnitude of this impact.

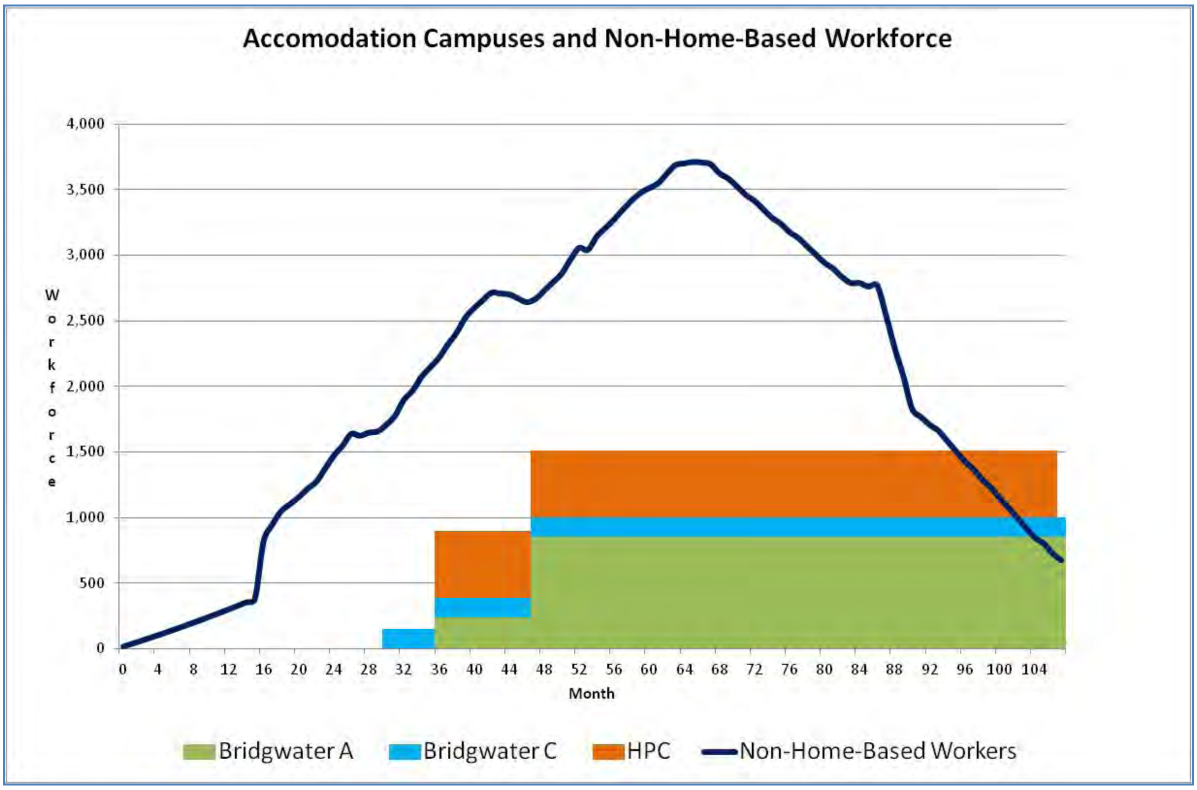
i. Accommodation Impacts

9.6.69 The central scenario for the construction phase identifies the non-home based workforce that will be required to build HPC, and that they will live within a 60 minute travel time of the HPC site. However, there are significant uncertainties related to the locations where workers will choose to live, how many non-home-based workers will be required, and which sectors of the housing market they will choose to live in. The precise location that workers choose will be dependent on a number of factors, including their duration of stay; the price and type of accommodation; access to their permanent homes, Park and Rides and the site (via direct buses); and access to amenities such as sport and leisure, and, in the case of families, schools.

9.6.70 As identified in the baseline, there are an estimated 4,200 vacant bedspaces at peak. However, some assumptions have been made relating to the likelihood/ability for non-home-based construction workers to take up accommodation in different sectors, for example affordability of tourist accommodation, where a 60% discount has been applied to take account of limited affordability of much tourist accommodation.

9.6.71 As part of the "built-in" mitigation for the scheme a campus-based accommodation strategy will underpin the development. **Plate 9.2** below shows how the construction of the campuses will be phased to reflect the numbers of workers requiring accommodation in the local area based on the central case workforce profile. It can be seen that the gap between the availability of campus accommodation and the total amount of accommodation required is at peak, in balance with the 4,200 bedspaces which EDF Energy assesses to be the minimum spare capacity available in the local area at August peak season. At the peak of construction they will provide accommodation for around 40% of the non-local workforce. The central case assumption therefore is that there is an impact of **negligible** significance on accommodation at the 60 minute drive time spatial level.

Plate 9.2: Construction Campus Phasing



9.6.72 Use of existing accommodation will be required prior to the completion of any purpose built campus accommodation provided by EDF Energy.

9.6.73 Overall, and noting that a degree of uncertainty is inherent in estimating the accommodation demand that will be generated by the project, it has been concluded that a total campus provision of around 1,500 will be provided, based on the following assumptions which are outlined in more detail in the **Accommodation Strategy**:

Table 9.60: Accommodation Analysis at Peak Construction

Accommodation at Peak Construction	
Peak workforce	5,600
Local recruitment at peak	34%
Non home based workforce requiring accommodation at peak	Approx. 3,700
Minimum spare accommodation capacity locally within 60 minutes	Approx.4,200
Additional accommodation to be provided by EDF Energy at peak	Approx.1,500

9.6.74 As well as the avoidance of impacts on the local accommodation market the campus accommodation is regarded by EDF Energy as essential because of availability for short stays, the ability to provide high quality and well managed amenities on the site, and the ability to manage workers' effects on the wider area. The on-site campus has additional advantages in that:

- Workers can either walk directly to site or take a very short bus journey within the site compound. This would materially reduce the trips of workers through Cannington and other local villages on the local road network.

- Having personnel close to site would ensure a rapid and effective response to any on-site issues or incidents.
- Minimising travel times between the accommodation campus and the construction area site helps to increase the productivity and efficiency of the workforce through minimising the effective length of their working day.
- It would be particularly beneficial for those working night shifts or irregular unsocial hours, including some supervisory and maintenance staff.

9.6.75 At the peak of construction around 3,700 (34%) of the 5,600 workforce will require accommodation locally (within the 60-minute travel distance) based on the 'central case'. It should be noted that, for several years either side of peak construction, accommodation demand generated by the project is expected to be less than this, but still substantial. It should be noted that these are "snapshot in time" figures (many employees will stay for only a limited period).

9.6.76 The scale of the HPC construction workforce, and especially the number of non-home based workers who will seek accommodation in the local area, needs to be seen in the context of wider local demographics. The non-home-based workforce will be relatively small in number when seen in the context of the existing population of Somerset (523,000) of the nearest districts of West Somerset, Sedgemoor and Taunton Deane (just under 260,000), and neighbouring North Somerset (212,200).

9.6.77 In order to assess impacts more specifically each component of the housing market has been considered separately. This includes owner occupied housing, the private rented sector, tourist accommodation, and latent accommodation.

Owner-Occupied Sector

9.6.78 Under the central scenario, it is anticipated that by the time of peak construction, around 500 workers will have moved to owner occupied properties. Some of these will eventually form part of the operational workforce, others will be long-term construction workers.

9.6.79 If spread over the first four years of the construction programme – given that those buying property are likely to arrive earlier in the construction programme and stay longer, the resulting 100+ units required per annum to accommodate the demand from non-home-based workers seeking owner-occupied units would account for less than 3% of all sales in 2009, which was a low year for sales. A comparison with the higher level of sales in 2006 reduces the figure to only 1.5%. These are very small impacts in the context of the regular churn of the owner–occupied housing market. In the context of the baseline of the total owner occupied housing stock within the three districts, an additional 500 units would only equate to 0.5% of the baseline stock.

9.6.80 As such, this impact is considered as being of **negligible** significance at all spatial scales.

Private Rented Sector

9.6.81 Based on the central scenario, around 750 non-home-based workers are expected to live in private rented accommodation at peak construction.

9.6.82 There is a substantial private rented sector accommodation (PRS) within the 60 minute zone, based on the 2001 Census, and at the time of the 2008 update included in the Housing Needs Survey (HNS) that was undertaken as part of the local authorities' Strategic Housing Market Assessment.

9.6.83 In total it can be seen that there are around 21,800 PRS units in the 60 minute zone equating to around 50,796 bedspaces.

9.6.84 The overall vacancy rate for dwellings in West Somerset, Sedgemoor and Taunton Deane were set out in the Strategic Housing Market Assessment (SHMA) at 3.5%, 4.2% and 3.3% respectively. However, there is significant difference in vacancy between tenures. The latest results from the 2008 English Housing Survey show national average vacancy rates by tenure of housing (where the tenure assigned to vacant properties relates to the previous occupancy), as follows:

- owner occupied: 2.7% of properties vacant;
- social rented: 4.6% of properties vacant; and
- private rented: 13.3% of properties vacant.

9.6.85 It is also important to note the degree of annual turnover (or 'churn') in the property market. The greater the degree, the more dynamic is the market. There is no comprehensive data on levels of turnover within the local housing stock; however evidence from the SHMA and the Census indicates the following annual turnover (churn) rates:

- West Somerset: 13%.
- Sedgemoor: 20%.
- Taunton Deane: 24%.

9.6.86 An indication of the likely degree of turnover can also be obtained from national survey-based evidence. The English Housing Survey provides data on the proportion of households living in their current home for less than a year (EHS Annual Household Report 2008/09). This provides an indication of typical annual turnover in the housing stock, and illustrates for example the very high churn in the private rented market. The latest results for 2008 are as follows:

- owner occupied: 4% of households have moved within the last 12 months;
- social rented: 8% of households have moved within the last 12 months; and
- private rented: 36% of households have moved within the last 12 months.

9.6.87 In order to understand the spare capacity in the private rented sector, this assessment has sought to break capacity down into two components. First, to operate effectively housing markets need a small level of capacity to allow for people in the process of moving, or the process of letting homes: this is called "frictional" capacity. Any capacity on top of that can be described as additional or spare capacity and it is this capacity that has been assumed would be available to HPC workers. There is no single data source which provides this capacity at the local level so a combination of national and local datasets has been used to identify some parameters.

9.6.88 Using the English Housing Survey data some parameters can be established. The annual churn rate of 36% equates to 3% of all properties turning over in each month. This would be the absolute minimum vacancy required for the market to turnover. However, using the same dataset, the vacancy rate at a given point in time is 13%, which suggests a maximum spare capacity of up to 10%.

9.6.89 Using more local data (HSSA, 2009), annual turnover is highest in Taunton Deane at 24%, which means 2% of all stock turns over each month. This sets the minimum benchmark for spare capacity required for the market to function. The local vacancy rate in the PRS is not known, however if it is similar to the national rate this suggests capacity up to a maximum of 11%.

9.6.90 Given the high levels of churn in the market, it is possible that genuinely spare capacity could be used, but that this could appear to be displacing existing tenants, either because it is concentrated in one location or in one part of the market, e.g. for the cheapest accommodation. However, the assessment suggests that the scale of demand from non-home-based workers will be low enough to prevent this happening. As such, this impact is considered as being of **negligible** significance at all spatial scales**.**

Tourist Sector

9.6.91 It is estimated in the central scenario that at peak around 600 non-home-based workers will live in tourist accommodation in the 60-minute area, in serviced, self-catered and caravan/camping sectors.

9.6.92 Moreover Somerset has a substantial tourist accommodation industry, where each year some 2.4million visitors spend almost 10million nights (Ref. 9.79). Relative to that, demand for accommodation from the HPC workforce will be small.

9.6.93 There are approximately 50,000 tourist bed spaces within the 60 minute zone, or 35,000 excluding holiday villages, based on 2009 South West Tourism data. This is an underestimate of the total tourist accommodation in the area because it only includes accredited or “rated” accommodation and there are many businesses that are not rated and therefore do not appear on the SWT database.

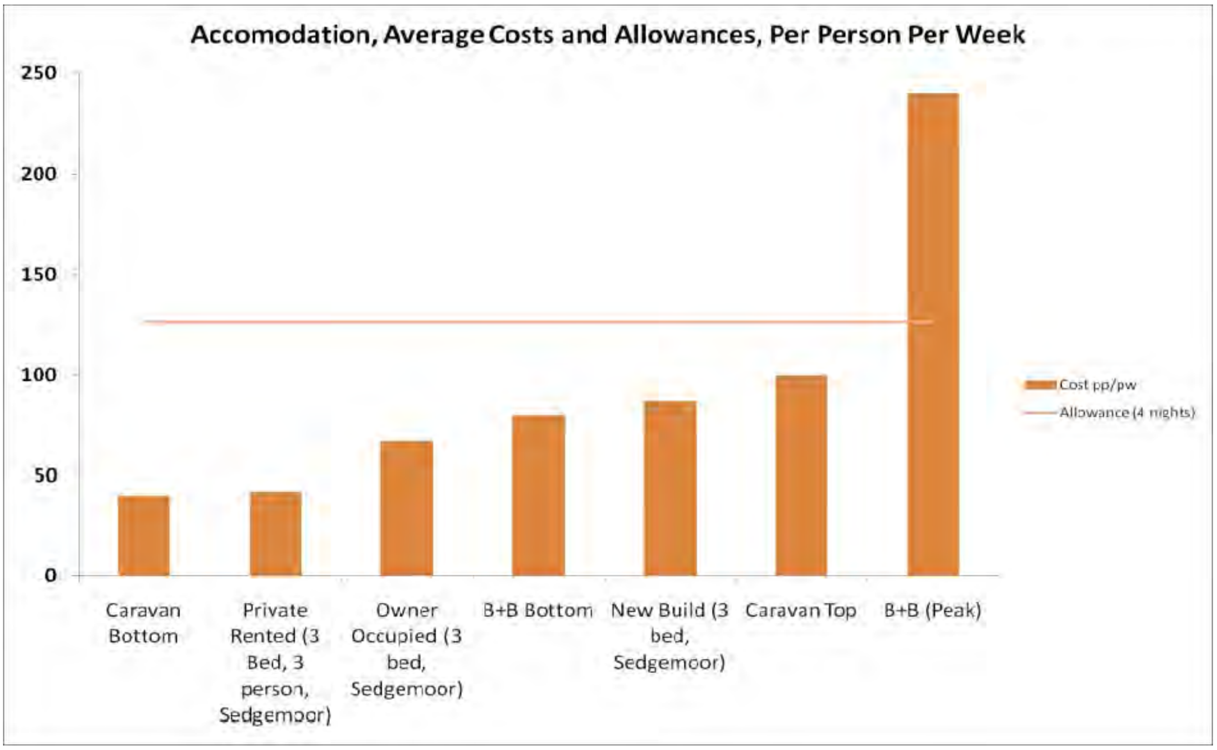
9.6.94 There are also significant fluctuations in the occupancy/vacancy levels of tourist accommodation based on seasonality. In assessing the potential availability of tourist accommodation for EDF Energy’s workforce, a conservative estimate has been made, based on the peak levels of tourist demand in August. Average occupancy levels for this accommodation outside of peak holiday periods are typically much lower – there are 24,500 vacant bedspaces in March and 6,500 in August.

9.6.95 There is therefore a large pool of tourist accommodation that could potentially be utilised by the construction workforce in off-peak periods. Use of some of this accommodation during off-peak periods would clearly offer economic benefits to tourist accommodation providers and other related local businesses.

9.6.96 However, it is recognised that not all of this accommodation is suitable for workers. Some rooms will be double or family rooms which workers are unlikely to want to share. There are also planning restrictions on the use of camping and caravan sites. These include restrictions on the use of sites during winter months, limits on the length of time a person can occupy a site and restrictions on non-tourist use. This will reduce the available supply to HPC workers below the figure above (and also limit demand to those who want only short-stay accommodation).

9.6.97 In addition, some accommodation will not be affordable to workers. The average costs per week of different forms of accommodation have been compared against a union-agreed accommodation allowance paid to construction workers. This shows that a significant proportion of serviced tourist accommodation will not be affordable to HPC construction workers, highlighted in the following chart:

Plate 9.3: Accommodation, Average Costs and Allowances Per Person Per Week



9.6.98 However, caravans and the bottom end of the bed and breakfast market will be accessible in price terms. To account for the fact that not all serviced accommodation will be suitable or affordable; a 60% discount has been applied to availability. That leaves an estimate of in the region of 2,070 spare bedspaces in August:

Table 9.61: August Vacancy

Type	August Vacant and Affordable
Serviced	840
Self-catering	172
Caravan/Camping	1,058
TOTAL	**2,070**

9.6.99 In practice, the risk of adverse effects on the tourism sector will also be further reduced by the seasonal pricing operating within tourist markets. Providers tend to put their prices up quite significantly over the peak holiday periods, such that it would not be affordable for the vast majority of HPC workers. This is likely to act to significantly reduce the take up by the HPC construction workforce of tourist accommodation during peak periods – for example the average price of a hotel or bed and breakfast accommodation in Somerset in August is substantially above the normal union-agreed accommodation allowance for the majority of the construction workforce. Therefore, the normal operation of market mechanisms would be likely to encourage the use of tourist accommodation mainly during the cheaper non-peak periods when there is significant spare capacity and when the tourism industry stands to benefit from the additional demand generated by the construction workforce.

9.6.100 There will also be a beneficial economic impact resulting from the spend by non-home-based construction workers on nights in tourist accommodation, off-peak and year-round, as identified above. Overall impacts on the tourist accommodation sector are anticipated to be of **negligible** significance at the 60 minute level.

Latent Sector

9.6.101 In addition to the above, it is expected that a proportion of non-home-based workers will live in accommodation that is considered ‘latent’ (i.e. not identified as being currently or previously rented, or within the tourist sector).

9.6.102 The central scenario estimates that around 400 non-home-based workers would live in latent accommodation at peak construction.

9.6.103 There is evidence from the responses to EDF Energy’s consultations and accommodation surveys of a high level of interest from local providers to offer accommodation to the construction workforce.

9.6.104 EDF Energy placed newspaper adverts on two separate occasions inviting potential landlords to register their property if they wished to offer accommodation to the HPC construction workforce. The initial response to these provided 750, of which over 450 were genuinely “additional” to existing supply, i.e. they had not been offered for rent before. This additional accommodation can be used without any risk of displacing existing residents. As at September 2011 the EDF Energy Accommodation database had increased further to 1,500 properties.

9.6.105 It is likely that the amount of latent accommodation of this kind will increase over time as the construction phase starts and more people realise that they can take advantage of the commercial opportunities which arise from it. Once people are aware of construction workers arriving in the area, and see others they know renting out rooms, it is likely that more people will come forward with offers of rooms to rent. EDF Energy has recently contacted those who expressed an interest in providing accommodation to check their availability and from a limited sample it appears that most of the rooms remain available to rent.

9.6.106 Given the economic impact of bringing forward rooms for rent, the impact on latent accommodation is estimated as being temporary and of **minor beneficial** significance at the 60 minute travel area level.

Summary

9.6.107 Overall, there is clear evidence that some local accommodation sources have significant spare capacity at certain times of the year (notably tourist accommodation during off-peak periods).

9.6.108 Based on the above analysis it is estimated that, during the peak tourist period, and looking across all sources of accommodation, the minimum capacity that HPC construction workers would be able to use without creating any risk of significant disruption to accommodation markets is 4,200 spaces. As explained above, this figure is based on very conservative assessments of spare capacity, in particular in relation to tourist accommodation where there is much more spare capacity outside the peak tourist season. For most of the year, there will be much more accommodation available without any risk of significant disruption to accommodation markets.

9.6.109 As a result of this analysis, EDF Energy has concluded that it is reasonable to assume that at least 4,200 bed spaces will be available locally to support the accommodation of the HPC construction workforce without displacing local people or tourists. Use of local accommodation up to this level will offer net positive benefits to the local area and economy, with a low risk of any material negative impacts. For the reasons set out above this is a very conservative estimate and there is potential to use much more tourist accommodation, in particular outside of the peak holiday periods.

9.6.110 Additionally, the demand created by the project should help to stimulate improvements in the existing housing and tourist stock, thus generating legacy benefits.

Sensitivity and Thresholds

9.6.111 The previous section highlights that there are defined negligible impacts within the owner-occupied sector, given the relative size of existing supply, levels of churn/migration, compared to the estimated non-home-based worker demand for this kind of accommodation.

9.6.112 However, there is a level of uncertainty related to other sectors, most notably the tourist and private rented sectors. The following tables identify variations on the central scenario of workers anticipated in each sector, and in specific locations based on the gravity model central assumptions.

9.6.113 Increased numbers could occur if there were more workers overall, a higher proportion of non-home based workers or if they were to occupy different locations. The tables show each of the "ward clusters" and compare their available accommodation capacity (at peak August season for tourism accommodation) to the likely number of workers using the central scenario, 600 workers at peak for the tourist sector and 750 for private rented accommodation. It then shows capacity where there are higher numbers of construction workers using the same distribution.

9.6.114 Those areas highlighted in red are where the number of workers could exceed capacity.

Tourist Sector

9.6.115 **Table 9.62** demonstrates that HPC would be likely to have a **negligible** impact on the supply of bedspaces in all areas except for Cannington and Bridgwater, and an overall **negligible** impact for all scenarios. It could have a moderate adverse impact in Cannington before mitigation for higher scenarios.

9.6.116 Cannington is sensitive to the central case scenario and Bridgwater would be sensitive to a two-thirds increase in the number of workers demanding tourist accommodation at peak construction in the August peak. At other times of the year there would not be a problem. Even if there were higher demand in those two clusters it is unlikely to have wider economic impacts as tourists seeking accommodation in the area should be able to find alternatives in other clusters in the local area.

Table 9.62: Tourist Sector: Sensitivity Analysis

Forecast Available Capacity Levels – August			Non-home-based Construction Workers Sensitivity Scenarios						
			596	750	1,000	1,250	1,500	1,750	2,000
Ward Cluster/Available Bedspaces	Bridgwater	100	70	80	110	140	170	200	220
	Burnham and Highbridge	590	200	250	340	420	500	590	670
	Cannington	20	30	40	50	60	70	80	90
	Cheddar	230	40	50	70	80	100	120	130
	Glastonbury	90	40	50	70	80	100	120	130
	Hinkley Point	10	0	0	0	0	10	10	10
	Minehead	230	50	60	80	100	120	140	170
	Somerset South	80	10	10	10	20	20	20	30
	Somerset West	80	10	10	10	10	10	20	20
	Taunton	170	30	30	50	60	70	80	90
	Watchet and Williton	120	60	70	100	120	150	170	200
	Weston-super-Mare	360	70	90	110	140	170	200	230
	60-minute Area	2,050	600	750	1,000	1,250	1,500	1,750	2,000

Private Rented Sector

9.6.117 **Table 9.63**, below, demonstrates that HPC would be likely to have a **negligible** impact on the supply of private rented accommodation in all areas in the central scenario. The Bridgwater, Cannington and Williton and Watchet clusters could be sensitive to a one-third increase in demand. In general the potential impacts on the private rented sector would be more sensitive to increased demand than those on tourism – as highlighted in red where the number of workers could exceed capacity.

Table 9.63: Private Rented Sector Sensitivity Analysis

Ward Cluster/Available Bedspaces		Non-home-based Construction Workers Sensitivity Scenarios					
		750	1,000	1,250	1,500	1,750	2,000
Bridgwater	130	110	150	180	220	260	290
Burnham and Highbridge	90	60	80	110	130	150	170
Cannington	20	20	30	40	50	60	60
Cheddar	20	10	10	20	20	30	30
Glastonbury	60	20	30	40	40	50	60
Hinkley Point	10	10	10	10	20	20	20
Minehead	60	30	40	50	60	70	80
Somerset South	80	30	40	50	60	70	80
Somerset West	40	10	10	10	10	20	20
Taunton	240	130	180	220	270	310	360
Watchet and Williton	30	30	40	40	50	60	70
Weston-super-Mare	780	290	380	480	570	670	760
60-minute Area	1,570	750	1,000	1,250	1,500	1,750	2,000

9.6.118 Whilst the ward clusters provide a useful way of understanding the balance of supply and demand at a more local level, it must be remembered that the tables provide a static snapshot of the position at the current time. In reality the market is dynamic and existing residents already move both within and between districts and out of the area altogether. Analysis of the 2001 Census shows that only 37% of household moves in Sedgemoor and West Somerset were within the same ward so, as with tourism, there is some degree of movement between clusters from other sources of demand.

ii. Population and Population Dynamics/Structure

9.6.119 The population structure of the 60-minute travel area is likely to experience a level of change associated with the presence of a non-home-based construction workforce. Based on the central case, as described above, there would be an overall increase of approximately 3,700 non-home-based workers within the 60-minute area, distributed across the area. This distribution has been assessed against average annual population turnover (new residents taken from Census 2001 Moving Groups data) to identify the proportion of non-home-based workers compared with ‘usual’ turnover:

Table 9.64: Non Home Based Workers as Proportion of Annual New Residents

Ward Cluster	Total New Residents in 2001	% New Residents in 2001	Non-home-based construction workers at peak	Non-home-based workers as % of Average Annual New Residents
Bridgwater	2,461	5.5%	1,392	57%
Burnham and Highbridge	2,701	7.0%	378	14%
Cannington	556	8.1%	120	22%
Cheddar	725	7.2%	109	10%
Glastonbury	2,188	8.2%	81	4%
Hinkley Point and Stogursey	134	6.5%	496	370%
Minehead	1,408	8.7%	119	8%
Somerset South	2,009	7.5%	55	3%
Somerset West	836	8.0%	19	2%
Taunton	5,380	8.1%	362	7%
Watchet and Williton	757	7.0%	150	20%
Weston-super-Mare	6,049	5.5%	454	8%

9.6.120 As the table demonstrates the area which would have the largest proportionate population impact would be the Hinkley Point and Stogursey area adjacent to the site – principally because of the on-site campus. Bridgwater, being the nearest main town and location of the two other purpose built campuses would be likely also see a population increase at peak of over 50% the annual average increase. These would both be temporary **major impacts** at the local level. Cannington and Williton could also see **moderate temporary** impacts in terms of population growth. Impacts are likely to be **minor** or **negligible** for all other clusters.

Sensitivities and Thresholds

9.6.121 As highlighted in **Table 9.65** there is a baseline level of population 'turnover' within each ward cluster each year, against which the significance of the increase in non-home-based workers is assessed, outlined in the following table. This is set against sensitivity levels whereby the non-home-based workforce is increased by up to 50% on the central case, identifying a similar significance level to the central case, although 'moderate' significance in Burnham and Highbridge at 40% increase.

Table 9.65: Non Home Based Workers as Proportion of Annual New Residents: Sensitivity Test

Non-home-based construction workers			non-home-based workers as % of Average Annual New Residents					
			Central Case	10%	20%	30%	40%	50%
	Bridgwater	1,392	57%	62%	68%	74%	79%	85%
	Burnham and Highbridge	378	14%	15%	17%	18%	20%	21%
	Cannington	120	22%	24%	26%	28%	30%	32%
	Cheddar	109	10%	11%	12%	13%	14%	15%
	Glastonbury	81	4%	4%	4%	5%	5%	6%
	Hinkley Point	496	370%	407%	444%	481%	519%	556%
	Minehead	119	8%	9%	10%	11%	12%	13%
	Somerset South	55	3%	3%	3%	4%	4%	4%
	Somerset West	19	2%	3%	3%	3%	3%	3%
	Taunton	362	7%	7%	8%	9%	9%	10%
	Watchet and Williton	150	20%	22%	24%	26%	28%	30%
	Weston-super-Mare	454	8%	8%	9%	10%	11%	11%
	60-minute Area	3,700	15%	16%	18%	19%	21%	22%

9.6.122 It is not possible to identify the extent to which a population impact is "beneficial" or adverse" without considering the specific impacts which that population might have. This is dealt with further below. The area immediately around Hinkley Point is unlikely to see the higher proportions of workforce as there will be limited availability of accommodation outside the campuses.

iii. Public Services

9.6.123 The introduction of a new non-homed-based workforce into the 60 minute travel zone could have impacts on demand for public services, and the ability of service providers to respond. Demand will vary between different types of service depending on how the demographic profile of the workforce (particularly age and gender), and in some cases the location of workers.

9.6.124 Current services in the area which might have some relevance to the HPC workforce can be split between the following key service providers and topic areas. The proportions of public expenditure relate to service provision and therefore exclude benefit payments. This does not include the Unitary Authority of North Somerset which is also likely to house some non-home based workers and provides, for its area, all of the services provided by the Districts and the County.

9.6.125 Somerset County Council (SCC) (responsible for around 40% of public expenditure):

- Education and Social Services (between them accounting for around 80% of SCC expenditure).
- Regulatory and Environmental Services (County/District).
- Economic Development and Tourism (County/District).

- Libraries.

9.6.126 District Councils – mainly West Somerset and Sedgemoor (around 5% of public expenditure):

- Housing.
- Leisure.
- Economic Development and Tourism (District/County)).
- Regulatory and Environmental Services (District/County).

9.6.127 Emergency Services (around 10% of public expenditure):

- Policing.
- Fire.

9.6.128 Health (around 45% of public expenditure):

- Primary Care Trust – Commissioning services.
- Ambulance Service Trust (Providing Services).
- Other Health Trusts (Providing Services).

9.6.129 With the exception of health services all other services are funded by a combination of Council Tax, Central Government grants and fees. Health services are funded by a complex grant formula from Central Government.

9.6.130 Where workers are living in accommodation where they pay Council Tax, this should in effect self “mitigate” the impacts of their demand, and similarly where there are fees and charges for services (e.g. leisure). In theory central Government grant formulae should also respond to changing population, however they are generally based on population estimates which don’t take into account short term migrant workers and funding can be slow to adjust.

9.6.131 It should be noted more broadly that migrant construction workers generally make a net contribution to the national exchequer on the basis that they are in work and generally of age groups (younger) and in household types (with few dependents) that make less demand on public services, for example on social services, education and acute healthcare.

9.6.132 The assessment of the key service areas below therefore identifies a “gross” impact, based on the workforce model and spatial spread, and then a net impact on the basis of “automatic mitigation” by services provider and management proposals by EDF Energy for certain services. It is against the latter assessment that significance criteria are attached and any mitigation measures required. The assessment also identifies uncertainties, giving consideration to sensitivities and thresholds should the central case be exceeded.

9.6.133 This section covers all of the services listed above with the exception of housing services – which is covered in the accommodation section) and Tourism and Economic Development (which is covered in the economic impacts section).

f) County Council Services

i. Education – Gross Impacts

9.6.134 Demand for education provision would come from the children of non-home-based workers in the family type households identified above. The table below shows the possible spread of those family households, at peak, based on the owner occupied component of the gravity model. Experience from Sizewell suggests that family based workers are likely to arrive earlier and stay longer, so it is likely that these families will build up over the five years prior to the peak. Evidence also suggests that these families are likely to be more widely spread than single person non-home-based households.

Table 9.66: Spatial Spread of Family-type Households with Children in Non-home-based workforce

	Family Type Households	Pre-school	Primary	Secondary
Bridgwater	108	18	37	27
Burnham and Highbridge	74	13	26	18
Cannington	37	6	13	9
Cheddar	12	2	4	3
Glastonbury	6	3	6	5
Hinkley Point	6	1	2	2
Minehead	17	3	6	4
Somerset South	19	3	6	5
Somerset West	4	1	2	1
Taunton	83	14	29	21
Watchet and Williton	24	4	8	6
Weston-super-Mare	98	17	34	24
60-Minute Travel Distance	500	85	174	124

ii. Pre-School

9.6.135 Based on estimates of children of pre-school age taking residence within the area as a result of a non-home-based worker population in the area there are likely to be around 37 pre-school aged children in Sedgemoor, 17 in Taunton Deane, nine in West Somerset, 17 in North Somerset and 5 in Mendip. As such, against the assessed levels of sufficiency and existing provision, the impact at district-level is considered to be **negligible**.

iii. Education – Net Impacts

9.6.136 The way education demand interacts with current and projected education capacity depends whether the children are net additional to current demand. It is likely that if they live in owner occupied family accommodation they will be included in current and future projections as they are part of the overall housing market "churn". If families live in private rented accommodation they may contribute to net additional demand for school places. In either case the "revenue" cost of providing for additional pupils is formula based and these households will also be paying Council tax. Therefore the only impact would be if additional "physical capacity" was required to meet demand, or if high levels of turnover or mobility put increasing pressure on school resources.

9.6.137 The following tables outline the current capacity in local ward clusters and across the 60-minute travel area, and identify the possible impact at each locality of the forecast child population if they were all net additional.

Table 9.67: Primary Education Capacity Change as a Result of Forecast Population Increase (Primary School Places)

	Current Capacity	Current Surplus Places	Current Surplus Capacity	Possible HPC Children	Surplus Capacity If All Net Additional
Bridgwater	3,831	185	5%	37	4%
Burnham and Highbridge	2,995	177	6%	26	5%
Cannington	630	33	5%	13	3%
Cheddar	822	154	19%	4	18%
Glastonbury	2,708	535	20%	6	20%
Hinkley Point	84	21	25%	2	22%
Minehead	1,032	370	36%	6	35%
Somerset South	2,415	548	23%	6	22%
Somerset West	644	99	15%	2	15%
Taunton	5,551	372	7%	29	6%
Watchet and Williton	627	206	33%	8	32%
Weston-super-Mare	9,545	1,403	15%	34	14%
60-Minute Travel Distance	30,884	4,103	13%	174	13%

Table 9.68: Secondary Education Capacity Change as a Result of Forecast Population Increase (Secondary School Places)

	Current Capacity	Current Surplus Places	Current Surplus Capacity	Possible HPC Children	Surplus Capacity If All Net Additional
Bridgwater and Cannington	3,802	264	7.5%	36	6.0%
Burnham and Highbridge	1,980	-49	-2.4%	18	-3.4%
Cheddar	1,754	58	3.4%	3	3.1%
Glastonbury	1,090	-8	-0.7%	5	-1.2%
Minehead	2,202	292	15.3%	4	13.1%
Somerset South	860	38	4.6%	5	3.9%
Somerset West	725	-55	-7.1%	1	-7.7%
Taunton	4,274	31	0.7%	21	0.2%
Watchet and Williton	464	68	17.2%	6	13.4%
Weston-super-Mare	7,305	810	12.5%	24	10.8%
60-Minute Travel Distance	24,456	1449	6.3%	124	5.4%

9.6.138 On this basis, and assuming the central case scenario, the non-home based workforce could have a **negligible** impact at the 60 minute level, with a possible minor adverse impact in specific locations, including Bridgwater and possibly Cannington and Taunton.

9.6.139 It should be noted that as a result of increasing birth rates school rolls in Bridgwater and Taunton and some other areas at primary school level are anticipated to rise and capacity fall in future years. This is a background trend and will require new school places regardless of HPC but will need to be considered in monitoring and planning any mitigation measures.

iv. Childcare and Education – Sensitivity and Thresholds

9.6.140 There are two variations to the assumptions that have the potential to change the assessment of the impacts. These would be:

- More workers with dependent families
- Concentrations of workers in different locations from those suggested by the gravity model

9.6.141 The table below therefore tests the possible impacts on education services. Those scenarios highlighted in yellow are where capacity could move within 5% of total places and therefore result in an increased impact at the local level. The impact sensitivities take into account the existing baseline levels of surplus capacity, relative to the effect of the proposed development, since some areas are already close to capacity currently.

9.6.142 The following table highlights the sensitivity of the impact of the non-home-based construction workers' families on primary education capacity across the 60-minute travel area. It uses as threshold standard school planning measures, with a major impact being where a school was taken over capacity, a moderate impact where a school came within 5% of its capacity, and a minor impact within 10% of its capacity.

9.6.143 The table shows that Bridgwater schools are already within the 5% threshold, but that Burnham and Highbridge and, particularly, Cannington could be taken within the 5% threshold with a small uplift in numbers.

Table 9.69: Primary Education Capacity Sensitivity

	Baseline	Central Case	25%	50%	75%
Bridgwater	4.8%	3.9%	3.6%	3.4%	3.1%
Burnham and Highbridge	5.9%	5.1%	4.8%	4.6%	4.4%
Cannington	5.2%	3.2%	2.7%	2.2%	1.7%
Cheddar	18.7%	18.2%	18.0%	17.7%	17.4%
Glastonbury	19.8%	19.5%	19.5%	19.4%	19.3%
Hinkley Point	25.0%	22.5%	21.9%	21.3%	20.6%
Minehead	35.9%	35.3%	35.1%	35.0%	34.9%
Somerset South	22.7%	22.4%	22.4%	22.3%	22.2%
Somerset West	15.4%	15.1%	15.1%	15.0%	15.0%

	Baseline	Central Case	25%	50%	75%
Taunton	6.7%	6.2%	6.1%	5.9%	5.8%
Watchet and Williton	32.9%	31.5%	31.2%	30.9%	30.5%
Weston-super-Mare	14.7%	14.3%	14.3%	14.2%	14.1%
60-Minute Travel Distance	13.3%	12.7%	12.6%	12.4%	12.3%

9.6.144 The following table highlights the sensitivity of the impact of the non-home-based construction workers' families on secondary education capacity across the Schools Planning Areas within the 60-minute travel area, highlighting that the change in capacity is largely negligible in local areas, although may be specific to individual schools, and several of the areas are operating close to or at capacity at present.

Table 9.70: Secondary Education Capacity Sensitivity

	Baseline	Central Case	25%	50%	75%
Bridgwater and Cannington	**7.5%**	6.0%	5.8%	5.5%	5.3%
Burnham and Highbridge	**-2.4%**	-3.4%	-3.6%	-3.8%	-4.1%
Cheddar	**3.4%**	3.1%	3.0%	3.0%	2.9%
Glastonbury	**-0.7%**	-1.2%	-1.3%	-1.4%	-1.5%
Hinkley Point	**N/A**	N/A	N/A	N/A	N/A
Minehead	**15.3%**	13.1%	13.0%	13.0%	12.9%
Somerset South	**4.6%**	3.9%	3.7%	3.6%	3.5%
Somerset West	**-7.1%**	-7.7%	-7.8%	-7.8%	-7.8%
Taunton	**0.7%**	0.2%	0.1%	0.0%	-0.1%
Watchet and Williton	**17.2%**	13.4%	13.1%	12.7%	12.4%
Weston-super-Mare	**12.5%**	10.8%	10.7%	10.6%	10.6%
60-Minute Travel Distance	**6.3%**	5.4%	5.3%	5.2%	5.0%

v. Social Services

9.6.145 Around 20% of Somerset County Council's Social Services expenditure is on children and families on which an additional "family" population may impact. The majority of the remaining expenditure is on older people and therefore unlikely to be impacted on by the HPC workforce. Possible "indirect" impacts are dealt with below under "Community Cohesion".

vi. Gross Impacts

9.6.146 The 380 children living in households with non-home-based workers represent approximately 0.2% of the total number of children in Somerset and North Somerset. As these are authority wide services specific local capacity issues are not relevant.

vii.Net Impacts

9.6.147 It is anticipated that all family households will live in accommodation through which they will pay Council Tax. As noted above, those living in owner occupied accommodation are unlikely to be additional to the current population. Net additional impact on social services is therefore regarded as ***negligible*** at all levels.

viii. Sensitivity and Thresholds

9.6.148 As it is assumed that all family households will live in accommodation where they pay Council Tax which should mitigate any impacts, an increase in such households would be likely to have a negligible impact on services at all levels.

ix. Other County Council Services Impacts

9.6.149 Due to the demographic profile of the non-home based workforce – mainly single, male and of working age – their likely shift patterns, and the temporary nature of much of the workforce – impacts on other County Council run services for example libraries, arts and other cultural services are assumed to be negligible.

District Council Services

x. Leisure – Gross Impacts

9.6.150 The non-home based workforce is likely to create some additional demand for leisure provision. In order to assess the scale of this the age and gender profile of the non-home-based workforce has been entered to Sport England's Sports Facilities calculator (SFC), both for the peak and the average workforce, to identify the likely demand for provision.

9.6.151 The sports facilities calculator relates to the need for new facilities for new permanent residential communities. The following table shows the additional demand at the peak and the average across the whole construction period. The non-home-based workforce is only temporary and therefore an adjustment has been made to take account of this. **Technical Note 5** (**Appendix 9E**), breaks this assessment down to the main accommodation clusters, which given the likely very small overall demand, confirms negligible requirements at all levels.

Table 9.71: Sports Facilities Calculator

		Average Non-home-based Workforce over Construction Period	Peak Non-home-based Construction Workforce	Permanent Equivalent (Average)
Pools	Area	17.24	35.92	11.21
	Lanes	0.32	0.68	0.21
	Pools	0.08	0.17	0.05
Halls	Courts	0.62	1.29	0.40
	Halls	0.15	0.32	0.10
Indoor Bowls	Rinks	0.09	0.18	
	Centres	0.01	0.03	
Synthetic Pitches	Pitches	0.09	0.19	

9.6.152 **Table 9.71** highlights the overall requirements for sports facilities across the 60-minute travel area arising from the non-home-based workforce in terms of facilities and proportions of facilities.

9.6.153 In addition to the SFC, Sport England has produced typologies of demand for a wider range of sports, based on key demographics such as age, gender and employment. For the demographic of non-home-based workers, football and going to the gym are by far the activities most in demand, along with cycling which is undertaken by a much smaller proportion. There is very limited demand for swimming, and racquet sports.

9.6.154 Demand for sports facilities is therefore very modest and is likely to be able to be met from existing provision. The exception to this is where there is already a significant deficiency in sports provision, for example swimming pools in Minehead and Bridgwater, although as noted above the increased demand would in any case be small.

xi. Leisure – Net Impacts

9.6.155 Those workers living in private rented and owner occupied accommodation will contribute to the revenue costs of service provision through Council Tax. In addition most Council leisure services are subject to fees and charges and users will therefore be making a net contribution to that provision. For those workers living in campus accommodation EDF Energy will be providing on site sports provision. This will include one full size grass football pitch and two all weather 5-a-side pitches in the Bridgwater-A campus, one all-weather 5-a-side pitch at the Bridgwater-C campus, and two all weather 5-a-side pitches at the on-site accommodation campus. This will meet the main likely preferences of the construction workforce. The impact on leisure provision is therefore likely to be **negligible** at all levels.

xii. Leisure – Sensitivity and Thresholds

9.6.156 The non-home-based workforce would need to more than double to generate a net impact on provision greater than that already being provided through the campus facilities. Impacts on other sports provision are likely to remain negligible in any plausible scenario.

xiii. Regulatory and Environmental Services – Gross Impacts

9.6.157 The District Councils provide a range of regulatory and environmental services. These include:

- Waste Collection.
- Street Cleaning.
- Food Safety, Health and Safety, Pest Control and Public Health.
- Crime Reduction and Community Safety.

9.6.158 It is likely that a net temporary increase in population would require a proportionate increase in the delivery of these types of services although there is no detailed method for identifying impacts on specific services.

xiv. Regulatory and Environmental Services – Net Impacts

9.6.159 Those workers living in private rented and owner occupied accommodation will already be paying for these services through Council Tax. In addition, all accommodation providers (including the campus and tourist accommodation providers who may pay business rates) will be required to pay for waste collection.

9.6.160 There may be a small increase in demand for services, other than waste collection – which the facilities manager or EDF Energy will be required to pay for -, as a result of workers living in campuses and temporary accommodation. The central case assumption is that around 2,500 of the 3,700 peak workforce will live in these types of accommodation. This represents less than 1% of the total current population of the three immediate districts and is therefore a negligible impact at the local level.

9.6.161 However due to the location of the campuses and therefore a concentration of these workers in two specific locations, Bridgwater and Stogursey, the local significance is likely to be greater in these locations. In Bridgwater the increase would be just over 2%, and at the site 23%, although in the latter case this would be a self-contained campus.

Table 9.72: Non Home Based Workers in Non-Council Tax Accommodation

	Non-home-based Construction Workers in Non Council Tax Accommodation	Total Population	%
Bridgwater	1,180	50,380	2%
Burnham and Highbridge	100	39,009	0%
Cannington	60	7,142	1%
Cheddar	50	26,219	0%
Glastonbury	40	19,081	0%
Hinkley Point	480	2,104	23%
Minehead	70	14,140	0%
Somerset South	10	20,802	0%
Somerset West	10	4,814	0%
Taunton	150	77,748	0%
Watchet and Williton	100	11,026	1%
Weston-super-Mare	200	83,608	0%
TOTAL	**2,450**	**375,684**	**1%**

xv.Regulatory and Environmental Services – Sensitivity and Thresholds

9.6.162 This impact is potentially sensitive to a higher non-home-based workforce, a higher proportion of people living in tourist, or latent accommodation, and/or fewer in campuses. Any increase in non-home-based workers in these accommodation types would be likely to be more thinly spread as the main concentrations of population are caused by campus accommodation. The proposed monitoring system would identify the non-home-based workforce by location and type of housing and could therefore be used to manage and mitigate any additional impacts.

xvi. Crime, Anti-Social Behaviour and Policing

Gross Impacts

9.6.163 An increase in population arising from the non-home based workforce could have impacts on crime and anti-social behaviour, and consequent impacts on the requirement for policing services.

9.6.164 Likely impacts on crime are difficult to estimate as they will depend on both the behaviour of workers and the behaviour of current residents.

9.6.165 Using the construction of Hinkley Point A and B stations as a guide, there are indications that some increases above the norm in behavioural offences, such as drunkenness, minor public disorder, and car theft could occur. Increases in traffic could increase road accidents.

9.6.166 More recent experience from the construction of Sizewell B in the 1990s suggests some increases above the norm in petty crime and behavioural offences, such as drunkenness, minor public disorder and traffic incidents and offences, although the introduction of appropriate mitigation measures meant that rates fell even with major increases in the construction workforce.

9.6.167 EDF Energy has been working with Avon and Somerset Constabulary to anticipate the potential scale of impacts based on current incident rates in the area – on the assumption that a small proportion of non-home based workers and their families, like the current population – could be both perpetrators and victims of crime.

9.6.168 As noted in the baseline assessment, Somerset West Police District of the Avon and Somerset Constabulary covers the districts of West Somerset, Sedgemoor and Taunton Deane. Rates of crime and disorder vary between different parts of the District with very low rates in the more rural areas and higher rates (although at or slightly below the national average) in urban areas.

9.6.169 Avon and Somerset Constabulary's STORM and crime data identifies an average of 191 total incidents including 47 crimes per 1,000 head of population each year. It should be noted that around a third of the crime numbers relate to domestic violence which is likely to be lower for the HPC non-home based workforce given the low proportions of non-home-based workers with families, although some other rates could be higher e.g. "Nighttime economy crime". Application of these rates to the 4,725 HPC associated residents – 3,700 non-home-based workers and 1,025 family members at peak – would equate to around 902 incidents of which around 222 could be crimes. This would equate to 1.8% of current incidents and crimes. For the average annual workforce of 1,750, with a possible 375 family members, this would equate to around 400 incidents, and 98 crimes. This would equate to 0.7% of current incidents and crimes.

Net Impacts

9.6.170 Current police services are paid for through Police Grant, which is formula-based funding based on a range of demographic, social, economic and crime indicators, and through Council Tax. Those non-home-based workers living in owner occupied accommodation and private rented accommodation, which is likely to include up to 1,250 of the workforce and all households with families and dependents, will therefore have their services funded through normal mechanisms like any other local resident.

9.6.171 This would leave a potential net impact of around 470 incidents and 115 crimes at peak, equating to 0.9% of current incidents and crimes at peak. This is regarded as a **negligible** impact at the West Somerset Police District level.

9.6.172 There is the potential for crime and disorder to be concentrated in locations where there will be a significant concentration of non-home-based workforce. The table below shows indicative incidents and crimes at peak if one applies the incident and crime rates to the location of workers in "non-Council tax accommodation" in key town centre areas in the Somerset West Police area. This shows the potential, before mitigation, of greater potential impacts in Bridgwater and, to a lesser extent, Burnham town centres.

9.6.173 The same approach has not been applied to the area around the on-site campus as it is not appropriate to ascribe potential crime and disorder impacts to the immediate area given the relatively limited facilities, particularly the large scale town centre "night-time" uses where a high proportion of crime takes place. The location of any incidents arising from these workers is difficult to predict but picked up in the gross impacts described above.

9.6.174 Therefore in Bridgwater and Burnham before mitigation, there could be a **minor adverse** impact at peak. The impact would be **negligible** in all other areas.

Table 9.73: Workers in Non-Council tax Accommodation and Indicative Incidents

	Non Council Tax Accommodation	Incidents (2010)	Crimes (2010)	Indicative Incidents as % of Current Total) (Peak Workforce and W Somerset Rates)	Indicative Crimes as % of Current Total (Peak Workforce and W Somerset Rates)
Bridgwater (Town Centre and **Campus LSOAs)**	1,180	4,263	1,317	5%	4%
Burnham (Town Centre)	100	994	224	2%	2%
Minehead (Town Centre)	70	1,169	298	1%	1%
Taunton (Town Centre)	150	4,462	1,521	1%	0%

Sensitivity and Thresholds

9.6.175 This impact is potentially sensitive to a higher non-home based workforce, a higher proportion of people living in tourist, or latent accommodation, and/or fewer in campuses. Any increase in non-home-based workers in these accommodation types would be likely to be more thinly spread as the main concentrations of population are caused by campus accommodation.

9.6.176 The proposed monitoring system would identify the non-home-based workforce by location and type of housing and could therefore be used to manage and mitigate any additional impacts.

xvii. Fire Service

Gross Impacts

9.6.177 The development of HPC could potentially have impacts on the Devon and Somerset Fire and Rescue Service in two ways, firstly through potential incidents on the site during the construction process, and secondly through in any increase in services required arising from the temporary increase in population caused by the construction workforce. It is not possible to quantify these impacts as they will be based on responses to specific incidents.

Net Impacts

9.6.178 In relation to on-site incidents EDF Energy will have internal operating procedures in place to ensure that contractors operate in a safe way, and will provide equipment , resources and training so that it can provide first response to any fire incidents.

9.6.179 In relation to any increase in services required as a result of non-home based workers, those workers in owner occupied and private rented accommodation will be contributing to the cost of fire services. For workers living in Campus accommodation, EDF Energy will operate in line with statutory fire safety requirements.

9.6.180 Any additional impacts on services (apart from any possible large scale incidents which are dealt with in the mitigation section below) are likely to be small and relate either to residents in latent and tourist accommodation and the Fire and Rescue Service role in dealing with road traffic accidents. These are likely to be of **minor adverse** significance at the local level before mitigation and **negligible** at the County level.

Sensitivity and Thresholds

9.6.181 This impact is potentially sensitive to a higher non-home based workforce, a higher proportion of people living in tourist, or latent accommodation, and/or fewer in campuses. Any increase in non-home-based workers in these accommodation types would be likely to be more thinly spread as the main concentrations of population are caused by campus accommodation.

9.6.182 The proposed monitoring system would identify the non-home-based workforce by location and type of housing and could therefore be used to manage and mitigate any additional impacts.

xviii. Health and Ambulance Service

Gross Impacts

9.6.183 The site workforce and the non-home based workforce in the 60-minute travel area could have impacts on health and ambulance service provision in the area. This could include impacts on:

- GP services.
- Hospital services (acute and chronic care).
- Ambulance Services.
- Community Services, including:
  - Dental services.
  - Out of hours services.
  - Prescribing costs.
  - Mental health.

9.6.184 These services are mainly Primary Care Trust commissioned services together with some South Western Ambulance Service NHS Foundation Trust services.

Net Impacts

9.6.185 Increased demand for local health provision will arise from non-home based workers where:

- they, or their families, register for services with a local GP, and/or are referred by the GP for other specialist services;
- they require ambulance services; and
- the funding formulae through which health services are funded does not take into account growth in temporary or other population, or takes time to respond to changes in population.

9.6.186 EDF Energy has contracted with an external provider (Dura Diamond), to provide occupational healthcare services for both the HB and non-home-based workforce, with a clinic on site. As part of this they will also provide a comprehensive primary care service for non-home-based workers. It is assumed that the non-home-based workforce will not need to register with a local GP and that therefore the funding for any services they require (e.g. prescriptions and other services) will be met from their home PCT.

9.6.187 The principal net impact on health services will be in:

- cases where Dura Diamond have to refer workers to mainstream health services;
- where any incidents on site require ambulance call out or where non-home based workers require ambulance call out; and
- the families and dependents of non-home based workers who register for local GP (and other services) for the period that funding formulae need to “catch up” with any population growth.

9.6.188 As described above this latter group are not technically necessarily “additional” to the current population as there is in any case a significant annual population churn and if they weren’t living in a property it is likely another family group would.

9.6.189 The **Health Impact Assessment** sets out an assessment of these two types of impact based on assumed rates of use of health services.

9.6.190 For non-home-based workers these are based on the use of similar health services for the development of the Olympic Park, which involved a 4.1% take up of on-site health services, with 5.9 per cent of these referred to NHS providers. For HPC this would result in around five referrals per year to NHS services. This is a negligible impact at all levels.

9.6.191 For non-home-based workers families, there would be around 1,025 family members of which around 425 would be children at peak. Depending on the extent to which these residents are additional they could make additional demands on local health provision. However, demand on this scale would require the equivalent of half a GP, spread over a wide area with significant current capacity at peak, and around a quarter of a GP on average over the period. For other services delivered at a PCT level this population would account for less than 0.5% of the current Somerset PCT population. It would therefore be likely to have a **negligible** impact on demand for health care provision at all spatial scales.

9.6.192 For Ambulance Service provision, an assessment has been undertaken using current ratios of ambulances to population: one ambulance to every 8,290 people. As virtually all HB workers will live in the Avon and Somerset Ambulance Services area they can be discounted from having any net impacts. This leaves, at peak, 3,700 non-home-based workers, with an annual average of 1,900, both significantly below a level where new ambulance provision would be required. This would be a **negligible** impact at all spatial scales.

9.6.193 For the on-site construction workforce, the assessment has been based on the call out rate for the Olympic Park development in London which had a similar construction peak (c.5,000). This had a call out rate of 0.09 per worker per year. For HPC this would equate to around 45 call outs in the peak year and around 23 on average per year. This could have a **minor adverse** impact on ambulance services at the local level before mitigation, and a **negligible** impact at all other spatial scales.

Sensitivity and Thresholds

9.6.194 This impact is potentially sensitive to a higher overall workforce, a higher non-home based workforce, the types of accommodation in which the workforce reside and higher call out rates.

9.6.195 Given the relatively small impacts it is unlikely that any increase in these areas would change the significance of impacts outlined above, however the proposed monitoring system would identify the non-home-based workforce by location and type of housing and also cover call out rates for the ambulance service and could therefore be used to manage and mitigate any additional impacts.

xix. Community Cohesion

9.6.196 **Technical Note 6: Community Cohesion** (**Appendix 9F**) identifies and reviews current and recent community cohesion issues in the South West, which already has a substantial migrant workforce and has been the subject of a number of research papers. It should be noted that this body of research relates to workers born overseas and overseas nationals who will only make up a proportion of the non-home based workforce. However a number of the areas identified in the note would be generic amongst long-term migrant workers whether national or international and are therefore considered here.

9.6.197 The evidence review described in **Technical Note 6** is mainly qualitative, identifying a broad range of issues which have been raised by a (international) migrant workforce. It is therefore not possible to make a quantitative assessment of what the impacts of the HPC workforce might be. However, based on evidence from studies and experience elsewhere, it is possible to identify the types of impacts which could arise and plan to avoid any negative effects. Some of these issues are relevant to a non-home based workforce regardless of nationality, whilst others, in relation to language issues for example, could arise from the specific needs of foreign nationals.

9.6.198 The need for information is a key issue for non-home-based construction workers regardless of nationality, and can be addressed through the provision of 'welcome packs' and via a system of on-going and consistently updated information and guidance for workers, access to which can be gauged by monitoring the use of services. A key example is access to housing information, including the need to signpost access to housing for workers and to manage impacts particularly relating to houses in multiple occupation. A potential adverse effect that could arise is maintaining equal access to employment opportunities through positive community outreach projects and through supporting employment training.

9.6.199 It is critical to ensure equality of access to services – that non-home-based workers have equal access to necessary public services, whilst at the same time ensuring that existing residents have equal access to provision. Concerns have been raised through consultation about the integration of a predominantly male non-home-based worker population with existing residents, with potential adverse effects relating to community tension, the behaviour of workers in the local area, crime and anti-social behaviour. Overall, local tensions can be mitigated through other actions described above (maintaining equality of access to services and employment), and ensuring that the police and other services have the resources to deal with any specific problems should they arise.

9.6.200 Comparative data from the monitoring of the construction of Sizewell B noted that 'Representatives of the local police on the Sizewell B local consultative committee consistently expressed the view that, overall, the construction workforce had been relatively trouble–free, with fewer serious incidents than had been anticipated (Glasson and Chadwick, 1995).It should also be noted that developer drink and drugs policies/testing are now much more rigorous than for earlier developments.

xx. Localised Impacts (Bridgwater and Stogursey/Hinkley Point)

9.6.201 As noted above there are two areas where the concentration of the non-home based workforce could have a significant impact on the local area. These are Bridgwater and the area immediately around the HPC site.

9.6.202 In Bridgwater the identified local impacts will be likely to include:

- two worker campuses at Bridgwater A and Bridgwater C, and Park and Ride sites at Junctions 23 and 24 of the M5;
- the largest concentration of Non-Home Based workers in private rented accommodation, and probably the largest number of families;
- potential impacts on community cohesion, crime, anti-social behaviour and policing;
- employment and educational opportunities for local residents;
- expenditure from the workforce in local businesses and supply chain opportunities; and
- investment in leisure provision through the Site Preparation Section 106 agreement.

9.6.203 EDF Energy's proposed mitigation and enhancement measures through the Site Preparation Works Section 106 agreement and the Section 106 agreement associated with the current application will need to directly address these issues.

9.6.204 In Stogursey Parish, immediately adjacent to Hinkley Point, the main direct socio-economic impact will be the on-site campus.

9.6.205 The campus has been located in an area as far north as possible, away from Shurton. EDF Energy recognises the concerns of some in the local community regarding an on-site campus and has proposed a number of mitigation methods to address them. A planted landscape bund (area of raised ground) is proposed to screen the on-site accommodation campus at the time of construction, providing visual mitigation and some noise attenuation both for Doggetts and for the residents of Shurton. The lighting design, together with the landscaping strategy, has been designed to minimise light spill to the residential properties to the south.

9.6.206 The accommodation campus layout has been designed to reduce potential noise, light and visual impacts on the local community. The quieter, residential buildings have been positioned along the southern boundary of the site and the recreational facilities have been positioned to the north of the campus development, at the furthest point from Shurton village. There is no direct pedestrian access or road to the village of Shurton and access will only be obtained from Wick Moor Drove, the main access point. This will ensure that the development includes effective measures that prevent unofficial shortcuts from the site to Shurton and Stogursey.

9.6.207 It is not possible to quantitatively assess the extent to which workers living on the on-site campus will seek to use facilities in the nearby villages. However the design and operation of the campuses has taken into account the lessons from previous experience of Sizewell B with facilities on site and direct bus services to the larger settlements to limit impacts on the immediate area.

9.7 Assessment of Operational Phase Impacts

a) Employment

9.7.1 The predictions for the operational station takes the workforce at full operation of both reactors (in year 10 after the start of construction), and relates primarily to the more immediate districts. As noted previously the vast majority of the current HPB workforce lives within the three district area so that area has been used as local for this part of the assessment. Non-local are any residents from outside this area.

Operational Workforce

9.7.2 The operational workforce of the completed power station, with both reactors in operation, is approximately 700 direct EDF Energy employees and up to 200 contract staff – totalling 900. The contractor support also increases significantly to over 1,000 for during each unit's refuelling outage (every 15-18 months).

9.7.3 Estimates draw on previous studies of operational stations, including Hinkley Point A and B, and Sizewell B. These show that, on average, around 50% of the new workforce comes from within 10 miles of the new development. As for construction stage employment, they also show considerable variations between skill groups. Information from previous studies suggests a low local recruitment ratio, usually from 5% to 15%, for the managerial and technical category, but much higher ratios for administrative and clerical (55 to 85%) and the largest category, industrial staff (50 to 70%). For example, the combined pattern of recruitment at the Hinkley Point A and B stations showed only 5% local recruitment of managerial and technical staff, but around 60% for both administrative and clerical staff, and industrial staff (rising to 80% for the unskilled industrial staff).

9.7.4 The table below shows the recruitment assumptions for the directly employed EDF Energy operational workforce. It is assumed that contract workers (with the exception of outage workers) will follow a similar pattern. The predictions in this table suggest relatively high local recruitment figures, taking into account:

- The likelihood of some transfers from Hinkley Point B (and possibly from the decommissioning activities at Hinkley Point A); and
- Aspirations from EDF Energy and the local authorities to strongly encourage local recruitment through a number of channels.

Table 9.74: Operational Workforce: Local Recruitment

Employee Category	Total	Local			Non-Local		
		Proportion	Central Estimate	Range	Proportion	Central Estimate	Range
Managerial and Technical	180	15%	30	15-35	85%	150	145-165
Administrative and Clerical	60	70%	40	35-50	30%	20	10-25
Industrial	460	65%	300	260-340	35%	160	120-200
	700		**370**	**310-425**		**330**	**275-390**

Local= the immediate Districts of Sedgemoor, West Somerset and Taunton Deane. The numbers of employers are taken from EDF Energy's emerging operational workforce plans and then split into *broad occupational categories. The splits between local and wider recruitment are based on studies of operational stations.*

Local Recruitment

9.7.5 In summary, it is estimated that approximately 53%, or 370 of full operational employment, could be recruited locally. This is the midpoint of a range of 310 to 425 operational employees estimated to be recruited locally. The number of employees therefore likely to migrate into the three-district area from outside the local area is estimated at 275 to 390.

9.7.6 In addition, it is estimated that there will be up to 200 contract workers working on the HPC operational station at any one time; these are more likely to be from outside the local area, and many may be non home-based.

9.7.7 This workforce is included in the overall 'Workforce Profile' described in Appendix 1, and begins to build up from month 35 of the project. The precise levels of local recruitment at any one point are likely to vary depending on a variety of factors including the operational requirements at HPB at the time and EDF Energy's overall workforce management strategy in relation to its nuclear fleet including Sizewell. There is likely to be some fluidity between the different station workforces.

9.7.8 This would be a **moderate beneficial** impact at the three district level.

Higher Value Added Jobs

9.7.9 The proposed development, when operational, would cause an increase of 109% in jobs within the top 20 GVA-per-worker industrial sectors in the UK in the three district area, representing a **major beneficial** impact in terms of the policy aspirations of the local authorities and the sub-regional economy.

Outages Hinkley Point C

9.7.10 During the operational phase of the HPC project, there will be a number of planned outages, which will require a short-term, temporary additional workforce at the HPC site at regular intervals.

9.7.11 The outages will occur every 15 to18 months, and on average last 12 to18 days (up to a maximum of around 30 days). Every 10 years there will be an outage that lasts up to 40 days.

9.7.12 The first outage will occur 15 to-18 months after unit 1 of the HPC project has become operational, approximately at the same time unit 2 commences operation. When both units are operational, the outages for each will happen in sequence (i.e. unit 1 outage, followed by unit 2 outage).

9.7.13 A short-term, temporary workforce of 1,000 will be required in addition to the 900 (700 permanent and 200 contract staff) per outage. The largest outage at Hinkley Point B required 1,600 workers.

9.7.14 It is estimated that the majority of the annual temporary outage workforce will be recruited from outside the local area (around 80%), and that there will be much continuity of employment between the current and future outage teams – thereby minimising any additional new employment, but increasing the frequency for current employees.

9.7.15 It is therefore anticipated that around 800 outage workers would be non-local and therefore would require accommodation in the area. There is likely to be an impact on local accommodation, including tourist accommodation. A small proportion, estimated at fewer than 10%, tend to take up spare rooms in houses (latent accommodation) based on previous experience, and this is usually facilitated by people advertising in local shops, at the power station itself, and in newspapers.

9.7.16 Planned outages will be timed to avoid peak (August) seasons, in order to limit the level of significance of the impact on local accommodation provision. The 800 outage workers requiring bedspaces would be comfortably accommodated by the baseline demand in off-peak seasons, and the impact on accommodation is therefore likely to be negligible. If outages were to occur in peak season, given the identified 4,200 capacity in accommodation this should remain a negligible impact. The short-term increase in the local population and workforce is likely to have a **minor beneficial** economic impact through worker expenditure on local goods and services, the potential for employment and skills/training, and an overall temporary increase in local GDP. It is expected that suppliers will manage the needs of the staff brought in during outages in terms of accommodation and services, while EDF Energy will agree work patterns and on-site training.

b) Accommodation

9.7.17 It is estimated that by the time of peak construction, around 450 workers will have moved to the area with their families, and some of these will form part of the operational workforce, while others will be long-term contract workers.

9.7.18 An element of the operational workforce will be comprised of some of the 450 workers that are expected to have moved to the area at peak construction with their families, most likely into owner-occupied accommodation.

9.7.19 Information from Hinkley Point B shows that 94% of the operational workforce lives within the three immediate districts, with 70% living in Sedgemoor. It is EDF Energy existing nuclear policy that all operational permanent staff should live within 25 miles of the station, and it is envisaged that all but a very small minority will live in the three immediate districts. It is similarly envisaged that the non-local outage workforce will also be accommodated in the same area for the duration of their activities. As noted, of the 700 permanent operational staff, around 370 are likely to be recruited locally, with the remaining 330 likely to be drawn from the rest of the South West region, and some from further afield.

9.7.20 In terms of accommodation sectors, studies at a number of power stations show that permanent employees in the electrical supply industry have higher rates of owner occupation than the national average. Ownership rates are particularly high for staff employees. In the absence of any public sector provision, it is anticipated that most of those not buying will rent in the private sector. As such, the approximate tenure mix at full operation is estimated to be around 80% owner occupation, and around 20% private rented.

9.7.21 The anticipated demand in total for owner occupation and private rented accommodation is relatively low in comparison with the construction stage, and as the demand is likely to be spread over a number of years, coinciding with the rundown of construction (and the release of some accommodation previously used by construction stage workers), it is not expected that there will be any adverse effects in meeting the accommodation demands associated with the operational phase.

9.7.22 **Table 9.75** provides an estimate of the geographical distribution of operational staff accommodation, based on the premise that the pattern will be similar to that for the current operational Hinkley Point B.

9.7.23 It is envisaged that the temporary outages would be handled in similar ways to the current arrangements for the Hinkley Point B station, primarily via the use of serviced and rented accommodation. There would therefore be a **negligible** impact on local accommodation demand.

Table 9.75: Estimated Geographical Distribution of the Non Home-based Operational Workforce, by Accommodation Type – at Full Operation

District	Owner Occupied		All Rented		Total	
	#	%	#	%	#	%
Sedgemoor	190	70	40	62	230	68
West Somerset	40	15	20	31	60	18
Taunton Deane	25	10	5	7	30	9
Outside AIA	15	5			15	5
TOTAL AIA	**270**	**100**	**65**	**100**	**335**	**100**

Note: AIA (Accommodation Impact Area) = the three districts of West Somerset, Sedgemoor and Taunton Deane

c) Public Services

9.7.24 As noted above the operational workforce will have become established over the time of the construction period and become part of the permanent population of the area. Any impacts on education and public services will therefore have already been mitigated during the construction programme. As occupants of private rented or owner occupied accommodation the workforce will be Council tax and taxpayers and entitled to public services in common with other residents.

i. Perceptions

9.7.25 It is anticipated that community perceptions during the operational phase of the HPC project will differ little from those of the existing Hinkley Point B power station, with the new station being a provider of well paid, high technology and permanent employment, and contributing well to community activities.

d) Wider Economic Effects

i. Labour Market

9.7.26 It is anticipated that power station operational employment will be attractive to the local workforce as a result of the traditionally high level of wages in these industries. Local authorities and agencies will be keen to develop the external image of Somerset as an advanced economy, diversify the economic base, address some pockets of deprivation, improve the local long term skills base (especially in engineering and construction) and attract more workers (especially younger workers) to remain in employment within the immediate districts.

9.7.27 The operational project should provide a long term continuation of a substantial quota of skilled and secure jobs for local people with a major high-technology employer, partly offsetting the closure and decommissioning of Hinkley Point A and the eventual closure of Hinkley Point B. The significance of the project as a high tech/innovative activity, raising the local high tech business image, was seen as positive by participants in the Socio-Economic Topic Workshops.

ii. Local Indirect Employment

9.7.28 At full operation, the indirect employment effects and the increase in the level of income in the local economy will be of a more permanent nature. Estimates for the current Hinkley Point B station of the annual addition to local income from c.700 power station workers' and contract staff earnings and local contracts are of the order of £30 million (the average earnings of power station employees (both construction and operational) are substantially above the average for the area and will give a major boost to local average earnings, and to local services).

9.7.29 Figures for the new station are likely to be at least this, and may be of the order of £40million per annum (at 2010 prices). Previous studies suggest the additional local indirect employment of about 60% of direct employment, which would be of the order of 360 jobs for the proposed operational HPC station.

9.7.30 There will also be an extra 1,000 contract partner workforce during planned outages (approximately every 15-18 months for each reactor for 12-18 days, up to a maximum of one month). The outages will occur outside of summer months where possible, and will happen in sequence. Every 10 years there will be an outage of up to 40 days. The 1,000 additional workforce will be likely to have multiplier expenditure and employment impacts, proportionately more akin to those for un-accompanied non home-based construction workers. The local economic impact of outages may be of the order of £25million.

iii. Business Development and Supply Chain

9.7.31 It is also envisaged that the project will provide many opportunities for business growth, both directly associated with project contracts (construction and operational), and also indirectly (e.g. in encouraging new serviced and non-serviced accommodation provision).

9.7.32 In terms of potential impacts on other local industries, especially tourism, similar points can be made as for the construction stage, but on a smaller basis. Overall the development is likely to contribute to longer term economic stability in the area. It should also provide opportunities for the development of local firms with both nuclear construction and operational phase supply chain links, which will help to raise the skill level and presence of high-technology activity in the area.

9.7.33 Overall this should lead to economic diversification away from declining sectors, offering high quality employment and opportunities for local businesses in the first new nuclear project in the UK, through an intensive construction period of some nine years and a prospective operating lifetime of 60 years.

9.8 Mitigation and Enhancement

9.8.1 For the purpose of this assessment, mitigation measures have been proposed where there is an adverse impact of greater than minor significance and the impact magnitude, spatial scope and temporal nature make it appropriate to do so.

9.8.2 Socio-economic impacts are potentially sensitive to an increased overall workforce, a higher non-home based workforce, the mix of types of accommodation in which the workforce reside and higher use of services.

9.8.3 Across the socio-economic areas, EDF Energy has adopted a best practice precautionary approach to ensure that all evidenced impacts can be addressed, and that a monitoring system is in place to address the sensitivities and thresholds described in the impact assessments. These are listed and cross referenced below along with their key points. Where possible enhancements have been identified which can bring additional benefits to the area.

9.8.4 Through the managed signposting of workers, the HPC Accommodation Office will seek to reduce pressure in specific locations or on specific public services. Information will be held on such things as such as public transport, local amenities and school capacity. This will allow a worker to select accommodation which suits his/ her needs whilst minimising impact on public services and pressure on the road network.

9.8.5 Relevant mitigation and enhancement measures are listed and cross referenced below.

a) Economy and Skills

9.8.6 EDF Energy proposes to mitigate impacts and enhance benefits in relation to economy and skills through four main strands: The **Construction Workforce Development Strategy** (CWDS), the **Education (Inspire) Strategy**, the **Project Supply Chain Engagement Strategy**, and Tourism and Area Promotion. These are summarised in the **Economic Strategy** submitted with the planning application and the former three are appended to that document.

i. Construction Workforce Development Strategy

9.8.7 EDF Energy is committed through its **Construction Workforce Development Strategy** to maximising benefits to West Somerset, Sedgemoor and Somerset. The strategy was produced in consultation with partners and reflects jointly held priorities for action.

9.8.8 The CWDS comprises six key projects through which EDF Energy and partners will work to achieve this objective. They are:

- **Employment Brokerage**: The Brokerage will be a service delivered on behalf of EDF Energy and in collaboration with external partners. Its role is to place people into sustainable employment created by the building of Hinkley Point C and the construction of its associated developments. EDF Energy will also seek to extend the model in the future to include the employment of operational staff, recruited from the Somerset area. The remit of the Brokerage is to focus on:

- Providing employment opportunities for residents of Sedgemoor, West Somerset and the wider county of Somerset;
- Helping to tackle unemployment through the pre-training of suitable and assessed candidates at the proposed Construction Skills Centre in Sedgemoor in occupations that are in demand by EDF Energy's contractors;
- Working with contractors to provide apprentice opportunities for people;
- Widening employment and skills opportunities for Women, Disabled people, Black and Minority Ethnic People (BAME) and all under-represented groups in the construction and engineering sectors;
- Maximising leverage and support from funding agencies, sector skills councils, trusts, support organisations and businesses to ensure opportunity is available to a broad spectrum Somerset people and not only those who are in long term unemployment.

- **Employment Outreach:** This project will provide opportunities for "work ready" people, to become "job ready" and capable of entering sustainable employment at HPC, or elsewhere in the supply chain or wider economy. The role of Employment Outreach is to motivate and encourage people within the community to participate in the workforce. Through the Section 106 planning agreement for Site Preparation Works EDF Energy are supporting local councils through the provision of dedicated community outreach resource. Whilst the councils are responsible for the strategic use and deployment of their own dedicated staff there is future opportunity for EDF Energy to partner with them in outreach activities;
- **Construction Skills Centre**: EDF Energy has been working in partnership with Bridgwater College to enable local, demand led training to be delivered at a Construction Skills Centre in Cannington. The centre will be able offer courses ranging from basic health and safety and card schemes through to advanced training in specific skills. This will include a dedicated Civil Engineering site designed to accommodate state of the art training in all types of plant being used at HPC, OSAT NVQs, Building Services/Utilities, Formwork, Steel Fixing, Steel Erecting, New Roads and Street Works. The skills centre will host the Constructionarium, a hands-on construction experience for students following civil engineering and built environment courses. It allows the students to learn practically from industry - their future employers. It is designed to be part of a 21st Century engineering education which links academic theory with contractors and consultants from the construction industry. It will be established in partnership with education providers and based at the Construction Skills Centre;
- **Hinkley Skills Ready Project**: This will enable residents of West Somerset to get the skills they need to work at HPC. The project involves an element of physical remodelling of existing buildings at the school and the construction of a small extension. Collectively these modifications will enable the school to offer additional vocational subjects and qualifications, which are aligned to skills and employment needs at Hinkley Point C and the wider economy in West Somerset.
- **Apprenticeships**: EDF Energy has the aspiration to achieve the national benchmark for construction apprenticeships. EDF Energy will produce a specific Apprenticeship Strategy and work with its supply chain and other agencies to maximise apprenticeships for local residents.

- **The Enterprise Centre Project**: EDF Energy is working with West Somerset Community College and West Somerset Council on a feasibility study for an enterprise centre project, to support Somerset residents and businesses in providing services to the incoming workforce and prepare for other new markets (e.g. visitors and tourists) that may arise as a result of the HPC development.

9.8.9 An Employment and Skills Operations Group (ESOG) will meet monthly and include senior members of staff from each of the core stakeholders and partner organisations. EDF Energy's Construction Workforce Team will host meetings and provide the Secretariat. Key Performance Indicators have been produced and will be regularly monitored, so that the effectiveness of projects can be assessed and reviewed over the lifetime of the development. Quarterly performance data and analysis will also be used in a series of quarterly updates with stakeholders through the ESOG.

Education Strategy

9.8.10 EDF Energy is committed through its Education Strategy to working with schools, other education providers and young people in Somerset to engage and inspire young people in Somerset to follow a pathway in Science, Technology, Engineering and Mathematics (STEM), with the primary aim of raising aspiration and attracting school leavers into a career in Construction or Engineering.

9.8.11 The Inspire Strategy will include different themes for different age groups. These are:

- 6 to 11 year olds: Proposition: Inspire and Engage, the aim is to support activity that will help capture interest and inspire children to carry that interest into the next phase of their school life.
- 11 to 14 year olds: Proposition: Build STEM Skills and Influence Choices; Research in Somerset has identified a gap in informing the decision making process and advising on careers. The offer at this level is based on a series on interventions that will provide guidance and understanding of the opportunities available so they can make informed decisions.
- 14-19 year olds: Proposition: Career pathways/Job ready; Offering experiences and guidance regarding opportunities available in the construction and engineering industry will be the focus of the offer for this group. The next generation of construction workers, technicians and engineers will require a programme of career and Job Ready interventions in order to maximise the opportunities arising from HPC. This is an important cohort to focus on as current students in this age group will be entering the employment market at the time of peak build on HPC.

9.8.12 The strategy will include engagement with all primary schools in Sedgemoor and West Somerset, secondary and further education institutions throughput Somerset, and Higher education institutions in the wider 90 minute travel zone (CDCZ) from HPC.

9.8.13 Activities for younger groups will include the production of information packs, curriculum and teacher support, site visits, classroom support, careers events, an online environmental education tool (“the Somerset Pod”), specific training and support, expert visits to schools, and virtual work experience.

9.8.14 Activities for older groups will be linked with, and enhanced by, EDF Energy’s wider investments in the Construction Skills Centre and Constructionarium at Bridgwater College and the Hinkley Ready and Enterprise projects with West Somerset Community College.

Project Supply Chain Engagement Strategy

9.8.15 EDF Energy will use its role at the top of the supply chain for the project to seek to enable local participation. Its intention is to help UK and local companies to become part of the global supply chain for its new nuclear reactors. EDF Energy sees considerable advantages in being able to develop relationships with suppliers who will go on to play a part in supplying a number of its new build projects, including at Hinkley Point and Sizewell. This means that for local suppliers who get involved in the Hinkley Point project, there will be opportunities to leverage their involvement into other new build projects.

9.8.16 EDF Energy is working with the local authorities, local businesses and others to develop an understanding of the capabilities of the local area, and to produce a database of local firms who might be interested in playing a part in the supply chain. Due to the scale and specialist nature of the new build project, it is likely that most of these firms will be at a relatively low tier in the supply chain. EDF Energy’s efforts must therefore focus on enabling them to make links with upper-tier contractors, and encouraging those contractors to make use of local suppliers where possible.

9.8.17 Somerset Chamber of Commerce has been contracted as an independent broker to facilitate the involvement of local businesses in EDF Energy’s supply chain. The Chamber will act as the primary point of contact and information for both EDF Energy and local businesses through an online supplier portal and will have the primary focus to promote the health and development of the Somerset economy.

9.8.18 Local companies have been invited to register their interests, business details, capacity and capabilities on the online supplier portal and to update them as they change. The Chamber will then support those that are not yet ready to meet the basic requirements and those that are ready will be invited to local events organised by the Chamber which seek support local involvement in the supply chain and to match businesses with new opportunities.

9.8.19 While EDF Energy cannot prescribe the proportion of local suppliers who will be contracted by the Hinkley Project, the contracts will include a strong encouragement to the contractor and subcontractors to maximise the use of Somerset businesses.

9.8.20 In addition to the nuclear supply chain, the Hinkley Project will also generate more generic contracts and opportunities that will be made available to local businesses. These include contracts and arrangements for transport, hotel accommodation, office supplies, recruitment, work wear and catering. EDF Energy’s commitment to mitigate the effect of the HPC’s construction activities on nearby residents will also create a range of local supplier opportunities in double glazing, sound deadening loft insulation, window cleaning, window blind installation, and tree planting.

Tourism and Area Promotion

9.8.21 EDF Energy is committed to working in partnership with the local tourism industry and public bodies to promote tourism in Somerset. This includes supporting the development of a Tourism Strategy and Marketing Plan and marketing and promotional initiatives as well as utilising the benefits of the on-site Public Information Centre to enhance Somerset's tourism offer.

Agriculture

9.8.22 On completion of the construction phase, the land outside of the permanent development site would be restored as proposed in the Landscape Restoration Plan. This would involve the restoration of land to agricultural use and ecological habitat creation. As the scheme design incorporates elements that result in negligible socio-economic effects in terms of direct economic impact and severance/disruption impacts, the potential impacts do not require mitigation.

Summary and Residual Impacts after Mitigation

9.8.23 The impacts identified in relation to the labour market, local economy and skills were all beneficial. The actions outlined above have the potential to significantly enhance those impacts and create a ***long term major beneficial impact for the economy of the three districts and Somerset*** by improving the skills base and competitiveness of the economy and helping residents and businesses become part of a larger UK labour force supply chain for infrastructure development.

b) Accommodation

9.8.24 Although the central scenario assumes a negligible effect on the accommodation market, there are significant uncertainties related to the locations where workers will choose to live, how many non-home-based workers will be required and which sectors of the housing market they will choose to live in.

9.8.25 As such, mitigation has been proposed and targets pre-mitigation of adverse minor impacts to avoid them becoming moderate impacts. This is set out in the **Accommodation Strategy** submitted with the application and summarised below.

i. Housing Fund

9.8.26 EDF Energy is proposing additional support for housing in the local area by establishing a Housing Fund, informed by a clear understanding of local housing issues. The Housing Fund is to provide £5 million of financial support to a range of initiatives which deliver additional capacity within the housing market area which relates (by travel to work area) with the development site.

9.8.27 A priority is to target the low cost housing sector locally where the housing impacts could have the most significant affect.

9.8.28 A particular focus is the private rented sector with the Fund capable of both increasing supply and investing in a range of initiatives which provide greater housing choice and opportunities which would either not otherwise exist or be unduly constrained by existing funding.

9.8.29 The following initiatives and contributions are planned as part of the Housing Fund, which have been developed in conjunction with the local authorities stimulating new supply in the private rented stock:

- bringing empty homes back to beneficial use;
- supporting a rent deposit/guarantee scheme;
- providing equity loans to social rented sector residents;
- providing equity loans to residents in the owner occupied or private rented sector;
- tackling incidence of under occupation in the existing affordable stock;
- providing equity investment into new-build development schemes; and
- funding to act as ‘grant replacement’ for new-build development schemes.

9.8.30 A basket of these initiatives can be assumed to have an average cost of £5,000 to support an additional unit of accommodation or housing opportunity. Therefore the fund, if used effectively, could provide for 1,000 additional units or housing opportunities. Further support could be triggered if monitoring suggests that, at peak, or in specific locations, the project has exceeded the accommodation capacity by more than this amount.

ii. Monitoring and Management Strategy

9.8.31 Monitoring of accommodation take up will be addressed through the pre-induction questionnaire and induction process, which will confirm worker accommodation choice at arrival on site. In due course it is proposed that, through the operation of the accommodation website, information on bookings will be collected from listed providers.

9.8.32 Information will be collected by the workforce monitoring manager throughout the construction period. Pertinent to the Accommodation Office will be the collection of data on accommodation choices by; post code, accommodation type and duration of stay.

9.8.33 By monitoring accommodation patterns and through on-going stakeholder consultation, potential impacts arising from accommodating workers will be identified. A powerful tool available to EDF Energy will be to sign-post workers away from geographical areas or accommodation sectors where any issues have been identified, and adopting a pricing regime for the campuses that is attractive to the workforce. Additionally, EDF Energy is proposing a flexible bus strategy which will allow routes to be varied. This could be used to make areas that have spare accommodation more attractive to workers. This would then reduce pressure on areas that have attracted large numbers of workers and where there may be pressure on accommodation capacity.

9.8.34 Through the managed signposting of workers, the Accommodation Office can seek to reduce pressure in specific locations or on specific public services. Information will be held on such things as public transport, local amenities and school capacity. This will allow a worker to select accommodation which suits his/ her needs whilst minimising impact on public services and pressure on the road network.

9.8.35 There is potential for workers to make use of accommodation that would otherwise be let to tourists, so potentially causing pressure on availability, tourist frustration and the possibility of tourists staying away from the area.

9.8.36 While it is anticipated that the tourist market would largely be self-regulating, with summer time prices exceeding HPC workers' budgets, EDF Energy will be able to sign-post workers away from areas or types of accommodation under pressure by way of mitigation. Through a look-ahead with the construction team, spikes in worker demand can be mitigated through a proactive approach to identifying suitable accommodation with particular regard to holiday periods.

iii. Quality of Accommodation

9.8.37 Many providers of latent accommodation will be new to letting and may be unaware of the rules and regulations that apply. In addition, increasing demand may lead to providers entering the market with accommodation of an unacceptably low standard.

9.8.38 The Provider Information Pack will be issued to potential providers and serve to raise understanding of applicable regulations and sources of further information as well as confirming EDF Energy's expectations. It will also make expectations on quality clear, together with actions to be taken when minimum levels are not met.

9.8.39 The carrying out of home safety visits to a random sample of properties by the Fire Service and an awareness by accommodation providers that their information is being shared with public service providers will reduce risk of properties of an unacceptable standard being registered with EDF Energy.

iv. Summary

9.8.40 Impacts on accommodation were identified as **negligible** at all spatial levels. The mitigation proposals are intended to ensure that they remain negligible across the area and in specific locations through a monitor and manage approach. The investment of the Housing Fund in the local area could make 1,000 housing opportunities available in the 60 minute area which would have a long term use. This would have a **minor beneficial** impact at the 60 minute area level.

c) Population and Population Dynamics

9.8.41 As noted above the HPC workforce is likely to have a major impact on population and population dynamics in two areas: Bridgwater and the area immediately around Hinkley. This will partly be addressed through the mitigation measures on the economy and skills, accommodation and public services described elsewhere in this section but EDF Energy also proposes a number of actions to avoid/limit any negative impacts and to mitigate impacts locally. This is set out in the **Community Safety Management Plan** submitted with the application, which includes the Worker Code of Conduct as an appendix.

i. Worker Code of Conduct

9.8.42 A Code of Conduct (the Code), attached as an Appendix to the **Community Safety Management Plan,** has been written to set expectations of how workers use accommodation and the way they interact with the local community, and will:

- communicate the behaviour expected of workers and outline the means by which the Code will be communicated to all site preparation workers;
- outline the role of employers;
- outline the monitoring mechanism for the Code during the site preparation works; and
- inform the community of the standard of behaviour they should expect from workers and their employers.

9.8.43 The Code will be explained to workers at induction and in the course of the project through awareness campaigns. Each worker will be required to sign a copy of the document at induction. The Community Liaison Officer (see below) will monitor comments and complaints and will take necessary action, giving feedback to the person making initial contact. Whilst the absence of a contractual relationship means EDF Energy are not able to discipline workers directly, regular performance reviews with contractors will provide a means of ensuring good worker behaviour.

ii. Community Liaison Officer

9.8.44 The Community Liaison Officer will provide a point of contact between the community and the project, receiving comments, establishing a network of key stakeholders, and holding regular meetings. He or she will work to minimise negative impacts and community tension and will build on positive opportunities for community cohesion, and pro-actively monitor worker activity so as to minimise concerns. The terms of reference of the Community Liaison Officer are set out within the **Community Safety Management Plan.**

iii. Campus Management

9.8.45 EDF Energy will ensure the active management of its accommodation campuses, on site and in Bridgwater. This will include expected standards of behaviour from workers, hours of operation, security issues, liaison with public services and complaints procedures for local residents.

iv. Main Site Neighbourhood Support Scheme

9.8.46 A Main Site Neighbourhood Support Scheme has been established which recognises that hamlets in the immediate vicinity of HPC (Shurton, Burton, Knighton, Wick and parts of Stolford) will be affected by a unique combination of issues throughout the duration of the construction period. The Scheme contains elements to mitigate potential effects of noise, dust, and property value impacts that may arise. This includes a property price support scheme to assist residents who wish to move away and a noise insulation scheme that offers properties double glazing and ventilation. EDF Energy will provide window cleaning when monitoring equipment has indicated that agreed dust levels have been exceeded.

9.8.47 For property price support, properties would have to have been marketed at a realistic value for at least six months from the date of launch. Properties within the boundary can participate at any time from the date of trigger. The Scheme will run for five years from date of launch at which time the scheme will be reviewed.

v. Community Impact Fund

9.8.48 EDF Energy is also proposing a broader fund which can be used to address priorities identified by the communities most affected by the HPC project. This is in recognition of the fact that there are likely to be qualitative adverse impacts on the lives of people in the areas most affected by the development which can't be mitigated by conventional approaches.

d) Public Services

i. Education

9.8.49 The central assessment is that impacts on physical provision are negligible, although there are significant uncertainties around the likely location of the workforce, and available school capacity which could create more significant impacts in localised areas.

9.8.50 EDF Energy is therefore proposing in the draft Obligations, appended to the **Planning Statement**, to make an initial payment to Somerset County Council in advance of the main workforce build up which can be used to expand provision in locations with limited capacity. EDF Energy will also establish a monitoring system which will identify the locations of family households and, with Somerset County Council, identify impacts on education capacity. Where children of EDF Energy workers do lead to the exceeding of local school capacity in excess of the places funded in advance financial contributions will be made to address this. EDF Energy also proposes to contribute to funding a support teacher or member of staff who can co-ordinate any additional activities required to integrate children into the local school system. This will ensure that residual impacts are **negligible** at all spatial levels. Investment in new school places will continue to be available after the construction period and would be a **minor beneficial** impact at the local level.

ii. Social Services

9.8.51 Impacts on social services are identified as **negligible** at all spatial levels. EDF Energy is committed to seeking to link its other implementation strategies with priority social services target groups, for example so that outreach programmes target children Not in Education, Employment and Training (NEETs) and other vulnerable groups. The Community Liaison Officer identified in the **Community Safety Management Plan (CSMP)** will also liaise with those working with vulnerable groups to address any issues.

iii. Leisure

9.8.52 The impact on leisure service provision is likely to be negligible. However, in recognition that investment in facilities would be likely to make a positive contribution to integration and the experience of the workforce and local community EDF Energy has committed to significant investment in local leisure provision in West Somerset and Sedgemoor Districts as set out in the S106 for Site Preparation, and summarised in the **Section 106 Heads of terms which are appended to the Planning Statement**. These are significantly in excess of what would be required to mitigate any impacts of the workforce (**see Technical Note 5, Appendix E**) and site specific issues on associated development sites (see **Chapter 7** of **Volumes 3** and **4** of this ES) This will have residual impacts on leisure services which will be permanent **moderate beneficial** at the local level.

iv. Regulatory and Environmental Services

9.8.53 mpacts on regulatory and environmental services are identified as negligible at the district level, with the potential to be minor negative at the local (settlement) level. The proposed approach to mitigating housing impacts described above in paragraphs 9.9.35 to 9.9.37 will mitigate the impact on the main regulatory service functions. The residual impacts will therefore be **negligible** at the district and local levels.

v. Emergency Services

9.8.54 EDF Energy has been working with service providers (The District and County Councils, Avon and Somerset Constabulary, Devon and Somerset Fire and Rescue Services, South Western Ambulance Service Trust and NHS Somerset to address any potential community safety impacts arising from the project.

9.8.55 A **Community Safety Management Plan** has been produced which sets out the overarching approach to ensure that community safety and emergency services issues are comprehensively addressed, any identified impacts mitigated and monitoring arrangements are in place to deal with any sensitivities or variances from the central assessment.

9.8.56 EDF Energy has also produced draft Strategic Relationship Protocols (SRPs) with the emergency services setting out how the parties will work together and the roles and responsibilities of each. Where appropriate they confirm remuneration for services to avoid and/or manage impacts and financial and other contributions from EDF Energy towards this.

9.8.57 Likely impacts on crime and policing are identified as negligible at the level of the Police District, but there is a risk they could be minor negative in locations with a concentration of non-home based workers, particularly Bridgwater.

9.8.58 The SRP with the Police includes:

- funding of a Community Safety Beat Team to police the communities surrounding the construction sites;
- funding of intelligence officers to research and plan for potential impacts arising as a consequence of HPC;
- contribution to policing costs, including intelligence and incident planning, as well as costs associated with the increased non-home-based workforce; and
- a formula based approach has been developed for assessing future payments based on the level of non-home based workforce (excluding those paying Council tax).

9.8.59 As a result impacts on policing and community safety are likely to be **negligible** at all levels.

vi. Fire Service

9.8.60 Impacts on the Fire Service are likely to be negligible at the Devon and Somerset Fire Service level but there is a risk they could be minor adverse at the local level subject to the types of incidents.. As noted these risks have been minimised by the service which EDF Energy will purchase from DuraDiamond.

9.8.61 The SRP with the Fire Service therefore includes:

- contributions to incident planning and training prior to the substantial build up of the HPC workforce; and
- the employment of a Community Safety officer to raise awareness of fire safety issues in the local community and carry out home safety visits of private rented property.

9.8.62 As a result impacts on the fire service are likely to be **negligible** at all levels.

vii. Health and Ambulance Services

9.8.63 Due to EDF Energy's own internal mitigation the likely impacts on health provision are identified as negligible at all levels. The impact on the ambulance service is identified as negligible at the South Western Ambulance Service level with the risk of a minor negative impact at the local level.

9.8.64 Through discussion with the Primary Care Trust and Ambulance Service EDF Energy has proposed the following approach, details of which are set out in the Health Action Plan and draft Obligations.

9.8.65 For main health provision EDF Energy will provide contributions for referrals of workers from EDF Energy's contracted provider to NHS services – where these are not funded by their home PCT/Commissioning Body, and for families of non-home based workers, subject to monitoring demonstrating that they are net additional to the population for which the PCT is already funded and only for the time that such funding takes to adjust.

9.8.66 The SRP with the Ambulance Service includes:

- payment for emergency calls to site; and
- contribution to the cost of operational planning to address the specific demands of the HPC project.

9.8.67 As a result impacts on health and ambulance services are likely to be **negligible** at all levels.

9.8.68 In addition EDF Energy is also committed to provide £60,000 for a Fit to Work project. This will be a **minor beneficial** impact at the local level.

e) Operational Phase Mitigation and Enhancement

i. Operational Workforce

9.8.69 EDF Energy will work with partners at the appropriate time to plan for the recruitment and training of the operational workforce at HPC. This is likely to utilise many of the same routes as the construction workforce development strategy, and is also likely to offer apprenticeships and develop close relationships with Further and Higher Education institutions.

ii. Summary

9.8.70 The operational phase is identified as having long term **major** and **moderate beneficial** impacts at the three district level respectively. This assessment remains unchanged as a result of enhancements.

Table 9.76: Summary of Impacts with Mitigation and Enhancement Measures

	Duration	Temporary/ Permanent	Significance	Uncertainty/ Sensitivity	Mitigation and Enhancement	Residual Impact
Construction Employment (CDCZ)	Long term	Temporary	Moderate beneficial	None	Enhancement	Major Beneficial
Construction Labour Market (3 Districts)	Long term	Temporary	Moderate beneficial	Potential variance depending on recruitment	Enhancement	
Construction Supply Chain/Business	Long Term	Temporary	Moderate beneficial	Approach to contracting	Enhancement	
Accommodation Supply (60 minute zone)	Long Term	Temporary	Negligible	Numbers and concentrations of workforce	Accommodation Strategy including Housing Fund	Negligible/Minor Beneficial
Owner occupied Housing (60 Minute Zone)	Long Term	Temporary and Permanent	Negligible	Limited – could vary but not significant	None required	None
Private Rented Sector (60 minute zone and sensitive locations)	Long Term	Temporary	Negligible	Risk of concentrations and minor/moderate adverse impacts in specific locations	Accommodation Strategy including Housing Fund, Monitor and Manage	Negligible
Tourist Sector	Long term	Temporary	Negligible	Risk if greater demand for tourist accommodation in peak season	Accommodation Strategy including Housing Fund, Monitor and Manage	Negligible
Latent Sector	Long Term	Temporary	Minor beneficial	Potential for more to be brought forward or reduced uptake	None required	Minor beneficial

	Duration	Temporary/ Permanent	Significance	Uncertainty/ Sensitivity	Mitigation and Enhancement	Residual Impact
Education Capacity	Long term	Temporary	Negligible	Risk of higher child numbers or concentration in low capacity area	Preparatory financial contribution towards school places and support for management of children of workforce. Monitoring of impact and potential additional financial contribution	Negligible. Minor beneficial where additional places are provided.
Population Dynamics	Long term	Temporary	Major in Bridgwater and Stogursey/HPC	Possible variance in workforce locations	Various	Minor to Moderate
Social Services	None	None	Negligible	None	None	None
Leisure	Long term	Temporary	Negligible	Greater workforce or concentration in locations	Investment in provision	Moderate beneficial
Regulatory and Environmental Services	Long Term	Temporary	Negligible at District level, risk of Minor Negative at cluster/ settlement level	Greater workforce or concentration in locations	Monitoring of impact and financial contribution	Negligible
Crime, Anti-Social Behaviour and Policing	Long Term	Temporary	Negligible, possible minor adverse in Bridgwater	Greater workforce or concentration in locations	**Community Safety Management Plan**, Strategic Relationship Agreement (SRA) with the Police, monitoring and funding of services	Negligible
Fire Service	Long Term	Temporary	Negligible at Fire Service Level, risk of minor at cluster/ settlement level	Higher workforce or major incidents	SRA with Fire Service, Monitoring and Financial Contributions	Negligible

	Duration	Temporary/ Permanent	Significance	Uncertainty/ Sensitivity	Mitigation and Enhancement	Residual Impact
Health	Long Term	Temporary	Negligible	GP registration of workforce, size of workforce and dependents	Management and contracted service, service monitoring and financial contributions	Negligible
Ambulance Service	Long Term	Temporary	Negligible	Size of workforce, number of callouts	Monitoring of impact and financial contribution	Negligible
Operational Employment	Long term	Permanent	Major beneficial	None	Enhancement	Major beneficial
Operational: Supply Chain and Multiplier	Long Term	Permanent	Moderate beneficial	None	None required	Moderate beneficial

References

9.1 IPC. Working together on nationally significant infrastructure projects: advice note 2: IPC outreach programme. IPC: Bristol, 2010.

9.2 Equality Act. HMSO, 2010.

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CHAPTER 10: TRANSPORT

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PLATES

10. TRANSPORT

10.1 Introduction

10.1.1 This chapter of the Environmental Statement (ES) provides an assessment of the potential transport environmental impacts associated with the construction and operational phases of the proposed Hinkley Point C (HPC) Project. Detailed descriptions of the site, proposed development, construction, operational and decommissioning phases are provided in **Chapters 1** to **5** of this volume of the ES.

10.1.2 A glossary of the terminology used in this chapter is provided in **Volume 1** of this ES.

10.2 Scope and Objectives of Assessment

10.2.1 The scope of this assessment has been determined through a formal Environmental Impact Assessment (EIA) scoping process undertaken with the Infrastructure Planning Commission (IPC). It has also been informed by ongoing consultation with statutory consultees, including Somerset County Council (SCC), the Highways Agency (HA), Sedgemoor District Council (SDC) and West Somerset Council (WSC), the local community and the general public in response to the Stage 1, Stage 2, Stage 2 Update and M5 Junction 24 and Highway Improvements consultations. SCC and the HA are the highway authorities for the highways within the HPC study area.

10.2.2 The early sections of this chapter provide background on the scope of the assessment, the legislative and planning policy context, the assessment methodology and the key characteristics of the Hinkley Point C Project which inform the **Transport Assessment** as a whole. Section 10.7 describes the baseline transport conditions in the locality of the HPC development site and all associated development sites. Section 10.8 anticipates the future baseline condition taking into account the developments with planning approval and anticipated future traffic growth (but not the HPC development). Section 10.9 onward then discusses the transport impacts in the locality of the HPC development site and all associated development sites for the three assessment periods of 2013 (early construction), 2016 (peak construction) and 2021 (HPC operational phase with some remaining construction on site and deconstruction of some associated development).

10.2.3 This chapter is based upon the findings of the **Transport Assessment** which supports this application for Development Consent.

10.2.4 The assessment of transportation impacts has been undertaken adopting the methodologies described in **Volume 1**, **Chapter 7** of this ES, and Section 10.6 of this chapter.

10.2.5 This chapter focuses on the potential transport environmental impacts of:

- severance;
- driver delay;
- pedestrian delay;

- pedestrian amenity; and
- accidents and safety.

10.2.6 Other transport issues such as public transport, walking and cycling and travel planning are dealt with in the **Transport Assessment**.

10.2.7 The future baseline traffic conditions are compared with future With Development traffic conditions to assess the impact of the proposed HPC development on the transport networks. The traffic assessments used to inform this analysis assume implementation of the transport strategy and the proposed highway improvements which are both described in the **Transport Assessment** and summarised in this chapter. Any further mitigation measures are described in Section 10.10. An assessment of residual impacts following implementation of these mitigation measures is presented in Section 10.11.

10.2.8 Cumulative transportation impacts arising from the proposed HPC development in combination with other elements of the HPC Project and other relevant, committed projects are identified and assessed in this chapter of this ES. The traffic flows used in this chapter are those generated by committed developments and other predicted growth in the area plus those generated by the HPC Project (i.e. the HPC development site and all the associated development sites). In addition there are some other developments that have not been included in those assessments. These are dealt with in a qualitative way within **Volume 11** of this ES.

10.2.9 The objectives underlying the assessment are to:

- Identify the potential transport environmental impacts of the HPC Project, taking into account the characteristics of the development and the sensitivities of the local environment.
- Identify and describe measures which would be taken to mitigate any identified adverse environmental impacts.
- Predict and evaluate the extent and significance of residual effects taking into account the mitigation.

10.3 Legislation, Policy and Guidance

10.3.1 This section summarises the relevant policy at a national, regional and local level.

10.3.2 The Overarching National Policy Statement (NPS) for Energy (NPS EN-1) (Ref. 10.1) when combined with the NPS for Nuclear Power Generation (NPS EN-6) (Ref. 10.2) provides the primary basis for decisions by the IPC on applications for nuclear power generation developments that fall within the scope of the NPSs.

10.3.3 Notwithstanding this, the IPC may consider other matters that are both important and relevant to its decision making. This could include Planning Policy Statements (PPSs), Planning Policy Guidance Notes (PPGs), regional and local policy documents, although, if there is a conflict between these and the NPS, the NPS prevails for the purposes of IPC decision making.

10.3.4 Furthermore, the Planning Act 2008 (Ref. 10.3) provides that the IPC must, in making its decision on an application, have regard to any Local Impact Report (LIR) prepared by relevant local authorities. It is anticipated that the LIRs will rely in part on PPSs, PPGs, and regional and local policy to provide a context for their assessment. On this basis, regard has been given to these documents (where relevant to the technical assessment) since they are likely to inform the LIRs prepared by the relevant local authorities.

10.3.5 It is also noted that, on 25 July 2011, the Department for Communities and Local Government issued the consultation draft of the National Planning Policy Framework (NPPF) (Ref 10.4) which is intended to replace PPSs, PPGs and some Circulars within a single consolidated document. This provides another reason to attach primary weight to the policies of the NPSs. The consultation period concludes on 17 October 2011 and it is expected that the final NPPF will be adopted in 2012. The draft NPPF sets out a presumption in favour of sustainable development, and the need to support economic growth through the planning system. The draft NPPF also states that Nationally Significant Infrastructure Projects (NSIPs) are determined by the decision making framework set out in NPSs, which are part of the overall framework of planning policy (paragraph 6). The weight to be attached to different policy documents is addressed in the Planning Statement. For the purposes of this assessment, however, greatest weight is attached to the tests and guidance set out in the NPSs. Other policy documents are reviewed, however, as they may be relied on by others, including the IPC.

a) National Policy

10.3.6 In July 2011, parliament adopted the Overarching National Policy Statement for Energy (EN-1) which is the principal document for consideration of all new energy development and establishes the need for new energy infrastructure in the UK.

10.3.7 Paragraph 5.13.3 on Traffic and Transport Impacts sets out the requirement for a Transport Assessment in accordance with the NATA/WebTAG methodology stipulated in the Department for Transport's (DfT) 'Guidance on Transport Assessment' (March 2007) (Ref 10.5). Furthermore, clear direction is given on mitigation measures in paragraph 5.13.8 as follows:

> *"Where mitigation is needed, possible demand management measures must be considered and if feasible and operationally reasonable, required, before considering requirements for the provision of new inland transport infrastructure to deal with remaining transport impacts."*

10.3.8 Paragraph 5.13.10 states that:

> *"Water-borne or rail transport is preferred over road transport at all stages of the project, where cost-effective."*

10.3.9 Managing travel demand in this context can be broadly defined as prioritising the use of alternatives to private car use and road borne freight movements.

10.3.10 When referring to transport impacts the policy states at paragraph 5.13.7:

> *"Provided that the applicant is willing to enter into planning obligations or requirements can be imposed to mitigate transport impacts identified in the NATA/WebTAG transport assessment, with attribution of costs calculated in accordance with the Department for Transports guidance,*

then development consent should not be withheld, and appropriately limited weight should be applied to residual effects on the surrounding transport infrastructure"

10.3.11 Paragraph 5.13.5 also introduces the possibility of cost sharing between the applicant and Government for any third party benefits i.e. where the improvements provided more than offset the impact of the proposal.

10.3.12 Therefore the thrust of policy is that the applicant should take reasonable steps to provide mitigation so as to reduce impacts to an acceptable level but that limited weight should be applied to residual impacts.

i. Draft National Planning Policy Framework (July 2011) (Ref. 10.4)

10.3.13 Within the Transport Chapter, at paragraph 86 the NPPF advises:

"All developments that generate significant amounts of movement, as determined by local criteria, should be supported by a Transport Statement or Transport Assessment. Planning policies and decisions should consider whether:

- *the opportunities for sustainable transport modes have been taken up depending on the nature and location of the site, to reduce the need for major transport infrastructure.*
- *safe and suitable access to the site can be achieved for all people; and*
- *improvements can be undertaken within the transport network that cost effectively limit the significant impacts of the development. Subject to those considerations, development should not be prevented or refused on transport grounds unless the residual impacts of development are severe, and the need to encourage increased delivery of homes and sustainable economic development should be taken into account."*

ii. Planning Policy Statement 1: Delivering Sustainable Development (PPS1) (2005) (Ref 10.6)

10.3.14 Planning Policy Statement 1 (PPS1) was published in January 2005 and sets out the Government's overarching planning policies on the delivery of sustainable development through the town and country planning system.

10.3.15 PPS1 includes a number of key principles relating to development plans including the formulation of an integrated approach to development and the formulation of access policies.

10.3.16 Paragraph 27 (Delivering Sustainable Development) sets out the general approach to delivering sustainable development. In preparing development plans, planning authorities should, amongst other things,:

"Provide improved access for all to jobs, health, education, shops, leisure and community facilities, open space, sport and recreation, by ensuring that new development is located where everyone can access services or facilities on foot, bicycle or public transport rather than having to rely on

access by car, while recognising that this may be more difficult in rural areas."

iii. Planning Policy Guidance 13: Transport (PPG13) (2011) (Ref 10.7)

10.3.17 Originally published in March 2001 and revised in January 2011, Planning Policy Guidance 13 on Transport (PPG13) sets out the national context for planning for transport.

10.3.18 The objectives of PPG13 are to integrate planning and transport at the national, regional, strategic and local level to:

- "*promote more sustainable transport choices for both people and for moving freight*;
- *promote accessibility to jobs, shopping, leisure facilities and services by public transport, walking and cycling; and*
- *reduce the need to travel, especially by car."*

10.3.19 Paragraph 46 states:

"…Policies need to strike a balance between the interests of local residents and those of the wider community, including the need to protect the vitality of urban economies, local employment opportunities and the overall quality of life in towns and cities. Local authorities, freight operators, businesses and developers should work together, within the context of freight quality partnerships, to agree on lorry routes and loading and unloading facilities and on reducing vehicle emissions and vehicle and delivery noise levels, to enable a more efficient and sustainable approach to deliveries in such sensitive locations."

10.3.20 Annex C of PPG13 relates to transport infrastructure. It states that care must be taken to minimise the environmental impact of any new transport infrastructure projects, including the impacts which may be caused during construction (paragraph C1). Annex C goes on to state that particular emphasis should be given to the need to explore a full range of alternative solutions to problems, including solutions other than road enhancement (paragraph C4).

10.3.21 In a number of locations the PPG advises on the preference for using rail or sea to transport bulk goods. For example, at paragraph 47, when discussing minerals, the PPG states "*Local authorities should seek to enable the carrying of materials by rail or water wherever possible…"*

b) National Guidance

i. Circular 2/07 – Planning and the Strategic Road Network (Ref 10.8)

10.3.22 Circular 2/07 'Planning and the Strategic Road Network' published in 2007, details the Highways Agency's (HA) role and requirements in respect of the control of development in proximity to the Strategic Road Network (SRN), for which they are responsible. The Circular sets out:

- An approach adopted by the HA to encourage sustainable development while avoiding the potential for adverse effects on the SRN.

- A framework for collaborative working coordinating a number of organisations including Government Offices, regional and local planning authorities, local highway authorities, public transport providers and developers.
- How the HA will deal with planning applications. Although the Circular predates the Planning Act 2008, the collaborative approach which it advocates is firmly in line with the 'front loaded' approach to DCO applications.

10.3.23 The Circular draws on national policy and guidance and advocates the adoption of a demand management approach to development and promotes Travel Plans as an integral part of managing the capacity of the trunk road network.

ii. Department for Transport – Guidance on Transport Assessment

10.3.24 The DfT published its 'Guidance on Transport Assessment' (GTA) in March 2007. The guidance sets out the following principles:

- Reduce the need to travel, especially by car – thought should be given to reducing the need to travel; consider the types of uses (or mix of uses) and the scale of development in order to promote multi purpose or linked trips.
- Sustainable accessibility – promote accessibility by all modes of travel, in particular public transport, cycling and walking; assess the likely travel behaviour or travel pattern to and from the proposed site; and develop appropriate measures to influence travel behaviour.
- Mitigation measures – ensure as much as possible that the proposed mitigation measures avoid unnecessary physical improvements to highways and promote innovative and sustainable transport solutions.

iii. Highways Agency Protocol for Dealing with Planning Applications (Ref 10.9)

10.3.25 The HA has produced a protocol to assist developers in working with them when submitting a planning application for a development which could have an impact on the SRN.

10.3.26 The section titled 'Stage 2: Formal consultation by the Local Planning Authority' states that:

> *"For developments generating more than 30 two-way trips to the network during any peak period, a transport assessment and travel plan prepared in accordance with DfT and DCLG's 'Guidance on transport assessment' and meeting the requirements of DfT Circular 02/2007."*

10.3.27 This section also sets out the process that the HA requires regarding the consideration of mitigation measures:

- All reasonable steps shall be taken to minimise the level of physical mitigation required, through the use of measures such as travel plans, development phasing, heavy goods vehicle booking systems and encouraging flexible working.
- Physical measures on the local road network to minimise the impact on the strategic road network shall be utilised as far as is reasonably possible.
- Once all reasonable minimisation and off-network mitigation has been implemented, the HA will consider capacity improvements on the strategic road

network. The HA will not accept local capacity improvements where they would overload the wider network.

10.4 Regional Planning Policy

10.4.1 On 27 May 2010 the Secretary of State advised of the Government's intention to abolish regional planning policy and that this should be a material consideration in planning decisions. On 6 July 2010 the Secretary of State for Communities and Local Government revoked all Regional Strategies with immediate effect under section 79(6) of the Local Democracy, Economic Development and Construction Act 2009. This includes Regional Planning Guidance for the South West (RPG10) (Ref 10.10). However, following the High Court judgement on 10 November 2010 in a case brought by Cala Homes the Secretary of State's decision to revoke Regional Strategies was quashed.

10.4.2 As a result, on that same date, the Government wrote to the Chief Planning Officer to reiterate the Government's intention to abolish Regional Strategies through the Localism Bill.

10.4.3 This letter was also challenged on the grounds that the Government's intended revocation of Regional Strategies (including any Saved Structure Plan Policies) by the promotion of legislation for that purposes in the forthcoming Localism Bill was immaterial to the determination of planning applications and appeals prior to the revocation of Regional Strategies.

10.4.4 However, on 7 February 2011, the High Court held that the Government's advice to local authorities that the proposed revocation of regional strategies was to be regarded as a material consideration in their planning development control decisions should stand. The decision of the High Court was upheld by the Court of Appeal on 27 May 2011. The Court of Appeal clarified that it would be unlawful to have regard to the Government's intention to abolish regional strategies in the preparation and examination of Development Plan Documents. Therefore, the regional strategies remain in place but in the case of a development control decision it is for planning decision makers to decide on the weight to attach to the strategies taking into account, as a material consideration, the Government's stated intention to revoke them.

a) Regional Planning Guidance 10 for the South West 2001 – 2016 (RPG10) (2001) (Ref. 10.10)

10.4.5 Regional Planning Guidance for the South West (RPG10) sets out a broad strategy for the South West up to 2016.

10.4.6 Section 8 relates specifically to Transport and sets out the Regional Transport Strategy (RTS). The role of the RTS is to support the spatial strategy, to provide the strategic transport framework for the Local Transport Plans (LTPs) and development plans and to provide a framework for the investment and operational plans for relevant transport agencies/operators.

10.4.7 The RTS has 5 key objectives:

- *"To support the spatial strategy of RPG and to service existing and new development efficiently and in an integrated fashion;*

- *To reduce the impact of transport on the environment, by reducing the need to travel, encouraging travel by more sustainable means (especially by walking and cycling) and locating development at accessible locations, particularly by public transport; and to achieve environmental improvements by directing investment to those locations where infrastructure is required to offset the damaging effects arising from the impacts of traffic and transport;*
- *To secure improved accessibility to work, shopping, leisure and services by public transport, walking and cycling;*
- *To create a modern, efficient and integrated transport system that will meet the demands of a dynamic regional economy, help overcome regional peripherality and meet all travel needs; and*
- *To ensure the safe use of regional transport network and its associated facilities." (Page 83).*

10.4.8 Policy TRAN 1 (Reducing the Need to Travel) states that local authorities, developers and other agencies should work towards reducing the need to travel by private motor vehicle through the appropriate location of new development.

10.4.9 Policy TRAN 6 (Movement of Goods) states that local authorities, the business community, transport operators and other agencies should work together to achieve more sustainable patterns of distribution. Amongst other things, they should aim to locate major freight generating development close to the regional rail and road networks.

10.4.10 Policy TRAN10 (Walking, Cycling and Public Transport) states that:

"Local authorities, transport operators and other agencies should aim to increase the share of total travel by these modes and ensure that they provide attractive and reliable alternatives to the private car by:

- *Seeking transport assessments and travel plans for all new major developments and encouraging major organisations to prepare and implement such plans, having regard to sustainable transport objectives set by local authorities in the local transport plan; and*
- *Ensuring that major new development delivers (or sets out a clear and realistic strategy to deliver) a realistic choice of access by public transport, walking and cycling."*

b) The Draft Revised Regional Spatial Strategy for the South West Incorporating the Secretary of State's Proposed Changes 2008 – 2026 (July 2008) (Ref 10.11)

10.4.11 The Draft Regional Spatial Strategy (RSS) for the South West (2006-2026) was published by the South West Regional Assembly in 2006. In 2008 the Secretary of State published proposed changes to the draft RSS for further consultation.

10.4.12 If adopted, this document would replace the existing RTS, published in RPG10. Chapter 5 sets out the strategy's regional approach to transport. The main aim of the RTS is to support the RSS and reduce the rate of road traffic growth by:

- *"Supporting economic development (identified in the RES) by maintaining and improving the reliability and resilience of links from the region's Strategically Significant Cities and Towns (SSCTs) to other regions, international markets and connectivity within the region;*
- *Addressing social exclusion by improving accessibility to jobs and services;*
- *Making urban areas work effectively and creating attractive places to live by developing the transport network in support of the strategy to concentrate growth and development in the SSCTs; and*
- *Reducing negative impacts of transport on the environment including climate change." (Page 139).*

10.4.13 Policy RTS1 (Corridor Management) states that, in order to improve the reliability and resilience of journey times, to develop opportunities to facilitate a modal shift and support growth at the Strategically Significant Cities and Towns (SSCTs), which include Bridgwater and Taunton, provision will be made to manage the demand for long distance journeys and reduce the impacts of local trips on corridors of national and regional importance.

10.4.14 Policy RTS2 (Demand Management and Sustainable Travel Measures at the SSCTs) states that demand management measures should be introduced progressively at the SSCTs to reduce the growth of road traffic levels and congestion. This should be accompanied by a 'step change' in the prioritisation of sustainable travel measures serving these places.

10.4.15 Policy RTS3 (Parking) states that parking measures should be implemented to reduce reliance on the car and encourage the use of sustainable transport modes.

c) Somerset and Exmoor National Park Joint Structure Plan Review 1991 – 2011 (2000) (Policies 'saved' from 27 September 2007) (Ref 10.12)

10.4.16 The Somerset and Exmoor National Park Joint Structure Plan was adopted in 2000 with relevant policies saved from 27 September 2007. All policies have been saved with the exception of Policy 53 which related to the Department of the Environment, Transport and the Regions Road Schemes. The Plan provides a strategic base for all land use planning within the plan area for the period up to 2011.

10.4.17 The Structure Plan sets out a preferred strategy for development which includes the encouragement of a balanced and integrated transport system which emphasises alternatives to the private car, where practical (paragraph 3.8).

10.4.18 Policy STR1 (Sustainable Development) states that development should, amongst other things, develop a pattern of land use and transport which minimises the length of journeys and the need to travel and maximises the potential for the use of public transport, cycling and walking; and conserve biodiversity and environmental assets, particularly nationally and internationally designated areas.

10.4.19 Policy 39 (Transport and Development) states that proposals for development should be considered having regard to:

- The management of demand for transport.

- Achieving a shift in transport modes to alternatives to the private car and lorry wherever possible.
- The need for improvements to transport infrastructure.

10.4.20 Policy 45 (Bus) states that facilities for buses should be improved. This should include measures to give priority to buses and to introduce park and ride systems where these are the most sustainable option.

10.4.21 Policy 48 (Access and Parking) states that developments which generate significant transport movements should be located where provision may be made for access by walking, cycling and public transport. The level of parking provision in settlements should reflect their functions, the potential for the use of alternatives to the private car and the need to prevent harmful competitive provision of parking. The level of car parking provision associated with new development should first take account of the potential for access and provide for alternatives to the private car, and then, should be no more than is necessary to enable development to proceed.

10.4.22 Policy 49 (Transport Requirements of New Development) states that proposals for development should be compatible with the existing transport infrastructure, or, if not, provision should be made for improvements to infrastructure to enable development to proceed. In particular development should:

- Provide access for pedestrians, people with disabilities, cyclists and public transport.
- Provide safe access to roads of adequate standard within the route hierarchy and, unless the special need for and benefit of a particular development would warrant an exception, not derive access directly from a National Primary or County Route.
- In the case of development which will generate significant freight traffic, be located close to rail facilities and/or National Primary Routes or suitable County Routes subject to satisfying other Structure Plan policy requirements.

10.4.23 Policy 50 (Traffic Management) states that traffic management schemes which improve safety, travel conditions and the environment should be implemented to make the best possible use of the highway network. Such schemes should remove or reduce heavy or unnecessary vehicles from settlements or sensitive environments and improve conditions for pedestrians, cyclists and public transport users.

10.4.24 Policy 52 (Freight Traffic (Lorries in the Environment)) states that traffic, and particularly lorries, should be encouraged to use National Primary Routes wherever possible through appropriate measures such as positive signing and by discouraging the use of unsuitable roads through traffic management schemes.

10.4.25 Policy 54 (Transport Proposals and the Environment) states that new transport proposals and improvements, particularly road schemes must take into account the need to: minimise the impact of proposals through mitigation and compensation measures; improve or conserve the natural and built environment; avoid the risk of pollution to the water environment, including water resources; minimise the consumption of resources both in construction and operation; and, minimise conflict with adjoining land uses.

10.4.26 Policy 58 (Ports and Wharves) states that existing port and wharf facilities should be safeguarded from development which would prejudice their potential in the transport network. Any proposals for new facilities should be within or related to settlements.

10.5 Local Policy and Guidance

a) Local Policy

i. West Somerset Council Local Plan (2006) (Policies 'saved' from 17 April 2009) (Ref 10.13)

10.5.1 The West Somerset Local Plan forms part of the development plan for West Somerset. The Local Plan was adopted in 2006 (with relevant policies ‘saved’ from 17 April 2009). The key transport objectives of the West Somerset Local Plan are not saved as they are not policies, but were as follows:

- Reduce the need to travel and the distances travelled.
- Promote the best use of public transport routes and nodes, especially for journeys to work.
- Reduce environmental damage and promote environmental improvement by traffic management and calming measures, particularly in town and village centres.
- Promote the development of safe and convenient routes for cyclists and pedestrians.
- Ensure that new development proposals have appropriate access to public transport services.
- Safeguard the implementation of major highway schemes in the Structure Plan.

10.5.2 Policy T/3 (Transport Requirements of New Development) states that:

“New roads and improvement schemes should be designed to minimise their environmental impact. As far as the Local Planning Authority’s powers permit, planning permission will only be permitted where the proposal:

i) is of a design which both minimises the environmental impact and also the risk of accidents.

ii) has no adverse effects on the character of sensitive or distinctive landscapes, townscapes and areas of acknowledged historic or wildlife interest.

iii) uses materials and street furniture sympathetic to the locality.

iv) includes indigenous landscaping schemes to integrate into the surrounding area.

v) makes appropriate provision for pedestrians, cyclists the mobility impaired and for access to public transport.

vi) minimises the impact on the environment through mitigation and compensation measures where necessary; and

vii) conforms with national and county council design standards.”

10.5.3 Policy T/7 (Non-Residential Development Car Parking) states that:

> *"Car parking at non-residential development shall be provided on the following basis:*
>
> *i) Operational parking will be kept to the minimum necessary:*
>
> *ii) Non-operational parking will be set at a maximum of the level shown in Appendix 4, Table 3, reduced according to the availability of public transport and facilities for walking and cycling, as shown in Appendix 4, Tables 1 and 2; and*
>
> *iii) Where reduction in vehicle parking is appropriate, contributions will be sought for alternative modes of transport required to serve the development."*

10.5.4 Policy T/9 (Existing Footpaths) states that:

> *"Any development affecting an existing footpath will be required to incorporate the footpath into its design. Care should be taken to ensure that the footpath is attractive to users and safe."*

ii. West Somerset District Local Development Framework (LDF) Core Strategy (Options Paper) (January 2010) (Ref 10.14)

10.5.5 In accordance with the Planning and Compulsory Purchase Act 2004, West Somerset Council is in the process of producing its LDF, which, once adopted, will replace the Local Plan.

10.5.6 In January 2010, WSC published its Core Strategy Options Paper which is a material consideration for determining planning applications, although the weight attached to this document will be limited, given that it is at a relatively early stage of preparation.

10.5.7 The Options Paper does not include any specific policies relating to transport. The paper does however identify the types of policy that WSC considers could be included in the Core Strategy. In relation to transport, these are as follows:

- *"Reduce the threshold for travel plans to require them for medium sized as well as large development.*
- *Require contributions from new development to improve cycling and walking infrastructure.*
- *Locate new developments likely to give rise to significant numbers of trips in locations which are served by a range of modes of transport.*
- *Explore the opportunity offered by the West Somerset Railway to connect sites within the District to the national rail network for freight traffic.*

- *Examine the potential for a commuter train service to be offered using the West Somerset Railway.*
- *Any new major development to be of an appropriate mix of uses and facilities to offer the opportunity to reduce transport demand."*

iii. Sedgemoor District Local Plan 1991 – 2011 (2004) (Policies 'saved' from 27 September 2007) (Ref 10.15)

10.5.8 The Sedgemoor District Local Plan forms part of the Development Plan for Sedgemoor. The Local Plan was adopted in 2004 (with relevant policies 'saved' from 27 September 2007). The Transport and Movement chapter of the Local Plan states that an efficient transport system is vital to the economic and social well being of the District. It explains that policy on transport and movement will therefore support the Local Plan's strategy of balance between sustainability and controlled economic growth (paragraph 7.01).

10.5.9 Paragraph 7.05 states that the vision of the Local Plan is for an efficient, high quality and sustainable transport system, accessible to all sections of the community. This will be achieved by maintaining and improving transport infrastructure while reducing dependence on the private car.

10.5.10 Policy TM1 (Safe and Sustainable Transport) states:

"a) development will not be permitted which would prejudice the construction of cycle and pedestrian routes and bus lanes defined on the Proposals Map, unless suitable alternative routes are provided by the developer;

b) development will not be permitted which would reduce the convenience and safety of existing rights-of-way, bridle paths and cycle paths unless suitable alternative routes are provided by the developer;

c) development will only be permitted if the design makes adequate and safe provision for access by foot, cycle, public transport and vehicles so long as it's appropriate to the scale of the development and in accordance with National and County Council design standards and Somerset County Council's Highway hierarchy;

d) the Developer shall provide the transport infrastructure required by the development to an agreed phased programme. Where off-site works are required, these shall be appropriate to the scale and nature of the development and shall be funded by the developer; and

e) development will not be permitted for proposals which would have a significant impact on the highway network without the prior submission of a Traffic Impact Assessment."

10.5.11 The Local Plan states that current government guidance stresses the need to consider alternatives to building new roads. Proposals for construction of major new highways must therefore, meet the most rigorous levels of justification (paragraph 7.11).

iv. Sedgemoor Local Development Framework (LDF) Core Strategy (Proposed Submission) (September 2010) (Ref 10.16)

10.5.12 The Sedgemoor LDF Core Strategy (Proposed Submission) was consulted on from September to November 2010. An addendum to the Core Strategy was subject to a further consultation from 23 November 2010 until 18 January 2011. Changes prior to submission, proposed as a result of the consultation process were reported and endorsed by SDC's Executive Committee on 9 February 2011. The Core Strategy Proposed Submission was submitted to the Secretary of State on 3 March 2011 and an Examination in Public (EiP) was held in May 2011. Once adopted, the Core Strategy will form part of the Development Plan for Sedgemoor.

10.5.13 EDF Energy submitted representations objecting to the Core Strategy (Proposed Submission), relating to Chapter 4 'Major Infrastructure Projects' (and policies MIP1, MIP2 and MIP3 contained in that chapter) and those sections relating to housing and Hinkley Point. EDF Energy also participated at the relevant EiP hearings.

10.5.14 At the close of the hearing sessions on 26 May 2011, the Inspector agreed with SDC and EDF Energy that, in an attempt to reach agreement on the disputed Chapter 4, SDC would re-draft Chapter 4 and EDF Energy would have the opportunity to respond. The position of both parties in relation to the re-drafted Chapter 4 was set out in correspondence between SDC, EDF Energy and the Inspector. As a result of the correspondence invited by the Inspector, SDC has agreed to further changes to the Core Strategy which make clear that the Core Strategy does not set any policies, tests or requirements for the IPC to apply in deciding whether any element of the development comprised in an application for development consent is acceptable, nor the basis on which any such application should be approved. Instead, the Chapter is to set out those matters which SDC may take into account in preparing its LIR for the Hinkley Point C DCO application. These, therefore, represent aspirations of the Council, rather than formal planning policy for the Hinkley Point C DCO application. This status has now been confirmed in the Inspector's report on the examination of the Core Strategy, which was published on 27 September 2011.

10.5.15 Emerging policies MIP1, MIP2 and MIP3 relate specifically to the HPC Project, as set out in the re-drafted Chapter 4 (dated 29 July 2011).

10.5.16 Policy MIP1 (Major Infrastructure Proposals) explains that applications for major infrastructure development will be considered against the relevant national planning policy and the strategy and relevant policies of the development plan. The objective from the Council's perspective is that major infrastructure proposals should, where possible, contribute positively to the implementation of the spatial strategy and meet the underlying objectives of it.

10.5.17 Policy MIP2 (Hinkley Point C Associated and Ancillary Development) sets out the considerations that the Council will take into account in the preparation of a LIR in responding to proposals for development associated with, or ancillary or related to the HPC Project, where they are not the determining authority. Such considerations include: measures to avoid, minimise and then mitigate adverse impacts on the transport network; highway safety for all users should be maintained and where possible improved; investments that encourage travel by public transport, walking and cycling; and the delivery of investment in infrastructure, buildings and green infrastructure.

10.5.18 Policy MIP3 (Hinkley Point C: Planning Obligations and Mitigation) states that the Council will seek to ensure, wherever possible, that the proposals avoid, minimise and mitigate (including, where appropriate, compensate for) impacts during the construction, operation, decommissioning, and restoration phases.

10.5.19 In addition, the following emerging policies contained in the Core Strategy (Proposed Submission) are considered to be of potential relevance:

- Policy S1 (Spatial Strategy for Sedgemoor) states that development proposals will be expected to support the delivery of required infrastructure, including such things as transport infrastructure.
- Policy S2 (Infrastructure Delivery) states that all new development that generates a demand for infrastructure will only be permitted if the necessary on and off-site infrastructure required to support and mitigate the impact of the development site is either already in place or there is a reliable mechanism in place to ensure that it will be delivered at the time and in the location it is required.
- Policy S3 (Sustainable Development Principles) states that development proposals will be expected to, amongst other things, be located to minimise the need to travel and to encourage any journeys that remain necessary to be possible by alternative modes of travel including maximising opportunities for walking, cycling and the use of public transport.
- Policy S4 (Mitigating the Causes and Adapting to the Effects of Climate Change) states that development should mitigate the cause of climate change through, amongst other things, ensuring development encourages modes of transport other than the car.
- Policy D2 (Promoting High Quality and Inclusive Design) states, amongst other things, that development will need to demonstrate that it is accessible to all potential users using a range of transport modes, be integrated into existing patterns of movement and be permeable. Its design should create good connections to wider areas with a clear network of routes for walking and cycling.
- Policy D9 (Sustainable Transport and Movement) states, amongst other things, that travel management schemes and development proposals that reduce congestion, encourage an improved and integrated transport network and allow for a wide choice of modes of transport as a means of access to jobs, homes, leisure and recreation, services and facilities will be encouraged and supported.
- Policy D10 (Managing the Transport Impacts of Development) states that development proposals that will have a significant transport impact should, amongst other things: be supported by an appropriate Transport Assessment and Travel Plan; ensure inclusive, safe and convenient access for all; provide safe access to roads; ensure that the expected nature and volume of traffic and parked vehicles generated would not compromise road safety and/ or function; comprehensively address the transport impact of development and appropriately contribute to the delivery of necessary transport infrastructure; not prejudice safeguarded transport infrastructure; and enhance and develop rights of way.

b) Other Local Documents

i. Hinkley Point C Project Supplementary Planning Document Consultation Draft (February 2011) (Ref 10.17)

10.5.20 SDC and West Somerset Council (WSC) have jointly prepared draft supplementary planning guidance in relation to the HPC Project. Public consultation on the Consultation Draft version of the Hinkley Point C Project Supplementary Planning Document ("the draft HPC SPD") commenced on 1 March 2011 and concluded on 12 April 2011. EDF Energy has submitted representations which object to the draft HPC SPD.

10.5.21 Following the Sedgemoor Core Strategy EiP and subsequent correspondence with the Inspector, it is clear that the SPD cannot set tests, policies or requirements for the IPC to apply to the consideration of the Hinkley Point C project. If the Councils continue with the SPD preparation, its text will need to be considered in this light and it could not carry any weight in the determination of the DCO application. As it may be relied upon by some stakeholders, however, the principal contents of the draft SPD as it relates to the site are summarised below. In relation to transport, Box 8 of the draft HPC SPD states that the County Council and District Councils will expect the HPC Project promoter to:

- *"Align the Transport/Freight Strategy with other Council plans and strategies. The transport proposals for the HPC project during both the construction and operational phases of the power station should integrate with and contribute to the delivery of the approved transport strategies as set out in the Somerset Future Transport Plan and associated transport policies and implementation plan, the Bridgwater, Taunton and Wellington Future Transport Strategy, the Bridgwater Vision, Western Somerset Economic Development and Access Strategy and emerging Williton master-plan.*
- *Minimise the volume of road traffic associated with the development of the new power station at all times, but especially during peak hours and during the peak tourism season between the months of June, July and August. The efficient and safe functioning of key routes, including the M5, A38, A361, A370, A371 and A372 must be protected.*
- *Maximise the safe, efficient and sustainable movement of people and materials required for the proposed nuclear power station.*
- *Provide transport mitigation where additional traffic flows of the project exacerbate or cause highway congestion problems.*
- *Any new highway proposals are to be justified by a full New Approach to Appraisal (NATA) assessment. Appraisals should address potential impacts raised during consultation, such as the potential severance effect to Brymore School of the western by-pass option at Cannington.*
- *All proposed highway works are to be the subject of a full operational analysis and a road safety audit in accordance with then current guidance.*
- *Provide sustainable transport solutions for access to the site that workers and visitors will be required to use. This should include*

provision of public transport priority measures in the form of bus lanes and other bus priority measures on key routes from associated development sites to the main site for construction and other vehicles, providing a beneficial transport legacy.

- *Provide sustainable transport linkages to and from all associated development sites to provide access to employment, education, retail, leisure and healthcare facilities.*
- *Ensure the number of parking spaces provided at or near to the site during the construction phase is as close as possible to zero.*
- *Enable effective controls to be put in place to ensure workers and visitors do not park in inappropriate locations.*
- *Ensure as much construction material as possible is delivered by sea.*
- *Minimise the amount of waste materials, including topsoil, transported off-site.*
- *Provide necessary improvements to the transport network to mitigate against any adverse impacts on the community; including but not limited to congestion, air quality and road safety impacts. For example, include safety improvements where the additional traffic flows of the project exacerbate existing road safety problems.*
- *Minimise traffic disruption both for the local community and visitors to the area.*
- *Control and manage the flow of any road freight movement associated with the development in order to ensure appropriate routes are used, avoid peak hour movement and to respond to incidents on the transport network.*
- *Agree and enable deployment of robust plans for managing unforeseen incidents on the transport network, including but not limited to traffic management plans, diversionary routes and freight/ delivery management systems.*
- *Provide long-term, sustainable legacy benefits for the local community.*
- *Protect the natural and built environment and ensure the image of the area is not adversely affected.*
- *Ensure that public transport services are protected throughout the construction, operation and decommissioning of the Hinkley Point nuclear power stations.*
- *Ensure that the needs of cyclists and pedestrians are protected and enhanced throughout the construction and operation of the proposed nuclear power station. This should include enhanced pedestrian and cycle facilities from associated development sites to the centres of nearby towns and villages, including provision of the Bristol Road/(Bath Road) link and rail crossing in Bridgwater.*
- *Protect current Public Rights of Way (PRoW) in and around Hinkley Point and associated development sites, and where stop-ups are required, ensure that PRoW are implemented that do not result in significant diversion lengths.*

- *Develop and implement Travel Plans for the proposed power station and associated development that will be monitored during construction and operation of Hinkley Point C.*
- *Monitor all movement associated with the development to ensure agreed mode share targets and thresholds for traffic congestion, air quality and road safety are achieved during construction and operation.*
- *Fully mitigate against and compensate for the adverse environmental impact of development related traffic. This should involve providing sufficient funds through appropriate legal agreements to enable the relevant authorities and agencies to implement further mitigation measures should any unforeseen impacts occur during the construction of the development."*

ii. Somerset Future Transport Plan (Ref 10.18)

10.5.22 Somerset's Future Transport Plan 2011 – 2026 (FTP) replaced Somerset County Council's (SCC) Second Local Transport Plan (LTP2) in April 2011 and sets out a long-term strategy for helping to deliver transport priorities up until 2026.

10.5.23 The FTP contains the following statements:

- *"Help communities help themselves with regard to transport improvements;*
- *Assisting people to make smarter travel choices;*
- *Assisting people in being more active by providing more opportunities to travel in a healthy way;*
- *Manage the effect transport-related noise has on communities;*
- *Work with developers to ensure they take in to account the way people travel, and how people travel to access services;*
- *We will help hauliers choose the most appropriate routes and work to improve communication between communities and the hauliers that serve them;*
- *Encourage people to cycle and make more trips on foot."*

10.5.24 This demonstrates that local transport policy supports the provision of sustainable travel measures above new road building and capacity improvements.

iii. Technical Note 4 – Somerset County Council Transport Policies: Transport and Development (Ref 10.19)

10.5.25 The 'Technical Note 4 – Somerset County Council Transport Policies: Transport and Development – March 2010' document is a supporting Technical Document to the FTP.

10.5.26 Section 3 of the policy relates to Assessing Transport Impacts of Development.

10.5.27 Paragraph 3.19 states that:

"The Council will agree a suitable approach to determining the level of impact depending on the location and scale of the proposed development. In the main urban areas of Taunton, Bridgwater and Yeovil strategic traffic models are available and should be used in the first instance to identify potential development impacts. A useful starting point is to identify those junctions where the development traffic increases the modelled queue length by 5 or more vehicles on one or more arms of the junction. More detailed investigations into the impact of development traffic at these locations should then be undertaken using appropriate junction modelling tools. It should be noted that this is only a guideline value and the Case Officer may identify other junctions where detailed assessments will be required on a case–by-case basis."

10.5.28 Paragraph 3.21 states that:

"Once detailed investigations into the impact of development traffic have been undertaken at agreed locations the Council will consider whether measures are required to mitigate the impacts of the development. In considering the assessment and subsequent mitigation, the Council will seek to achieve the following outcomes. and will agree on a case by case basis how this will be assessed by the developer:

- *Nil-detriment to junction capacity and delay from development traffic where junctions currently operate at greater than 85% ratio of flow to capacity (RFC) for non-signalised junctions, or 90% for signalised junctions;*
- *Nil-detriment from development traffic on links where capacity is currently at 90% or more;*
- *Nil-detriment to journey times for traffic on agreed routes;*
- *Nil-detriment to journey times for public transport, walking or cycling;*
- *Nil-detriment to accident rates at clusters along key routes; and*
- *Agreed mode share targets for development related trips where travel plans are required (see Section 3.4)."*

10.5.29 Section 6 of this policy relates specifically to the proposed development at Hinkley. SCC should not seek to develop new planning policies to test a nationally significant infrastructure project (NSIP). NSIPs are subject to their own planning regime set out in the Planning Act 2008 and the primary consideration for NSIPs is the policy to be set out in the Energy and Nuclear National Policy Statement (NPS), in respect of both the HPC development site and the associated development.

10.5.30 Policy HIN 1: Transport requirements for new nuclear development states that Council will require the developer of new nuclear power stations in Somerset to:

- *"Minimise the volume of road traffic associated with the development of the new power station especially at peak hours.*

- *Provide sustainable transport solutions for access to the site that workers and visitors will be required to use.*
- *Provide sustainable transport linkages to and from all associated development sites.*
- *Ensure as close as possible to zero parking spaces are provided at or near to the site during the construction phase.*
- *Enable effective controls to be put in place to ensure workers and visitors do not park in inappropriate locations.*
- *Ensure as much construction material as possible is delivered by sea.*
- *Minimise the amount of waste materials transported off-site.*
- *Provide necessary improvements to the transport network to mitigate against any adverse impacts on the community; including but not limited to congestion, air quality and road safety impacts.*
- *Minimise disruption both for the local community and visitors to the area.*
- *Control and manage the flow of any road freight movement associated with the development in order to ensure appropriate routes are used, avoid peak hour movement and to respond to incidents on the transport network.*
- *Agree and enable deployment of robust plans for managing unforeseen incidents on the transport network; including but not limited to traffic management plans, diversionary routes and freight/delivery management systems.*
- *Provide long-term, sustainable legacy benefits for the local community.*
- *Protect the natural and built environment and ensure the image of the area is not adversely affected.*
- *Monitor all movement associated with the development to ensure agreed mode share targets and thresholds for traffic congestion, air quality and road safety are achieved during construction and operation.*
- *Provide sufficient funds through appropriate legal agreements to enable the relevant authorities and agencies to implement further mitigation measures should any unforeseen impacts occur during the construction of the development."*

10.5.31 Policy HIN 2 sets out the 'Requirement for an Evidence Based Approach' as follows:

"An evidence-based approach will be taken to determine the effectiveness of the proposed transport interventions for the implementation of the HPC transport/freight strategy. We will require the HPC project promoter to adhere to performance criteria in relation to key parts of the transport network. It should be noted that as such, a transport strategy package of measures will be expected to meet this approach, which would include:

- *Highway improvements, including junction improvements and more strategic network improvements identified through the transport assessment process and associated evidence base.*

- *Public transport provision, including waiting facilities, support for existing and additional services, and priority measures that will ensure public transport journey time reliability.*
- *Intelligent Transport Systems (ITS) to promote and support the use of public transport facilities.*
- *Road Safety Improvements.*
- *Infrastructure needs associated with deploying a Traffic Management Plan.*
- *Pedestrian and cyclist facilities, including those which support the use of public transport and support the provision of a high quality public realm.*
- *Motorcycle parking.*
- *Park and Ride facilities if demonstrated as necessary.*
- *Car parking management for the site, associated development and residential areas, including clearway provision.*
- *Coach and rail facilities.*
- *Provision and management of water-borne transport.*
- *Highways and bridge strengthening measures.*
- *Transport maintenance packages.*
- *Transport monitoring strategy to assess effectiveness of measures and identify further mitigation, where necessary."*

10.5.32 Policy HIN 3 summarises SCC's requirements for the 'Evidence for the Development Consent Application' as follows:

"Prior to the Development Consent Application to the IPC the Council will require the following evidence to be in place to enable the robust development of a Statement of Common Ground and a Local Impact Report:

- *A Transport Assessment to cover the construction and operation of the site and associated developments, including an assessment of the required access arrangements, likely impacts, appropriate mitigation and improvements to the transport system with completed technical audits.*
- *A Transport Strategy and associated evidential base for managing freight waste and people movements associated with the construction of the development.*
- *A Travel Plan for the construction phase; including mode share targets for access to and from the main site and each associated development site.*
- *Directly linked to parking standards, provision of access infrastructure, provision of sustainable transport linkages and design of development layouts.*
- *Full transport assessments and travel plans for any other significant related development proposals that emerge such as induction facilities.*

- *A Travel Plan to manage access to the development in its operational phase.*
- *A Visitor Management Plan to manage visitor access to the site and maximise access by sustainable transport.*
- *Traffic Management Plans to manage unforeseen incidents on the transport network.*
- *Construction Management Plan for HGV and construction worker movements.*
- *Agreed monitoring, control and enforcement proposals for all aspects of movement."*

10.5.33 Finally, Policy HIN 4 summarises SCC's requirements for 'Arrangements Prior to Commencement of Construction' as follows:

> *"Prior to commencement of construction the Council will require the following to be agreed with the relevant authorities and agencies:*
>
> - *Site specific travel plans for each associated development site.*
> - *Final detailed freight management plans based on actual materials sourcing.*
> - *Final detailed waste management plans.*
> - *Implementation of agreed access arrangements and necessary controls.*
> - *Implementation of an agreed transport mitigation package.*
> - *Implementation of visitor management, traffic management, monitoring and enforcement arrangements.*
> - *Any required financial contributions."*

iv. Bridgwater Vision (Ref 10.20)

10.5.34 Whilst not forming part of the statutory development plan for Sedgemoor, the Bridgwater Vision (2009) sets out a regeneration framework for Bridgwater, comprising a 50 year vision and seven transformational themes for the town.

10.5.35 The document makes specific reference to Hinkley Point as a strategic project and acknowledges the opportunities and challenges such development will have on the area.

10.5.36 Bridgwater's overall vision is encapsulated in Vision V1, which states:

> *"In 2060 Bridgwater will be an energy conscious town known for its ambitious approach to sustainability and low carbon living. Bridgwater will be seen as a place that has been re-energised into a confident town through its strong, innovative architecture, its vibrant town centre and its revitalised neighbourhoods – encouraging a greater sense of local community, wellbeing and civic pride.*
>
> *Bridgwater will have a reputation for successful, coordinated delivery of its ambitious place shaping programme. The town's people, businesses and agencies will continue to work in partnership to improve housing and*

transport, deliver its flooding solution; the Parrett barrier and provide outstanding health and recreation facilities. Bridgwater will continue to attract new investment, maintaining its new position as a regional centre of enterprise excellence. Its highly skilled workforce will be utilised by the many cutting edge employers in the town, encouraged by the focus on innovation and knowledge, offering quality job opportunities and training in new and emerging sectors."

10.5.37 Theme 5 of the Vision is 'An accessible and well connected Bridgwater'. The document explains that:

"This theme promotes measures to control traffic growth through improvements to public transport, improved facilities for pedestrians and cyclists, and creating better links to the wider network including Hinkley Point..." (page 38).

10.5.38 Section 4 (A New Direction for Bridgwater) gives further consideration to Hinkley Point:

"The planned construction of a new nuclear power station will not only bring many jobs, but also will require local businesses to improve their skills in order to prepare for future bidding, which in its own turn should contribute to the development of a knowledge economy.

It will also be essential to evaluate the environmental impact of proposals and the impact on local communities, both in construction and post construction. This may include for example, noise and disturbance from traffic and construction, the impact of abnormal loads, and the possible development of Combwich Wharf. It will also be important to assess the impact of the proposals on strong existing economic sectors such as tourism, where compensatory mitigation may be required to support the sector." (page 44)

10.5.39 The Strategic Spatial Diagram (pages 60-61) within the document identifies a potential new link road between Dunball roundabout and Hinkley Point.

10.5.40 The potential for road improvements to Hinkley from Junction 23 of the M5 motorway is identified as an opportunity, which may require a new link road running from the Dunball roundabout travelling west across the River Parrett towards Hinkley (page 106). The design principles for this include:

"Dunball roundabout provides a key gateway into the town from Junction 23 of the M5 motorway and potentially to Hinkley Point through a possible new link road.

The area will incorporate a possible new link road from the Dunball roundabout across the River Parrett connecting Hinkley Point to Junction 23 of the M5 motorway…"

10.5.41 The transport related design principles for the North Bridgwater character area (within which the Junction 23 site is located) are set out in the Vision as follows:

- Dunball roundabout provides a key gateway into the town from Junction 23 of the M5 motorway and potentially to Hinkley Point through a possible new link road.

- Bristol Road will be part of the key public transport corridor providing high frequency bus connections to the town centre from a sequence of bus stops along the route. The road corridor will also incorporate segregated pedestrian and cycle lanes providing safe, high quality connections to the town centre.
- A new link road into North East Bridgwater accessed directly from Bristol Road should be provided.
- A park and ride facility in conjunction with enhanced bus services will also provide connections from the North Bridgwater area to Bridgwater town centre (page 107).

10.5.42 The transport related design principles for North East Bridgwater character area (within which the Bridgwater A accommodation campus is located) are set out in the Vision as follows:

- The dismantled railway line should be retained as a key pedestrian/cycle green link east-west across North East Bridgwater.
- High quality cycle and pedestrian connections should be made to Sydenham, the town centre, the railway station, and the adjacent employment areas.
- A public transport route should be provided facilitating safe, easy and well-connected movement through and close to important amenities and high density areas of housing in particular (page 91).

10.5.43 The transport related design principles for the Sydenham and Bower character area (within which the Bridgwater C accommodation campus is located) are set out in the Vision as follows:

- Improved pedestrian and cycle routes will be promoted throughout the area to connect residents to local shops and services, community facilities, employment areas, the rail station and the town centre.
- The strategic role of Bower Lane will be strengthened as development occurs with connections between North East Bridgwater and South Bridgwater promoted (page 84).

10.5.44 The transport related design principles for the Huntworth character area (within which the Junction 24 site is located) are set out in the Vision as follows:

- Taunton Road will be promoted as a key public transport corridor with high frequency bus services giving workers in the area direct and frequent access to the town centre.
- A park and ride site adjacent to the A38 Taunton Road in conjunction with enhanced bus services will also provide connections to Bridgwater town centre.
- High quality, safe and legible pedestrian and cycle routes will be created through the area strengthening links back to the town centre particularly along the Canal corridor.
- Consideration should be given to improving pedestrian and cycle connections to the footbridge over the M5 to connect new development on the eastern side of the motorway into Bridgwater.

- A Travel Plan would be critical to the options presented for the site, with the potential for a bespoke public transport service and connecting pedestrian and cycle infrastructure back to the town centre (page 88).

v. Bridgwater, Taunton and Wellington Transport Strategy (Ref 10.21)

10.5.45 The Transport Strategy for Bridgwater, Taunton and Wellington for the period 2009 – 2026 was adopted by SCC in March 2010. The strategy indicates a number of infrastructure improvements that may be implemented during the strategy's lifespan in support of the draft Regional Spatial Strategy and will likely be a key component of the Third Somerset LTP.

10.5.46 At section 5.1 on Bridgwater the strategy states that SCC:

> *"…..will further investigate the potential for introducing park and ride sites on the edges of the town to reduce town centre congestion. We will seek to improve sustainable links to the railway station, as well as increasing opportunities for walking and cycling in the town by removing physical barriers created by roads, by providing new infrastructure and by improving the pedestrian environment in the town centre."*

10.5.47 SCC's transport strategy document also indicates a number of improvements that may be implemented during their strategy's life-span. Some of the improvements that are listed are advised to be development-related and will only be implemented should the site specific developments proceed.

10.6 Methodology

10.6.1 The Institute of Environmental Management and Assessment (IEMA) 'Guidelines for the Environmental Assessment of Road Traffic' (Ref.10.22) have been used to ensure that the environmental impacts arising due to predicted changes in traffic levels are properly and comprehensively addressed. In addition the Design Manual for Roads and Bridges (DMRB) Volume 11 has been referred to in the development of this chapter (Ref 10.23).

10.6.2 The IEMA guidelines advise the use of a 'check-list' of potential effects covering noise, vibration, visual impact, severance, driver delay, pedestrian delay, pedestrian amenity, accidents and safety, hazardous loads, air pollution, dust and dirt, ecological impact and heritage and conservation areas.

10.6.3 The guidelines acknowledge that for many developments some of the effects listed may not be widely relevant, but suggest that reasons should be provided for any exclusions.

10.6.4 This chapter deals only with the transport related effects i.e. severance; driver delay; pedestrian amenity; accidents and safety. Other effects such as noise and air quality are dealt with in other chapters of the Environmental Statement.

10.6.5 The sections below describe the information for the different elements of the assessment and then provide detail on the application of the IEMA methodology to the transport environmental effects of the HPC Project.

a) Study Area

10.6.6 In accordance with the IEMA guidelines, the study area has been defined by identifying any link or location where it is felt that significant environmental impacts may occur as a result of the HPC Project.

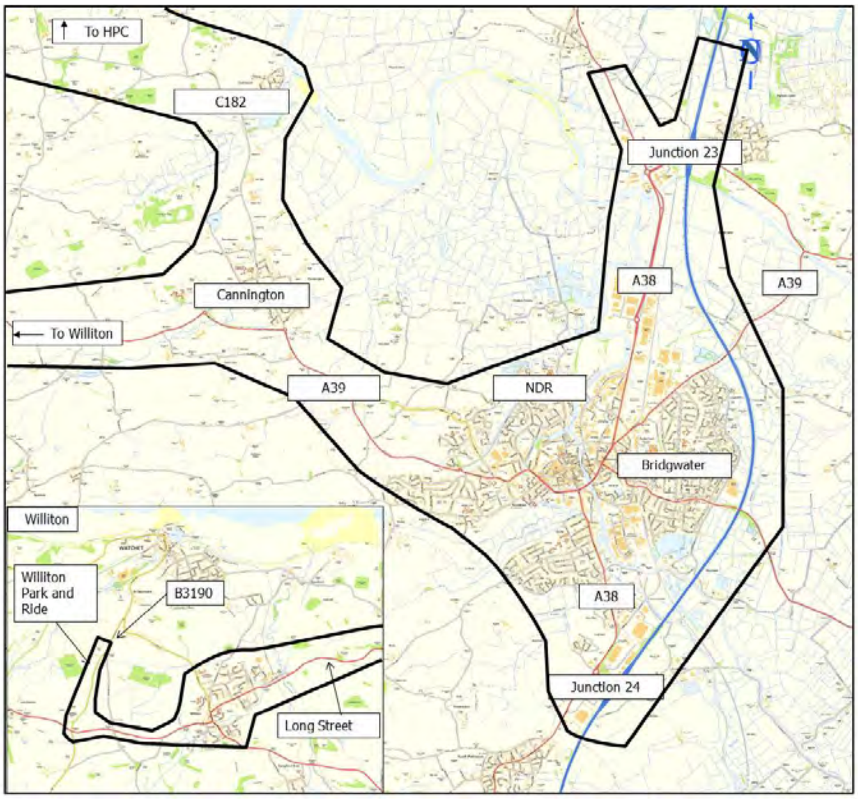
10.6.7 The geographical extent of the study area includes:

- The M5 motorway between and including Junction 23 and Junction 24.
- The A39 from the Crandon Bridge/Silverfish junction to the east of the M5 motorway to the A39 just to the west of A39/High Street junction in Cannington.
- The A38 from just to the north of Dunball roundabout to just to the south of Huntworth roundabout.
- Bridgwater town centre.
- Cannington village.
- C182 (Rodway) between Cannington and the HPC development site.
- Williton.

10.6.8 Links through Stogursey have not been included within the detailed assessment as it is not planned to route buses through the village except those that pick up workers from the village. The size of the buses that do pass through the village would be limited to 15 person vehicles. The small number of these vehicles would not have a material effect on the issues studied in this chapter.

10.6.9 The links modelled in the Paramics model (referred to hereafter as the model) are shown at **Plate 10.1**.

Plate 10.1: HPC Development Site Study Area



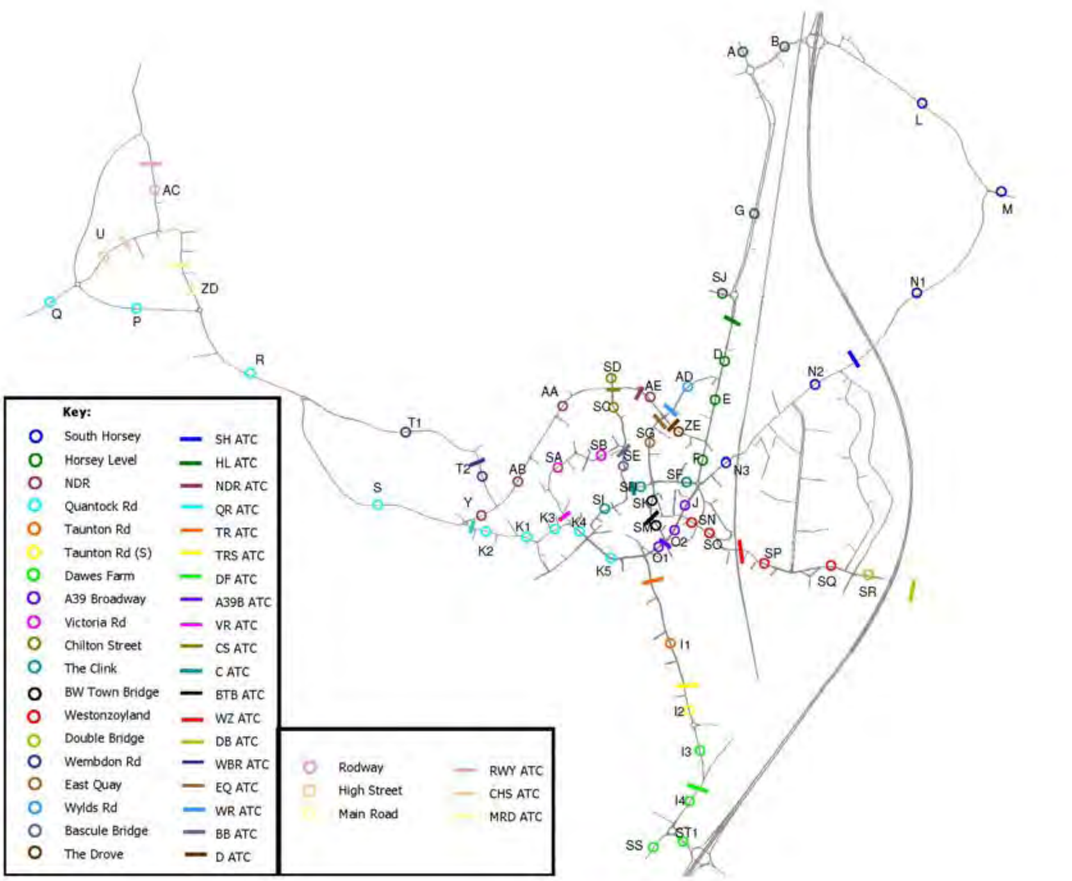
b) Traffic Assessment

10.6.10 This section summarises the methodology used to derive traffic flows used in the environmental assessment. Full details are included within the **Transport Assessment.**

10.6.11 The traffic assessment for the HPC Project has been undertaken using a model. The model has been used to predict changes in flow and junction performance as a result of the traffic generated by committed developments in the area and the HPC Project. It also predicts the effects of future changes to the highway network.

10.6.12 The links modelled are shown at **Plate 10.2**.

Plate 10.2: Paramics Modelled Links



i. Assessment Years and Quarters

10.6.13 The following assessment periods have been considered:

- 2009: Base Year.
- Quarter 3 2013.
- Quarter 4 2016.
- 2021.

10.6.14 2009 is the base year selected and is the year when the majority of traffic surveys were undertaken. This establishes the existing traffic conditions in the area.

10.6.15 Quarter 3 2013 is when the HPC development site construction would have commenced but the majority of the associated development sites would not be operational. At this stage park and ride and freight management facilities along with the temporary induction centre would be operational at Junction 24. The Cannington bypass would not completed at this stage.

10.6.16 Quarter 4 2016 is the assessment of peak construction impacts. At this stage all highway improvement measures would be in place, including the Cannington bypass. Based on the workforce and freight movement profiles, the fourth quarter is the period when traffic impacts are likely to be at their greatest.

10.6.17 In 2021 the HPC development site would be fully operational and some of the associated development sites would be being decommissioned. Junction 24 and Cannington park and ride would still be operational. In addition some construction activity would still be ongoing on the HPC development site (mainly the Intermediate Spent Fuel Store). The scenario used for assessment is a combination of the worst case quarter for construction workforce and the worst case quarter for operational staff.

10.6.18 Given that 2021 is not just an operational year, comment is made in the analysis about the likely effects when all construction activity would cease and there would be just the operational staff on site. This would at the end of 2022.

10.6.19 The first assessment in this chapter is for 2016 since this is the anticipated period of peak construction impact at the HPC development site. Following this, an assessment is made of the impacts in 2013 and 2021.

ii. Assessment Periods

10.6.20 The primary assessments have been undertaken on a daily basis (24 hour Annual Average Daily Traffic) since this reflects the impacts on severance, pedestrian amenity and safety. However, the peak network periods have also been assessed since these are relevant for pedestrian and driver delays. Vehicle delays have been assessed for all the hours modelled in the model i.e. 06:00 to 10:00 and 13:00 to 20:00.

iii. Baseline Traffic Flows

10.6.21 The baseline year for the purposes of this assessment is 2009.

10.6.22 The **Local Model Validation Report (LMVR)** appended to the **Transport Assessment** sets out all of the traffic data that has been collected to build the model. Further traffic data has been collected for junctions outside of the model as follows:

- A39 Long Street/North Street, Williton (turning count November 2009).
- A39 Fore Street/A358 High Street, Williton (turning count November 2009).
- A39/B3190 Washford Cross, Williton (turning count May 2011).
- A39 Fore Street south of Killick Way, Williton (Automatic Traffic Count (ATC) July 2010).

- A39 Priest Street to the west of Mamsey Lane (ATC July 2010).
- C182 (Rodway) near the Combwich Wharf access road (ATC October 2010).
- Proposed HPC development site access (permanent ATC count).

10.6.23 The surveyed traffic data is input to the model and a 2009 Base Model produced. This is validated against existing conditions – i.e. outputs from the model (traffic flows; queue lengths and journey times) are compared with actual conditions measured on site. The validated 2009 model has been agreed as fit for purpose by the transport authorities.

10.6.24 The model outputs hourly flows for the modelled hours (06:00-10:00 and 13:00-20:00). This data has been used to provide baseline environmental traffic data. The methodology for calculating 24 hour Annual Average Daily Traffic (AADT) and 18 hour Annual Average Weekday Traffic (AAWT) flows is summarised as follows:

- The agreed 2009 base model has been run 20 times and the results have been averaged. The need for 20 model runs of the 2009 base model is set out in the **LMVR** appended to the **Transport Assessment**. The total vehicles and percentage of Heavy Duty Vehicles (HDVs) i.e. Other Goods Vehicles 1 (OGV1), Other Goods Vehicles 2 (OGV2) and Public Service Vehicles (PSV) on each link in each direction have been obtained from the average results for the 11 model hours of 06:00-10:00 and 13:00-20:00.
- For the links at Junction 23 and Junction 24 of the M5, TRADS data from the HA has been used for the period between 01 January 2009 and 31 December 2009 to provide a factor to convert the 11 hours of model output data to 18 hour Annual Average Weekday Traffic (AAWT) (06:00-00:00) and 24 hour Annual Average Daily Traffic (AADT) flows. As the annual average traffic volumes have been taken from the HA's online database, a seasonality factor is not required for these links as it is already included.
- For the links on the local highway network a factor has been derived for each link to convert the 11 hours of modelled traffic data into 18 hour AWT and 24 hour AADT flows. The 18 hour AWT and 24 hour AADT factors for each link are based on the nearest ATC survey data available.
- The same 18 hour AWT and 24 hour AADT factors have been applied to provide the volume of HGVs by applying the factor to the total volume of HGVs provided by the base model between the hours of 06:00-10:00 hours and 13:00-20:00 hours. The ATC data collected does not provide a breakdown of vehicle classification therefore the proportion of HDVs is unknown. For this reason it is considered that the best alternative is to use the all vehicle factor for HGV proportions.
- The 18 hour AWT and 24 hour AADT flows have then been factored using a seasonality factor for the local highway network to provide 18 hour AAWT and 24 hour AADT flows. This is because the ATCs do not cover a full year.

iv. Future Year Baseline Traffic Flows

10.6.25 Baseline traffic models have been developed for 2013, 2016 and 2021. These incorporate the traffic generation from all committed developments in the area i.e.

those with planning permission. In addition, other growth has been allowed for by using TEMPRO and NTEM growth factors agreed with the transport authorities. Also included are any committed highway improvement schemes. These are as follows:

- Committed highway schemes implemented by 2013:
  - South Bridgwater Link Road
  - A39 Silverfish/Crandon Bridge
- Committed highway schemes implemented by 2016:
  - North East Bridgwater Link Road
- Committed highway schemes implemented by 2021:
  - Dunball roundabout improvement.

10.6.26 The future year base models for 2013, 2016 and 2021 have been agreed in principle by the transport authorities. These are referred to as the Reference Case Models.

v. Trip Generation

10.6.27 Given the bespoke nature of the proposed HPC development there are no UK Power Station land use trip rates available to determine the likely trip generation of the construction and operational phases of the HPC Project. Instead a first principles trip generation methodology has been employed as summarised below. The details of the methodology are set out in the **Transport Assessment**.

Workforce

10.6.28 The construction workforce required to construct the HPC Project has been derived from EDF Energy data collected from constructing similar reactors. It is anticipated it would take approximately nine years to complete the main construction works for the HPC Project when both units would be operational (including preliminary works); during this period it is forecast that the construction workforce would peak at 5,600 in 2016. Workforce numbers have been profiled for the construction period including the construction (2013) and deconstruction (2021) of the associated development sites.

10.6.29 A profile of the number of operational workers required to operate the two UK EPR Reactor Units has been derived based on data from similar existing UK EDF Energy managed power stations (i.e. Hinkley Point B (HPB) and Sizewell B). It is anticipated an operational workforce of 900 personnel would be required of which 810 would be present on site on any one day. Operational staff have been included in the workforce profile.

10.6.30 EDF Energy has developed a transport strategy that is described fully in the **Transport Assessment**. A summary of the strategy for the movement of construction staff is set out below:

- On-site parking at the HPC development site would be heavily constrained – with only 200 on-site parking spaces for contractors' staff. As such the large majority of the construction workforce would travel to and from the HPC development site by bus, either from park and ride sites or by direct bus services.

- Park and ride: park and ride facilities would be established near to Junction 23 and Junction 24 of the M5 motorway, and at Cannington and Williton. These would serve both home-based and non-home-based workers who would travel to the park and ride facilities and then be transferred by bus to the HPC development site or associated development site.
- Direct bus services: direct bus services would be provided from the accommodation campuses in Bridgwater and there would also be buses provided for workers on key routes to the HPC development site. The routes would need to align to the location of workers and would need to be reviewed on a regular basis in order to respond to fluctuations in the patterns of workforce demand and location.
- Walking and cycling: Walking and cycling forms an element of the strategy for workers. The elements of this are: directly to the HPC development site from suitable locations; to the park and ride sites; and to bus routes. In conjunction with SCC an audit of relevant cycling and walking routes has been undertaken and a number of proposed improvements identified
- Major infrastructure interventions: Even with the transport strategy and **Freight Management Strategy** there would inevitably be an increase in traffic movements (freight; buses and cars) on the local network. After careful consideration and consultation, EDF Energy has concluded that a bypass around Cannington should form part of the proposals. This is in order to mitigate the impacts of additional traffic and in particular HGVs and buses through the village.
- Highway network improvements: A series of highway improvements have been developed in conjunction with stakeholders and the local community. These measures include those that assist safety as well as capacity. These improvements are included in the HPC project as associated development.
- Travel Plans: Travel planning would form an integral part of the transport strategy. The **Framework Travel Plan** requires the use of sustainable modes and seeks to minimise use of the private car where practicable. One of the key features of the transport strategy is that workers would be required to use certain modes. For example, if a worker lives at an accommodation campus they would be required to use a direct bus to get to the HPC development site

10.6.31 The people trip generation has been based on the workforce profiles and the transport strategy described above. The mode assigned to workers (walk, cycle, direct bus, park and ride) has been based on an assessment of the distribution of the staff and the most suitable mode for them. Workers would be prescribed a mode of travel by EDF Energy. For example, workers assigned to a particular park and ride site would be required to use that site for their onward journey to the HPC development site.

10.6.32 The number of buses estimated to use the road network is based on a high frequency timetable of buses allowing workers to arrive at the pick up point over a period of time. When the detailed bus operations are refined the number of buses is likely to reduce significantly since there would be more precise adjustment of buses to match demand.

Freight

10.6.33 The development of the new nuclear power station would require significant quantities of construction materials to be delivered to the HPC development site. EDF Energy has developed a **Freight Management Strategy** (**FMS**) which is appended to the **Transport Assessment.**

10.6.34 The proposed freight measures aim to reduce and control the use of road freight traffic during the construction phase, especially in the peak hours. As for worker movements, a range of options have been investigated and further details are provided in the **FMS**.

10.6.35 A summary of the **FMS** is shown below:

- The re-use and storage of excavated materials on-site to avoid exporting off-site.
- The use of water for delivery of bulk materials and the largest abnormal indivisible loads (AILs) through the construction of a temporary jetty at HPC, the refurbishment and extension of Combwich Wharf and the construction of a new freight laydown facility at Combwich.
- Introducing off-site freight management facilities at Junction 23 and Junction 24, to control incoming freight traffic flow and holding freight vehicles in case of an incident on the local network or on-site.
- Regulating traffic flow by using a project-wide delivery management system (DMS) to regulate flows and move away from peak time congestion.
- Reducing small vehicle movements through consolidation of postal and courier deliveries at the freight management facilities.

10.6.36 EDF Energy is committed to bringing at least 80% of bulk materials required for HPC development site concrete production by sea. In accordance with EDF Energy's objectives, the use of water would be maximised to what is practicable. However, it must be recognised that there are constraints to the use of water and in particular tides and poor weather can affect use.

10.6.37 The freight generation and material quantities figures are based on EDF Energy's extensive experience of constructing Pressurised Water Reactors in France as well as information from the construction of Sizewell B in the UK. It is also augmented by data emerging from the on-going construction of Flamanville 3 in France. Where additional materials are required due to site specific elements of the HPC Project (e.g. for such items as the construction of the jetty and sea wall) estimates have been made by the engineering team based on the design of the infrastructure.

10.6.38 The quantum of materials required to construct the associated developments has been derived based on the proposed layout and construction specification.

10.6.39 The material and waste quantities have been profiled over the construction phase in accordance with the construction programme. The material and waste have then been assigned a mode of transport (i.e. Jetty, Combwich Wharf or by road). Any material or waste to be delivered or removed by road has been converted to freight vehicle movements by applying average vehicle payload assumptions to each type of material and waste.

10.6.40 For the purpose of quantifying freight traffic the freight vehicles associated with the construction of the HPC Project have been categorised as follows:

- Heavy Goods Vehicles – HGVs: all vehicles exceeding a maximum gross weight of 3.5 tonnes (maximum allowable total weight when loaded). These include medium goods vehicles (maximum gross weight between 3.5 and 7.5 tonnes) and heavier 2, 3 or more axle lorries.
- Light Goods Vehicles – LGVs: vans, pickups, 4x4s and cars with a maximum gross weight of 3.5 tonnes.

10.6.41 It has been assumed that the construction materials, plant and equipment for the project would be transported by HGVs while LGVs would be used for transporting food and consumables, small items and specialist tools/equipment. LGVs would also include Contractors' fleet vehicles.

10.6.42 The above categorisation is important. As can be seen the definition of HGVs used includes Medium Goods Vehicles (MGVs). Therefore, when the numbers and impacts of HGVs are discussed later in this chapter they include MGVs.

10.6.43 The number of HGVs per day would fluctuate around the average figure depending on the type of on-site activities and delivery requirements. It is considered that a factor of ±50% applied to the average would provide an adequate range to cater for these variations e.g. an average of 250 HGVs (500 movements) per day over a quarter may result in the number of HGVs per day varying between 125 (250 movements) and 375 (750 movements).

Overall Trip Generation

10.6.44 In overall terms it is considered that the trip generation for both people and freight is robust for at least the following reasons:

- Assessment in Quarter 4 2016 is for the peak of the construction process and that level of activity lasts only approximately 5 months.
- Traffic using the park and ride sites includes a contingency of 10%.
- HGV movement estimates are based on conservative assumptions on the use of sea for deliveries and on the payloads per HGV.
- A 20% contingency has been included in the estimate of HGV numbers for construction of all associated developments.
- The definition of a HGV used includes Medium Goods Vehicles.
- Bus numbers are based on a high frequency timetable. Numbers will reduce when bus timetables are more precisely matched to worker demand and location.
- No allowance has been made for the fact that the Bridgwater A accommodation campus is on land allocated for housing and for which a traffic allowance is already made in the Reference Case flows. Similarly, no reductions have been made for traffic that would cease to be generated as the existing use of the Somerfield Site at Junction 24 has come to an end.

vi. Trip Distribution

10.6.45 The detailed methodology for estimating the trip distribution is set out in the **Transport Assessment** and is summarised in this section.

Workforce Distribution

10.6.46 Given the bespoke and complex nature of the HPC Project, there is no historical data that can be used to establish a robust trip distribution for employees who would be working on the construction of the HPC Project. Instead a gravity model has been built using data from the socio-economics impact assessment. A detailed methodology is included in the **Transport Assessment.**

10.6.47 In terms of skills, the construction workforce can be divided predominantly into civil operatives and mechanical and electrical operatives with the remaining workforce comprising supervisory, managerial and clerical staff, plus site services and security employees.

10.6.48 The existing skills profile in the local area does not fully meet the specialised requirements of the construction of the HPC Project and therefore there would be two types of construction workers, as follows:

- Home-based workers, who would commute to and from work on a daily basis from their home address.
- Non-home-based workers who cannot feasibly commute to and from work on a daily basis from their home address and would therefore require temporary accommodation in the vicinity of the HPC development site.

10.6.49 The split of home-based and non-home-based workers would change over the course of the construction phase as the nature of the construction evolves. As the construction progresses, a different, more specialised, workforce would be required. These workers would most likely need to be attracted from further afield, resulting in an increase in the number of workers occupying local temporary accommodation.

10.6.50 In order to assist with the housing of the non-home-based workers, EDF Energy proposes to provide accommodation campuses both on the HPC development site and within Bridgwater. A total of 1,510 spaces would be provided. In addition to the campus provision, non-home-based workers would also live in existing accommodation in the vicinity of the HPC development site.

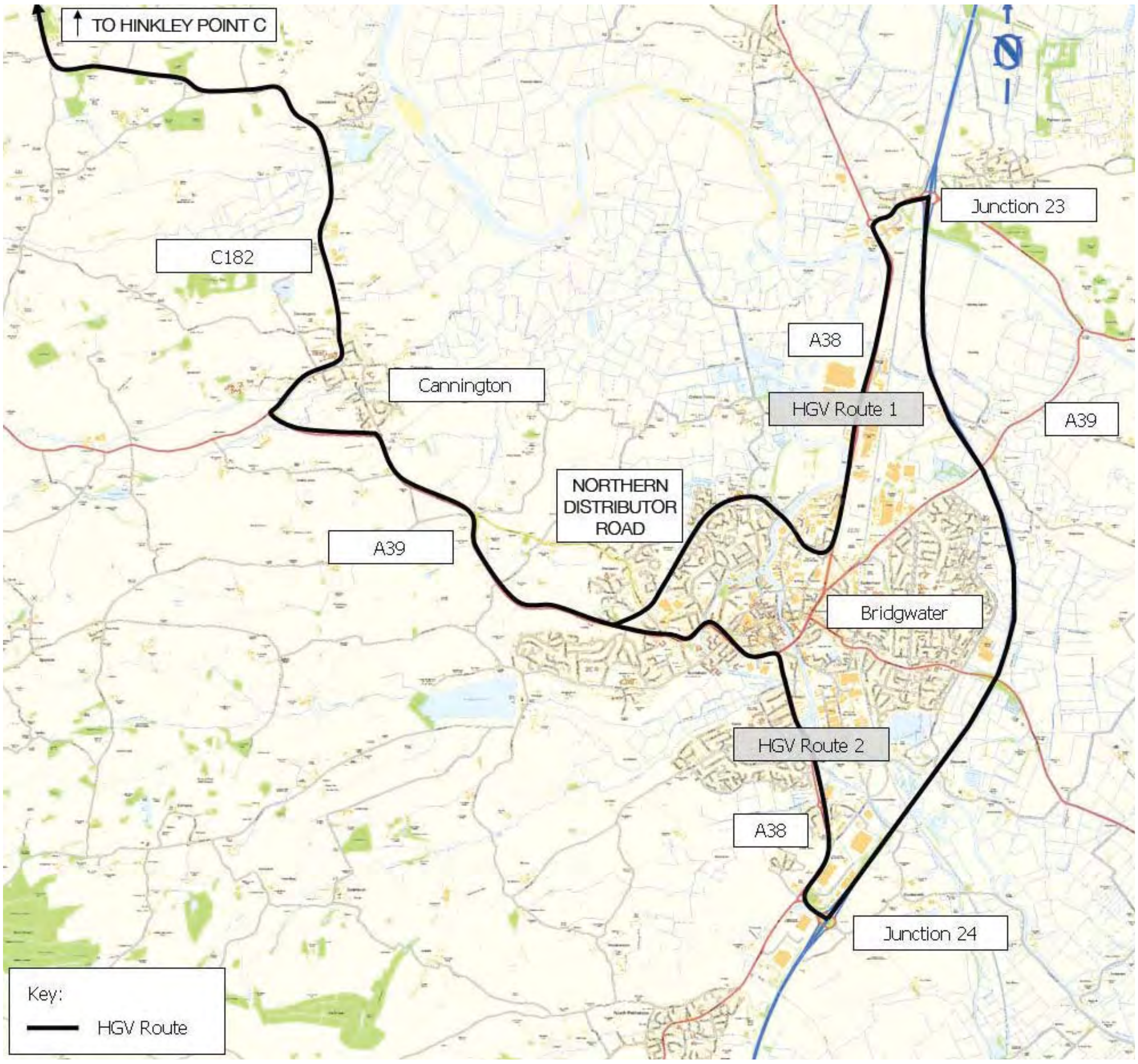
10.6.51 Research within the UK construction industry has demonstrated that construction workers would tend to commute daily up to 90 minutes. It has therefore been assumed that the home-based workers would commute up to 90 minutes from their home to the HPC development site. It is considered that the non-home-based workers would tend to live closer to the HPC development site as they are moving into the area primarily for work and the travel time to work would be a material factor when choosing accommodation. It has therefore been assumed that the non-home-based workers would commute up to 60 minutes from their accommodation to the HPC development site.

Freight Distribution

10.6.52 Full details of the freight distribution are set out in the **Transport Assessment** and appended **Freight Management Strategy.**

10.6.53 It has been assumed that all HGV movements associated with construction at the HPC development site would travel via the M5 motorway and through Bridgwater. HGVs travelling to the HPC development site would pass through freight management facilities at Junction 23 or Junction 24 of the M5 and then use the routes shown in **Plate 10.3** to access the HPC development site. Prior to completion of the Cannington bypass, HGVs would pass along High Street Cannington. After completion of the Cannington bypass, all HGVs connected with the HPC Project would route via the Cannington bypass. In 2013, when only the freight management facility at Junction 24 is operational, some HGVs would travel from Junction 24 via the M5 to Junction 23 and then use the northern HGV route via Bristol Road and the Northern Distributor Road to access the HPC development site.

Plate 10.3: Designated HGV Routes to the HPC development site



vii.Impact Assessment

10.6.54 The trip generation and trip distribution have been used to derive a matrix of vehicular trip origins and destinations. These are then added to the Reference Case models for 2013, 2016 and 2021 to give the ‘with-development’ models.

10.6.55 Examination of the 2016 Reference Case and 2016 with-development models identified certain capacity issues in both scenarios. Therefore mitigation measures were introduced to seek to assist traffic movements. In addition, certain safety enhancements were agreed with the transport stakeholders and local community. A list of the proposed highway improvements is shown below. These improvements are in addition to accesses provided to the HPC development site and associated development sites. For the purposes of this assessment, they are mitigation incorporated as part of the HPC Project.

- M5 Junction 23 roundabout.
- A38 Bristol Road/Wylds Road junction.
- A38 Bristol Road/The Drove junction.
- Wylds Road/The Drove junction.
- A38 Bristol Road/A39 (Bath Road) (Cross Rifles) junction (see note below).
- A39 Broadway/A38 Taunton Road junction*.
- A39 New Road/B3339 Sandford Hill roundabout*.
- Washford Cross roundabout*.
- Huntworth roundabout*.
- Claylands Corner junction*.
- Cannington traffic calming measures*.
- C182 Farringdon Hill Lane horse crossing*.
- Cannington bypass.

10.6.56 These changes to the highway network were added to the model for 2016 and 2021. In 2013 only the improvements shown with a (*) above were included although it would be EDF Energy’s intention to implement as many schemes as possible by the end of 2013.

10.6.57 The HPC generated traffic flows have a very small impact on Cross Rifles roundabout. However, a proposed improvement scheme has been introduced in the model to assist traffic flow at this critical node which currently experiences congestion. This is a scheme derived by EDF Energy that is all within the highway boundary. However, it is proposed that EDF Energy make a contribution to SCC to allow them to promote their own larger scheme using funding from other development contributions in the area.

10.6.58 Adding the proposed highway improvements to the With Development models leads to the production of the With Development and Mitigation models.

10.6.59 Extensive output can be derived from a run of the model and this is discussed in detail in the **Transport Assessment**. For the purposes of this assessment, the outputs used have been the changes in traffic flows on sections of the highway network (known as links). Outputs have been shown in this chapter for:

- All vehicles.
- HGVs and buses.

viii. Accidents and Safety

10.6.60 The **Road Safety Strategy** prepared for the HPC Project is provided as an appendix to the **Transport Assessment**. This section summarises the agreed methodology used for the study to assess the impact of the HPC Project on road safety.

10.6.61 Accident data for the five years up to the end of June 2010 has been obtained from SCC and the HA for the study area.

10.6.62 The accident data has been compared against the national accident rates to determine if any links have rates significantly higher than would otherwise be expected.

10.6.63 The local road network has then been broken down into parishes and accident clusters identified using the definitions developed by the Somerset Road Safety Partnership (SRSP) as follows:

- an accident cluster in an urban location is where at least seven accidents have occurred within a 50 metre radius in a five year period; and
- an accident cluster in a rural location is where at least seven accidents have occurred within a 100 metre radius in a five year period.

10.6.64 The accident data relating to the M5 has also been analysed to determine if there are any sites that have experienced a high number of accidents, when compared to the national average.

10.6.65 An assessment has then been made of the likely impact of the proposed HPC Project on road safety in the study area. This has been done based on the likely changes in traffic flows as a result of the proposed development. However, it is important to note that traffic flows would also increase as a result of increases in traffic flows excluding HPC (i.e. due to committed developments and general growth).

10.6.66 Measures to mitigate the impact on road safety in the study area have been identified. These aim to address issues at existing sites that have experienced a higher than average accident rate that could be exacerbated by any increase in traffic flow generated by the HPC Project. However, suggested measures recognise improvements to be brought forward by EDF Energy to address capacity issues and SCC's own safety improvement programme.

c) Consultation

10.6.67 Extensive consultation has been undertaken throughout the EIA process. As a result of the consultation process, comments have been received from the highway authorities and have informed this assessment. In addition meetings and discussions with the highway authorities have been extensive and on-going to agree the scope of the assessment. The highway authorities have agreed the methodology for estimating the traffic flows for this assessment, in addition to other traffic data required for the noise and air quality assessments. For further details, refer to the **Consultation Report**.

d) Detailed Assessment Methodology

10.6.68 The following paragraphs provide a detailed methodology of how the IEMA 'Guidelines for the Environmental Assessment of Road Traffic' (1992) (Ref. 10.1) have been applied in this assessment.

i. Screening Process

10.6.69 The potential effects of the HPC Project have been determined by comparing the With Development and Mitigation scenario to the Reference Case scenario in the assessment years. Within the IEMA guidance, two broad rules are suggested which can be used as a screening process to limit the scale and extent of the assessment:

- Rule 1: include highway links where traffic flows would increase by more than 30% (or the number of heavy goods vehicles would increase by more than 30%).
- Rule 2: include any other specifically sensitive areas where traffic flows have increased by 10% or more.

10.6.70 Where the predicted increase in traffic flows is lower than the above thresholds, the IEMA guidelines suggest the significance of the effects can be stated to be negligible and further detailed assessments are not warranted. Increases in traffic flows below 10% are generally considered to be insignificant in environmental terms given that daily variations in background traffic flow may vary by this amount.

ii. Sensitivity of Receptors

10.6.71 The sensitivity of a road can be defined by the vulnerability of the user groups who may use it, e.g. elderly people or children. A sensitive area may be where pedestrian activity may be high, for example in the vicinity of a school or where there is already an existing accident issue. It should be noted that the sensitivity of the receptor is judged on the sensitivity of road users (primarily pedestrians). It also takes account of the existing nature of the road e.g. an existing "A" road is likely to have a lower sensitivity than a minor residential road. **Table 10.1** below provides a summary of the types of receptors and the sensitivity of each, defined as substantial, moderate, minor or negligible.

Table 10.1: Sensitivity of Receptors

Receptor Type	Receptor Sensitivity
Receptors of greatest sensitivity to traffic flow: schools, colleges, playgrounds, accident clusters, retirement homes, roads without footways that are used by pedestrians.	Substantial
Traffic flow sensitive receptors: congested junctions, doctors' surgeries, hospitals, shopping areas with roadside frontage, roads with narrow footways, recreation facilities	Moderate
Receptors with some sensitivity to traffic flow: places of worship, public open space, tourist attractions and residential areas with adequate footway provision	Minor
Receptors with low sensitivity to traffic flows and those sufficiently distant from affected roads and junctions	Negligible

10.6.72 A desktop exercise augmented by a number of site visits has been undertaken to identify the sensitive receptors in the study area. All road links within the study area have been assessed and assigned sensitivity. Recognising the quantity of road links within the study area, for ease of review the assessment narratives have focused on the road links that would lead to highest impact. The results of the analysis are shown at **Table 10.2** below. A plan of the link locations is shown earlier in this chapter at **Plate 10.2**.

Table 10.2: Study Area Receptor Sensitivity

Link	Link Ref.	Sensitivity
M5 Junction 23 northbound on-slip	V1	Minor
M5 Junction 23 southbound off-slip	V2	Minor
M5 Junction 23 northbound off-slip	V3	Minor
M5 Junction 23 southbound on-slip	V4	Minor
A39 spur east of Dunball	B	Minor
A39 east of J23	L	Minor
A38 north of Dunball	A	Minor
A38 south of Dunball	G	Minor
A38 between Wylds Road and The Drove	E	Moderate
A38 between The Drove and Cross Rifles	F	Moderate
A38 between Cross Rifles and St. John Street	J	Moderate
A38 between St. John Street and Taunton Road	O2	Minor
A39 (Bath Road) north-east of Cross Rifles	N3	Moderate
St. John Street	SN	Moderate/Substantial
The Clink	SF	Minor
Wylds Road	AD	Minor
The Drove	ZE	Minor
Western Way (west of Chilton Street)	AA	Moderate
B3339 Wembdon Hill	T1	Substantial
M5 J24 northbound on-slip	ST2	Minor
M5 Junction 24 southbound off-slip	ST3	Minor
M5 Junction 24 northbound off-slip	ST4	Minor
M5 Junction 24 southbound on-slip	ST5	Minor
A38 spur east of Huntworth	ST1	Minor
A38 Taunton Road south of Showground	I2	Minor
A38 Taunton Road (south of Broadway)	I1	Moderate
A39 Broadway	K5	Moderate
A39 west of Quantock roundabout	S	Moderate
A39 south-east of Cannington	R	Minor
A39 south of Cannington	P	Minor
A39 west of Cannington	Q	Minor

Link	Link Ref.	Sensitivity
High Street, Cannington	U	Substantial
Main Road, Cannington	ZD	Substantial
Rodway south of bypass	AC	Substantial
Rodway north of bypass	12	Minor
Cannington bypass	Z1	Minor
A39 Williton	2	Substantial

iii. Magnitude of Impact

10.6.73 To assist with the judgement of magnitude of impact, reference has been made to the IEMA guidelines (Ref. 10.1). This guidance sets out consideration, and in some cases, thresholds, in respect to changes in the volume and composition of traffic to facilitate a subjective judgement of traffic impact and significance. These thresholds are guidance only and provide a starting point by which a detailed analysis will inform a subjective analysis of the impact magnitude.

10.6.74 It is important to note that the impacts assessed are temporary, not permanent, and this affects the significance attached to them. In 2016 the maximum workforce would be present at the HPC development site for approximately five months. Similarly, the peak HGV flows in 2013 occur for only a few months. However, it is also recognised that, whilst it would be below the peaks which have been assessed here, there would be sustained traffic generation arising from the HPC construction phase for a significant number of years and therefore that the temporary effects associated with the construction of HPC would continue for longer than would normally be the case for the construction phase of most developments. The period of relatively high levels of traffic generation related to the construction of HPC and the operation of the associated developments is approximately 5-6 years and, as a worst case assumption, it can therefore be assumed that the impacts assessed for the 2016 period would persist for that length of time. In reality traffic flows would often be at a somewhat lower level than have been assessed for 2016, and where it is considered that the period for which the 2016 impact is likely to persist is materially shorter or longer, comment is included in the text.

10.6.75 As described earlier in this chapter, within any quarter the number of HGV movements would vary from the average for that quarter. Some days the number would be above average and some days below. The hour by hour modelling has been undertaken on the basis of a peak day within the quarter under analysis. However, the daily flows (AADT) are for an average day to be consistent with other analysis within the Environmental Statement (e.g. air quality) and because it is normal practice to assess the average i.e. the most likely set of circumstances. However, where there is likely to be a significant impact, a commentary on the peak day for HGVs is also provided.

iv. Types of Impact

10.6.76 The following paragraphs cover each of the impacts that are considered in this chapter.

Severance

10.6.77 Severance is defined as the perceived division that can occur within a community when it becomes separated by a major traffic artery and describes a series of factors that separate people from places and other people. Such division may result from the difficulty of crossing a heavily trafficked road or a physical barrier created by the road itself.

10.6.78 The measurement and prediction of severance is difficult, but relevant factors include road width, traffic flow, speed, the presence of crossing facilities and the number of movements across the affected route.

10.6.79 IEMA guidelines refer to the Department of Transport's 'Manual of Environmental Appraisal' (Ref. 10.1), which suggests that changes in traffic flow of 30%, 60% and 90% would be likely to produce 'slight', 'moderate' and 'substantial' changes in severance, respectively. It is advised that these broad indicators should be used with care and regard paid to specific local conditions.

Pedestrian Delay

10.6.80 IEMA guidelines note that changes in the volume, composition and or speed of traffic may affect the ability of people to cross roads. Typically, increases in traffic levels result in increased pedestrian delay, although increased pedestrian activity itself also contributes. The guidelines do not set any thresholds, recommending instead that assessors use their judgement to determine the significance of the impact.

10.6.81 The IEMA guidelines refer to a report published by the Transport Research Laboratory (TRL SR356, Goldschmidt, 1976) as providing a useful approximation for determining pedestrian delay. The TRL research concluded that mean pedestrian delay was found to be eight seconds at flows of 1,000 vehicles per hour and below 20 seconds at 2,000 vehicles per hour for various types of crossing condition. This research has been reproduced in DMRB Volume 11, Section 3, Part 8. Figure 1 of Part 8 provides predictive mean pedestrian delay based on empirical data taking into account traffic flow and a range of parameters such as crossing width and vehicle speeds.

10.6.82 A two-way flow of 1,400 vehicles per hour has been adopted as a lower threshold for assessment (equating to a mean 10 second delay for a link with no pedestrian facilities in the TRL report). Below this flow pedestrian delay is unlikely to be a significant factor. This is deemed a robust starting point for narrowing down the modelled routes within the study area and ensuring the routes selected exceeded the suggested threshold of analysis in DMRB Volume 11. It should be noted that for controlled forms of pedestrian crossing the pedestrian delays are less.

Pedestrian Amenity

10.6.83 IEMA guidelines define pedestrian amenity as the relative pleasantness of a journey and can include fear and intimidation if they are relevant. As with pedestrian delay, amenity is affected by traffic volumes and composition along with pavement width and pedestrian activity. The guidelines suggest tentative thresholds of significance would be where the traffic flow is halved or doubled.

Driver Delay

10.6.84 IEMA guidelines note that driver delay can occur at several points on the network, although the effects are only likely to be significant when the traffic on the highway network is predicted to be at or close to the capacity of the system.

10.6.85 A comparison of journey times on key routes in the model has been undertaken to establish the increase in driver delay as a result of the HPC Project. These are reported in full in the **Transport Assessment** and summarised in this chapter.

Accidents and Safety

10.6.86 IEMA guidelines do not include any definition in relation to accidents and safety, suggesting that professional judgement will be needed to assess the implications of local circumstance, or factors which may increase or decrease the risk of accidents. The full results of the **Road Safety Strategy** are reported in the **Transport Assessment** and are summarised in this chapter.

10.6.87 **Table 10.3** summarises the criteria that has been used to determine magnitude of impacts. However, the absolute level of an impact is also important e.g. the total flow of traffic or HGVs on a link. Comment is made on this in the analysis.

Table 10.3: Magnitude of Impact Criteria

Impact	Magnitude of Impact			
	Negligible	Minor	Moderate	Substantial
Severance	Change in total traffic or HGV flows of less than 30%	Change in total traffic or HGV flows of 30-60%	Change in total traffic or HGV flows of 60-90%	Change in total traffic or HGV flows over 90%
Pedestrian Delay	Two way traffic flow < 1,400 vehicles per hour	A judgement based on the road links with two way traffic flow exceeding 1,400 vehicles per hour in context of the individual characteristics		
Pedestrian Amenity	Change in total traffic or HGV flows < 100%	A judgement based on the routes with >100% change in context of their individual characteristics		
Driver Delay	A judgement based on the journey time assessment			
Accidents and Safety	A judgement based on analysis detailed in the **Road Safety Strategy**			

v. Significance of Impacts

10.6.88 The significance of the impact is judged on the relationship of the magnitude of impact to the assessed sensitivity and/or importance of the receptor. The predicted significance of the impacts is outlined in **Volume 1**, **Chapter 7** and summarised in **Table 10.4** below:

Table 10.4: Significance of Impacts

Sensitivity of Receptor	Magnitude of Impact			
	Negligible	Minor	Moderate	Substantial
Negligible	Negligible	Negligible	Negligible	Minor
Minor	Negligible	Negligible	Minor	Moderate
Moderate	Negligible	Minor	Moderate	Substantial
Substantial	Minor	Moderate	Substantial	Substantial

10.6.89 Potential effects are therefore concluded to be of negligible, minor, moderate or substantial significance. Moderate and substantial significance effects are considered to be significant in terms of EIA guidance.

vi. Cumulative Impacts

10.6.90 The assessments for each of the elements of the HPC Project, i.e. the HPC development site and associated development sites (see **Volume 2**, **Chapter 10** and **Chapter 8** in each of **Volumes 3** to **10** of this ES), include all flows associated with the overall HPC Project i.e. flows to and from the HPC development site and the associated development sites. Furthermore, these assessments include other committed, non-HPC, developments for the area. In addition there are some other developments that have not been included in those assessments. These are dealt with in a qualitative way within **Volume 11** of this ES.

vii.Limitations, Constraints and Assumption.

10.6.91 The main limitation in baseline conditions presented in this chapter is the precision of traffic counts. Such counts are recorded over a day or a week and are subject to an accuracy of + or – 10%. However conditions predicted by the model have been validated using standard criteria and are therefore considered to provide a representative estimate.

10.6.92 Traffic generation estimates for HPC are based on a number of assumptions on matters such as materials quantities, number of workers and construction programme. However, worst case assumptions have been made in a number of instances. For example, the peak construction quarter in 2016 is assessed and conservative assumptions are made on goods vehicle payloads. Furthermore, the expected use of the park and ride sites has been increased by a contingency of 10%.

10.7 Baseline Conditions

10.7.1 The transport effects of the construction and operation of the HPC Project cover the full study area described earlier in this chapter. Furthermore, the effects during the construction phase are closely linked with activities at the associated development sites. Therefore, the transport baseline conditions at the HPC development site and all associated development sites are described in this chapter of the ES.

a) HPC Development Site

i. Pedestrian Network

10.7.2 Paragraph 74 of PPG13, advises that walking offers the greatest potential to replace short car trips, particularly those under 2km. Facilities and infrastructure for pedestrian movement along existing highways in the immediate vicinity of the proposed HPC development site are extremely limited to the site. There are no pedestrian facilities adjacent to the local roads within a 2km isochrone except within the village of Shurton.

10.7.3 There is, however, a network of Public Rights of Way (PRoW) within the local area. Within the HPC development site the following PRoW exist:

- A portion of the West Somerset Coast Path which links the River Parrett Trail at Steart in Bridgwater Bay with the South West Coast Path National Trail at Minehead.
- The Green Lane which is an east-west track that runs along the ridge through the middle of the HPC development site.
- A number of smaller, interconnecting footpaths running north-south and east-west.

ii. Cycling Network

10.7.4 Paragraph 77 of PPG13 advises that cycling also has potential to substitute for short car trips, particularly those under 5km, and to form part of a longer journey by public transport.

10.7.5 There is no dedicated cycling infrastructure present within a 5km isochrone of the HPC development site. The traffic volumes on the roads within the cycle catchment are currently low. The roads within the cycle catchment are generally subject to the national speed limit of 60mph with the exception of sections through the local villages, where the speed limit reduces to 30mph. The roads are also unlit outside of the villages.

iii. Bus Network

10.7.6 The Institute of Highways and Transportation (IHT) ‘Guidelines for Planning for Public Transport in Developments’, published in 1999 (Ref. 10.24), recommends a maximum walking distance to bus stops of 400m. At present there are no bus stops within the recommended walking distance to the HPC development site. There are also currently no bus services that serve the existing Hinkley Point Power Station Complex.

10.7.7 The only bus stop located within a 2km radius from the HPC development site is Lower House Farm bus stop located on Shurton Lane. This stop is served by the First Group service 614 that operates on ‘college days’ only and travels between Shurton and Bridgwater College. It has one outbound service at 07:55 and one inbound service at 17:30.

10.7.8 A second bus stop is located in Stogursey, at Acland Hood Arms. Four bus services serve this stop, the 614, 14, 23A and 23B. Further details on these services are provided in **Table 10.5** below.

Table 10.5: Existing Bus Services

Route	Route Description	Days of Operation	Time	Peak	Off Peak
614	Bridgwater College, Cannington, Stogursey, Shurton via Wembdon	Mon-Fri	17:30	N/A	N/A
614	Shurton via Wembdon, Stogursey, Cannington, Bridgwater College	Mon-Fri	07:55	N/A	N/A
14	Bridgwater (Polden Meadows), Cannington, Watchet via Bus Station, Wembdon, Nether Stowey	Mon-Sun	10:41-16:41, 18:11	N/A	2 hourly
14	Nether Stowey, Wembdon, Watchet via Bus Station, Cannington, Bridgwater (Polden Meadows)	Mon-Sun	08:18-16:18	2 hourly	2 hourly
23A	Bridgwater, Taunton via Stogursey, Nether Stowey, Kingston St. Mary	Mon-Fri	09:28	N/A	N/A
23A	Kingston St. Mary, Nether Stowey, Taunton via Stogursey, Bridgwater	Mon-Fri	13:45	N/A	N/A
23B	Williton, Taunton via Stogursey, Nether Stowey, Kingston St. Mary	Mon-Fri	07:43	N/A	N/A
23B	Kingston St. Mary, Nether Stowey, Taunton via Stogursey, Williton	Mon-Fri	17:30	N/A	N/A

10.7.9 There is a bus lay-over facility located near the junction of Brookside Road and Withycombe Hill in Combwich where buses stand between services.

iv. Rail Network

10.7.10 The nearest effective railhead is at Bridgwater, some 16km from the proposed HPC development site. Bridgwater railway station is located on the main rail network on the route between Bristol and Exeter and links the major population centres in the region.

10.7.11 There is another railway line that passes some 12km to the west of the proposed HPC development site which is one that is privately operated by West Somerset Railway. This line starts at Minehead and terminates at Bishops Lydeard.

10.7.12 Passenger services through Bridgwater station are operated by First Great Western and Cross Country train operating companies. The basic service pattern between Cardiff Central and Taunton is one train per hour in each direction Monday to Sunday.

10.7.13 Direct services from Bridgwater to Exeter are limited with one train service in the morning at 07:10 and one night service at 00:04. Further details on train services are provided in **Table 10.6** below:

Table 10.6: Train Services from Bridgwater Railway Station

Destination	Days of Operation	AM Peak Times (06:00-10:00)	PM Peak Times (16:00-20:00)
Taunton	Mon-Fri	06:09, 07:10, 08:09, 09:19, 09:48	16:45, 17:46, 18:46, 19:15, 19:48
	Sat	06:09, 07:06, 08:10, 09:52	06:42, 17:42, 18:42, 19:42
	Sun	08:24, 09:15	06:48, 18:54, 19:59
Bristol	Mon-Fri	06:14, 06:48, 07:05, 07:25, 07:40, 08:48, 09:49	16:28, 17:17, 18:19, 19:24
	Sat	07:05, 07:44, 08:09, 09:10	16:19, 17:19, 18:19, 19:19
	Sun	08:55	17:30, 18:34, 19:16
Cardiff	Mon-Fri	06:14, 06:48, 07:05, 07:25, 07:40, 08:48, 09:49	16:28, 17:17, 18:19, 19:24
	Sat	07:05, 07:44, 08:09, 09:10	16:19, 17:19, 18:19, 19:18
	Sun	N/A	N/A
Exeter (indirect)	Mon-Fri	06:09, 07:10, 08:09, 09:19, 09:48	16:45, 17:46, 18:46, 19:15, 19:48
	Sat	06:09, 08:10, 09:52	16:12, 17:42, 18:42, 19:42
	Sun	08:24, 09:15	06:48, 18:54, 19:59

v. Maritime

10.7.14 EDF Energy owns a Roll-on Roll-off facility at Combwich Wharf on the River Parrett some 6km from Hinkley Point which is described in the Combwich Wharf section below.

vi. Highway Network

10.7.15 **Plate 10.1** at the beginning of this chapter illustrates the highway network in the vicinity of the HPC development site and wider local area. The transportation network surrounding the HPC development site is commensurate with a rural location with a network of country lanes linking scattered residences, farmhouses and a number of small hamlets.

10.7.16 The main access road serving the existing Hinkley Point Power Station Complex is the C182 which is a single carriageway road passing from Hinkley Point south-east to the village of Cannington. The C182 routes to the east of Shurton and to the west of Combwich and passes through the centre of Cannington to join the A39 to the south of the village.

10.7.17 The C182 is an unlit, single-carriageway rural road generally subject to the national speed limit for such roads i.e. 60mph for most of its length. There are sections where lower speed limits are in force and the C182 is subject to a speed limit of 30mph through the village of Cannington. There is a limit of 40mph immediately to the north of the village.

10.7.18 The A39 runs westwards towards Williton and Minehead and south-eastwards towards Bridgwater and then eastward to Glastonbury.

10.7.19 The A38 routes through Bridgwater on a predominantly north-south alignment. The A38 provides access to Bristol to the north and Taunton to the south. The M5 motorway bypasses Bridgwater to the east of the town with two interchanges at Junction 23 and Junction 24. Junction 23 is located north of Bridgwater and Junction 24 of the motorway is located south-east of Bridgwater.

10.7.20 The Northern Distributor Road (NDR) was built during 2001/02 and links the A38 with the A39 to the west of Bridgwater. The NDR was built to route traffic around central Bridgwater to reduce congestion and HGV flows through central Bridgwater as well as act as a distributor road for new housing. The NDR has recently been reclassified as the A39.

10.7.21 Two of the key junctions in the area are the Cross Rifles roundabout at the junction of the A39 (Bath Road) and A38 Bristol Road and the A38 Taunton Road/A39 Broadway junction.

10.7.22 The baseline traffic flows for the highway network are shown in **Table 10.7** below.

Table 10.7: 2009 Baseline Two-way Daily (24 hour AADT) Vehicular Traffic Flows

Link	Link Ref.	2009 Base
M5 Junction 23 northbound on-slip	V1	8,154
M5 Junction 23 southbound off-slip	V2	7,754
M5 Junction 23 northbound off-slip	V3	3,904
M5 Junction 23 southbound on-slip	V4	4,091
A39 spur east of Dunball	B	19,361
A39 east of J23	L	14,061
A38 north of Dunball	A	10,678
A38 south of Dunball	G	21,971
A38 between Wylds Road and The Drove	E	13,159
A38 between The Drove and Cross Rifles	F	16,818
A38 between Cross Rifles and St. John Street	J	20,240
A38 between St. John Street and Taunton Road	O2	18,820
A39 (Bath Road) north-east of Cross Rifles	N3	17,129
St. John Street	SN	11,549
The Clink	SF	17,521
Wylds Road	AD	10,323
The Drove	ZE	7,030
Western Way (west of Chilton Street)	AA	12,033
B3339 Wembdon Hill	T1	1,518
M5 J24 northbound on-slip	ST2	4,104
M5 Junction 24 southbound off-slip	ST3	4,774
M5 Junction 24 northbound off-slip	ST4	4,776
M5 Junction 24 southbound on-slip	ST5	5,065
A38 spur east of Huntworth	ST1	18,510

Link	Link Ref.	2009 Base
A38 Taunton Road south of Showground	I2	21,644
A38 Taunton Road (south of Broadway)	I1	24,728
A39 Broadway	K5	20,410
A39 west of Quantock roundabout	S	12,959
A39 south-east of Cannington	R	14,468
A39 south of Cannington	P	6,399
A39 west of Cannington	Q	7,703
High Street, Cannington	U	2,151
Main Road, Cannington	ZD	8,533
Rodway south of bypass	AC	6,706
Rodway north of bypass	12	6,706
Cannington bypass	Z1	0
B3190	10	1,063
Williton	2	5,722

10.7.23 Personal injury accident data has been assessed for the period 1 August 2004 – 31 July 2009 for the HPC study area and is summarised in **Table 10.8** below. Further details on accident details are included in the **Road Safety Strategy** appended to the **Transport Assessment**.

Table 10.8: Personal Injury Accident Data Summary – 1 August 2004 until 31 July 2009

Area	Link	Accident Severity				Accidents Involving Vulnerable Users			
		Total	Slight	Serious	Fatal	Total	Peds	Cyclist	Motor-cycle
Cannington	A39 south-west of High Street	0	0	0	0	0	0	0	0
	A39 between Main Road and High Street	1	0	1	0	1	0	1	0
	High Street	5	3	2	0	5	2	0	3
	Main Road	0	0	0	0	0	0	0	0
	A39 south-east of Main Road	1	1	0	0	1	0	0	1
	C182 Rodway Road	1	0	1	0	1	0	0	1
Combwich	C182 north	0	0	0	0	0	0	0	0
	Combwich Wharf Access Road	0	0	0	0	0	0	0	0
	C182 south	1	0	0	1	0	0	0	0
Williton	A39 Long Street	2	1	1	0	2	0	0	2
	North Street	0	0	0	0	0	0	0	0
	A39 Fore Street	10	9	0	1	10	5	1	4
	A358 High Street	0	0	0	0	0	0	0	0
	A39 between A358 junction and park and ride access	0	0	0	0	0	0	0	0
	A39 west of park and ride access	0	0	0	0	0	0	0	0
Bridgwater Accommodation Campuses	A38 north of The Drove	4	3	0	1	3	1	1	1
	The Drove west of A38	4	4	0	0	2	1	0	1
	Union Street	1	1	0	0	1	0	1	0
	A38 between The Drove and Cross Rifles	7	7	0	0	7	3	2	2

		Accident Severity				Accidents Involving Vulnerable Users			
Bridgwater Accommodation Campuses	The Clink west of Cross Rifles	0	0	0	0	0	0	0	0
	A39 south of Cross Rifles	5	4	1	0	5	3	2	0
	A39 west of Campuses	16	13	3	0	16	6	5	5
	A39 east of Campuses	5	4	1	0	5	0	1	4
M5 Junction 23	A38 Bristol Road north	5	3	2	0	4	1	2	1
	A39 spur road	4	4	0	0	0	0	0	0
	A38 Bristol Road south	7	7	0	0	1	0	1	0
	M5 Junction 23 roundabout	28	28	0	0	2	0	0	2
	M5 Junction 23 northbound on-slip	2	2	0	0	0	0	0	0
	M5 Junction 23 southbound off-slip	6	6	0	0	0	0	0	0
	A39 Puriton Hill	6	6	0	0	2	0	0	2
	M5 Junction 23 southbound on-slip	1	1	0	0	0	0	0	0
	M5 Junction 23 northbound off-slip	5	5	0	0	0	0	0	0
M5 Junction 24	A38 Taunton Road north	4	3	1	0	2	0	0	2
	A38 spur road	2	2	0	0	1	1	0	0
	A38 Taunton Road south	3	2	1	0	2	0	0	2
	Bridgwater Motorway Service Area access	3	2	1	0	1	0	0	1
	M5 Junction 24 roundabout	11	11	0	0	0	0	0	0
	M5 Junction 24 northbound on-slip	1	0	1	0	1	0	0	1
	M5 Junction 24 southbound off-slip	0	0	0	0	0	0	0	0
	Huntworth Lane east of M5 Junction 24	0	0	0	0	0	0	0	0
	M5 Junction 24 southbound on-slip	0	0	0	0	0	0	0	0
	M5 Junction 24 northbound off-slip	4	4	0	0	0	0	0	0

b) Combwich Wharf

i. Pedestrian and Cycle Networks

10.7.24 A narrow footway with grass verges on each side runs along the east side of the C182 between Cannington village and Brookside Road, the vehicular access road to Combwich village. A footway runs along the southern side of Brookside Road from the C182 to the edge of Combwich village from which point footways are provided on both sides of the road throughout most of Combwich village.

ii. Bus Networks

10.7.25 The nearest set of bus stops to Combwich Wharf is at the junction of C182/Brookside Road, approximately 400m to the north of the Combwich Wharf private access road. The bus stops are served by Routes 14, 23A and 614.

iii. Maritime

10.7.26 The Roll-on and Roll-off facility was mainly used during the construction of Hinkley Point A (HPA) and Hinkley Point B (HPB), and its use for the import of occasional Abnormal Indivisible Loads (AILs) by EDF Energy and National Grid has continued. In the early 1990s the facility was upgraded and a new private road linking it to the C182 was constructed. Use of the facility therefore necessitates the onward transfer of loads to the site by road.

10.7.27 As use of the Combwich Wharf facility by the existing HPA and HPB operations and National Grid is infrequent, there is no current baseline with regard to movement by this mode which can be quantified.

iv. Highway Network

10.7.28 Combwich is a small village with roads unsuitable for the passage of large vehicles and therefore a private access road has been built from Combwich Wharf, which passes to the south of the village and connects to the C182. EDF Energy owns Combwich Wharf and the private access road.

c) M5 Junction 23

10.7.29 The proposed park and ride facility, freight management facility, induction centre and consolidation facility for postal/courier deliveries in close proximity to M5 Junction 23 would be located off the A38 Dunball roundabout with access provided off the Bridgwater Business Park arm.

i. Pedestrian and Cycle Networks

10.7.30 There are no controlled pedestrian or cycle crossing facilities within the vicinity of the A38 Dunball roundabout. A narrow footway routes along the southern side of the A39 spur road arm of the roundabout. A footway routes along both sides of the A38 Bristol Road south arm and along the western side of the A38 Bristol Road north arm. A footway is also provided along the southern side of the Bridgwater Business Park arm.

ii. Bus Network

10.7.31 A set of bus stops is currently located on the A38 Bristol Road south arm, approximately 100m south of the A38 Dunball roundabout. There are dedicated bus laybys on both the north and southbound carriageways providing safe places for buses to stop without affecting the flow of traffic. These bus stops are served by Route 21/21A, the Taunton to Burnham on Sea service. The bus stops are simple flag stops without covered waiting facilities. There is also a set of bus stops on the A38 Bristol Road north arm, approximately 400m to the north of the A38 Dunball roundabout. These stops are served by Routes 21/21A, 102 and 375.

iii. Rail Network

10.7.32 Bridgwater railway station is approximately 4.5km from the Junction 23 site via A38 Bristol Road, (Bath Road), Polden Street and Wellington Road. **Table 10.6** summarises the services stopping at Bridgwater railway station.

iv. Highway Network

10.7.33 The A38 Dunball roundabout is a four arm roundabout. The four arms of this roundabout are the A38 Bristol Road north, the A39 spur road (i.e. the road between the A38 Dunball roundabout and the M5), the A38 Bristol Road south and the access road to the Bridgwater Business Park.

10.7.34 M5 Junction 23 is a four arm grade separated roundabout with the M5 motorway running north-south beneath the roundabout. The four arms of the roundabout are the M5 on and off-slip roads to the north and south, A39 Puriton Hill to the east and the A39 spur road to the west.

d) M5 Junction 24

10.7.35 The proposed park and ride facility and freight management facility in close proximity to M5 Junction 24 would be located near the A38/Huntworth roundabout on the former Somerfield Distribution Centre site. Access would be from the arm of the roundabout giving access to the Motorway Service Area and industrial area.

i. Pedestrian and Cycle Networks

10.7.36 There are no controlled pedestrian or cycle crossing facilities at the Huntworth roundabout. A footway routes along the southern side of the A38 spur road arm, along the eastern side of A38 Taunton Road north and south arms and along the northern side of the Stockmoor Village residential access road and the Bridgwater Motorway Service Area access road. There are no controlled pedestrian or cycle crossing facilities at the M5 Junction 24.

ii. Bus Network

10.7.37 The nearest bus stops to the Junction 24 site are a set of bus laybys located approximately 100m south of the Huntworth roundabout on the A38 Taunton Road south, which are served by Route 21/21A.

iii. Rail Network

10.7.38 Bridgwater railway station is approximately 4km from the Junction 24 site via A38 Taunton Road, Broadway, St. John Street and Wellington Road. **Table 10.6** summarises the services stopping at Bridgwater railway station.

iv. Highway Network

10.7.39 The Huntworth roundabout is a five arm roundabout to the west of the M5 Junction 24. The five arms are the A38 Taunton Road north, the Bridgwater Motorway Service Area access, the A38 spur road (i.e. road between A38 roundabout and M5), the A38 Taunton Road south and the access to the Stockmoor Village residential development to the west.

10.7.40 M5 Junction 24 is a four arm grade separated roundabout with the M5 motorway running north-south beneath the roundabout. The four arms of the roundabout are the M5 on and off-slip roads to the north and south, an unclassified road to the east and the A38 spur road to the west.

e) Cannington Bypass

i. Pedestrian and Cycle Networks

10.7.41 The proposed bypass passes through open fields and bisects Public Right of Way BW5/8.

ii. Bus Network

10.7.42 The nearest bus stops to the proposed development are located on High Street close to the Memorial junction.

iii. Rail Network

10.7.43 The nearest railway station to Cannington is at Bridgwater, approximately 6km to the south-east of the proposed development. Bridgwater railway station is located on the mainline rail network on the route between Bristol and Exeter.

iv. Highway Network

10.7.44 The A39/Main Road (western) roundabout is a three arm roundabout with the AA39 forming the southern and western arms and Main Road forming the northern arm, which leads to Cannington village. The A39/High Street roundabout is a three arm roundabout with the A39 forming the eastern and southern arms and High Street forming the northern arm, which leads to Cannington village.

f) Cannington Park and Ride Site

10.7.45 The proposed park and ride facility at Cannington would be located to the north of the A39 between the A39/Main Road and A39/High Street roundabouts.

i. Pedestrian and Cycle Networks

10.7.46 There are no controlled pedestrian or cycle crossings within the vicinity of the proposed Cannington park and ride facility. There are footways around the A39/Main Road roundabout connecting local properties to the south of the junction with the footway network in Cannington. A footway is provided on the eastern side of the A39 between the A39/Main Road roundabout and Sandford Hill, beyond which the footway reduces in width to be unusable. There are no footways in the vicinity of the A39/High Street roundabout and no footways on either side of the A39 near to the proposed Cannington park and ride facility.

ii. Bus Network

10.7.47 The nearest set of bus stops to the proposed Cannington park and ride facility are a set of bus stops located on Main Road approximately 100m north of the A39 roundabout, in the vicinity of Southbrook. These bus stops are served by Routes 14, 23A and 615.

iii. Rail Network

10.7.48 The nearest railway station to Cannington is at Bridgwater, approximately 6km to the south-east of the proposed park and ride facility. Bridgwater railway station is located on the mainline rail network on the route between Bristol and Exeter. **Table 10.6** summarises the services stopping at Bridgwater railway station.

iv. Highway Network

10.7.49 The A39/Main Road roundabout is a three arm roundabout with the A39 forming the southern and western arms and Main Road forming the northern arm, which leads to Cannington village. The A39/High Street roundabout is a three arm roundabout with the A39 forming the eastern and southern arms and High Street forming the northern arm, which leads to Cannington village.

g) Williton Park and Ride

10.7.50 The proposed park and ride facility at Williton is to be located on an existing lorry park site on the B3190 to the west of Williton.

i. Pedestrian and Cycle Network

10.7.51 There are no footways on the B3190 in the vicinity of the site. There are no designated cycle facilities although cyclists can use local roads.

ii. Bus Network

10.7.52 The B3190 is a bus route served by the 14, 18, 28, 105 services which travel via Watchet.

iii. Rail Network

10.7.53 Williton railway station forms part of the West Somerset Railway, a heritage railway line. Williton station is located on Station Road, off the A39 to the east of Williton village centre. Trains run between Minehead and Bishops Lydeard, via Williton, daily during the late Spring and Summer and less frequently in the Winter months.

iv. Highway Network

10.7.54 The B3190 is a typical rural road of approximately 5-6m width. It joins the A39 at an uncontrolled crossroads.

h) Bridgwater Accommodation Campuses

10.7.55 Bridgwater A site is located to the north of the A39 (Bath Road). The Bridgwater C site is located to the west of College Way, to the south of the A39.

i. Pedestrian Network

10.7.56 There are footways along both sides of A39 (Bath Road), approximately 2m in width. A zebra crossing is provided to the west of Union Street and a further zebra crossing is provided to the west of College Way. Over the railway bridge on A39 (Bath Road) there is a footway on the northern side approximately 2m wide. A separate footbridge is provided on the southern side of (Bath Road), which is approximately 3m in width.

10.7.57 There is a zebra crossing approximately 30m north of the Cross Rifles roundabout on the A38 Bristol Road that provides pedestrian access to the nearby Sainsbury's supermarket. There are footways on both sides of the A38 Bristol Road and two arms of the A38/Bristol Road/The Drove junction have signal controlled pedestrian crossing facilities (i.e. The Drove and A38 Bristol Road south arm).

ii. Cycle Network

10.7.58 The existing cycle facilities within a 5km cycle catchment of the Bridgwater accommodation campus sites include:

- A signed cycle route provides a connection between Bridgwater railway station and the town centre via St. John Street and Eastover.
- A high quality segregated cycle/footpath along one side of the northern section of Feversham Road.
- A high quality off-road cycle route connecting the NDR to Crowpill Lane.
- An off-road shared pedestrian and cycle route is provided in the Sydenham part of Bridgwater, connecting Redgate Street to Longstone Avenue.
- A high quality segregated cycle/footpath along at least one but in parts on both sides of the NDR between A39 and the junction with Wylds Road.
- As the NDR segregated cycle/footpath approaches the River Parrett, it routes south to connect to Linham Road. The cycle route runs south along Linham Road and at the Marina the route divides in two with one route heading west along the Bridgwater to Taunton Canal to connect to Victoria Road. The other part of the route heads south off-road along the River Parrett, over The Clink (no formal crossing facilities provided) and then continues along West Quay and Binford Place. At the southern end of Binford Place the cycle route continues off-road through Blake Gardens, under the A39 Broadway and connects to Old Taunton Road and then connects back onto the Canal towpath, which forms part of the River Parrett Trail (National Cycle Network Route 3).

iii. Bus Network

10.7.59 Within Bridgwater there is a bus and coach station at Watsons Lane, near to the ASDA supermarket. The bus and coach station was opened in 2004 and is operated by First Group.

10.7.60 With regard to bus stops near to the proposed accommodation campus sites in Bridgwater, there is a set of bus stops immediately to the west of the A39 (Bath Road)/Union Street/Lower (Bath Road) junction and these are served by Route 1, the Sydenham/Wyndham Road Circular.

10.7.61 There is also a set of bus stops on A39 (Bath Road), adjacent to Frederick Road, which are served by Route 1, Route 102 to Burnham on Sea and Route 375 to Wells and Bristol.

10.7.62 There are also a number of bus stops on the A38 Bristol Road, the nearest of which to the accommodation campus sites is a set of bus stops to the south of Union Road. These are served by Route 21/21A from Taunton to Burnham on Sea.

iv. Rail Network

10.7.63 Bridgwater railway station is approximately 1.5km from the Bridgwater A site and 1.3km from the Bridgwater C site. The shortest walking route from the accommodation campuses to the railway station is via A39 (Bath Road), Polden Street and Wellington Road.

v. Highway Network

10.7.64 The A39 (Bath Road), within the vicinity of the proposed accommodation campus sites, is a 7.3m single carriageway with street lighting.

10.7.65 There is a bridge over the Bridgwater to Highbridge (part of the Bristol to Penzance) railway line, where it is crossed by the A39. The bridge carriageway has a reduced width and there is signage advising that eastbound traffic has priority over westbound traffic over the bridge.

10.7.66 The junction of A39 (Bath Road)/A38 Bristol Road is referred to as the 'Cross Rifles' roundabout. This is a four arm roundabout with the A38 Bristol Road joining from the north, the A39 (Bath Road) joining from the east, A39 Broadway joining from the south and The Clink joining from the west.

10.7.67 The A38 Bristol Road is a main arterial route into Bridgwater and, as such, carries significant volumes of traffic especially in the peak periods. During peak periods queues form on the A38 into Bridgwater, which affect the operation of the A38/Express Park roundabout as the queues extend across the circulatory carriageway.

10.7.68 To the south of Express Park is the A38/Wylds Road priority junction, which provides vehicular access to a major industrial/commercial area of Bridgwater. Wylds Road is restricted and vehicles are only permitted to turn left from Wylds Road to the A38 Bristol Road. Immediately to the west of the junction, on Wylds Road is Allerton Road and the operation of this minor junction can impede the flow of traffic turning to and from the A38, particularly as Wylds Road is used by a significant volume of heavy goods vehicles accessing/egressing the industrial areas nearby. It should also be noted that Wylds Road is also used by southbound traffic heading into Bridgwater who are avoiding the delays further south at the Cross Rifles roundabout.

10.7.69 Further south, is the signal controlled junction of A38 Bristol Road/The Drove. The operation of this junction is complicated by the proximity of Union Street on the eastern side of the A38 immediately to the south of the signal controlled junction. Union Street is a 'left-in left-out' priority junction and its bellmouth kerbs encroach into the traffic signal controlled junction. The Drove forms part of what is referred to as the 'Northern Distributor Road' (NDR), which was built in 1992.

10.8 Future Baseline Conditions

10.8.1 As set out earlier in this chapter, the assessment years selected are 2013, 2016 and 2021. Therefore future baseline conditions have been assessed for these years. Future baseline conditions are referred to as the Reference Case.

10.8.2 For 2016 the Reference Case flows are shown below along with the comparison to the 2009 Base Case flows. For 2013 and 2021 the Reference Case flows are shown in the Assessment of Impacts section.

10.8.3 **Table 10.9, Table 10.10** and **Table 10.11** summarise the 2009 Base and 2016 Reference Case flows for the daily (24 hour AADT), AM peak (08:00 to 09:00) and PM peak (17:00 to 18:00) hours. These are two way flows (e.g. sum of the eastbound and westbound flows). It should be emphasised that these are flows that occur without the HPC development. The increases in flow compared with the 2009 Base Case are due to other planned developments in the area and application of DfT growth factors.

10.8.4 Changes in predicted flows on a link can take place for a number of reasons. Additional traffic from planned developments would add traffic to a link. However, if congestion and delay on one link increase this can lead to traffic diverting to an alternative route. This then leads to an increase in flow on the diversion route but a decrease on the congested link from which traffic diverts.

Table 10.9: 2009 Base vs. 2016 Reference Case Two-way Daily (24 Hour AADT) Vehicular Traffic Flows

Link	Link Ref.	2009 Base	2016 Ref Case	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	8,154	8,256	102	1%
M5 Junction 23 southbound off-slip	V2	7,754	8,057	303	4%
M5 Junction 23 northbound off-slip	V3	3,904	4,815	911	23%
M5 Junction 23 southbound on-slip	V4	4,091	4,701	610	15%
A39 spur east of Dunball	B	19,361	21,422	2,061	11%
A39 east of J23	L	14,061	14,427	366	3%
A38 north of Dunball	A	10,678	10,772	94	1%
A38 south of Dunball	G	21,971	24,935	2,964	13%
A38 between Wylds Road and The Drove	E	13,159	15,904	2,745	21%
A38 between The Drove and Cross Rifles	F	16,818	18,764	1,946	12%
A38 between Cross Rifles and St. John Street	J	20,240	22,485	2,245	11%
A38 between St. John Street and Taunton Road	O2	18,820	20,802	1,982	11%
A39 (Bath Road) north-east of Cross	N3	17,129	15,740	-1,389	-8%

Link	Link Ref.	2009 Base	2016 Ref Case	Increase (Numerical)	Increase (%)
Rifles					
St. John Street	SN	11,549	12,638	1,089	9%
The Clink	SF	17,521	16,541	-980	-6%
Wylds Road	AD	10,323	11,145	822	8%
The Drove	ZE	7,030	7,666	636	9%
Western Way (west of Chilton Street)	AA	12,033	12,649	616	5%
B3339 Wembdon Hill	T1	1,518	1,523	5	0%
M5 J24 northbound on-slip	ST2	4,104	4,600	496	12%
M5 Junction 24 southbound off-slip	ST3	4,774	5,202	428	9%
M5 Junction 24 northbound off-slip	ST4	4,776	5,034	258	5%
M5 Junction 24 southbound on-slip	ST5	5,065	5,364	299	6%
A38 spur east of Huntworth	ST1	18,510	20,018	1,508	8%
A38 Taunton Road south of Showground	I2	21,644	23,738	2,094	10%
A38 Taunton Road (south of Broadway)	I1	24,728	26,962	2,234	9%
A39 Broadway	K5	20,410	22,114	1,704	8%
A39 west of Quantock roundabout	S	12,959	13,293	334	3%
A39 south-east of Cannington	R	14,468	14,790	322	2%
A39 south of Cannington	P	6,399	6,638	239	4%
A39 west of Cannington	Q	7,703	7,969	266	3%
High Street, Cannington	U	2,151	2,175	24	1%
Main Road, Cannington	ZD	8,533	8,558	25	0%
Rodway south of bypass	AC	6,706	6,779	73	1%
Rodway north of bypass	12	6,706	6,779	73	1%
Cannington bypass	Z1				
B3190	10	1,063	1,412	349	33%
Williton	2	5,722	6,150	428	7%

Table 10.10: 2009 Base vs. 2016 Reference Case Two-way AM Network Peak Vehicular Traffic Flows

Link	Link Ref.	2009 Base	2016 Ref Case	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	842	821	-21	-2%
M5 Junction 23 southbound off-slip	V2	763	803	40	5%
M5 Junction 23 northbound off-slip	V3	392	442	50	13%
M5 Junction 23 southbound on-slip	V4	538	650	112	21%
A39 spur east of Dunball	B	1,869	2,089	220	12%
A39 east of J23	L	1,244	1,288	44	4%
A38 north of Dunball	A	899	907	8	1%

Link	Link Ref.	2009 Base	2016 Ref Case	Increase (Numerical)	Increase (%)
A38 south of Dunball	G	1,998	2,266	268	13%
A38 between Wylds Road and The Drove	E	1,159	1,431	272	23%
A38 between The Drove and Cross Rifles	F	1,386	1,481	95	7%
A38 between Cross Rifles and St. John Street	J	1,507	1,673	166	11%
A38 between St. John Street and Taunton Road	O2	1,625	1,712	87	5%
A39 (Bath Road) north-east of Cross Rifles	N3	1,564	1,481	-83	-5%
St. John Street	SN	950	1,060	110	12%
The Clink	SF	1,199	1,133	-66	-5%
Wylds Road	AD	899	990	91	10%
The Drove	ZE	508	617	109	22%
Western Way (west of Chilton Street)	AA	1,084	1,198	114	11%
B3339 Wembdon Hill	T1	65	66	1	1%
M5 J24 northbound on-slip	ST2	364	392	28	8%
M5 Junction 24 southbound off-slip	ST3	385	440	55	14%
M5 Junction 24 northbound off-slip	ST4	447	473	26	6%
M5 Junction 24 southbound on-slip	ST5	605	529	-76	-13%
A38 spur east of Huntworth	ST1	1,796	1,845	49	3%
A38 Taunton Road south of Showground	I2	1,929	1,915	-14	-1%
A38 Taunton Road (south of Broadway)	I1	1,996	1,984	-13	-1%
A39 Broadway	K5	1,755	1,844	89	5%
A39 west of Quantock roundabout	S	1,267	1,303	36	3%
A39 south-east of Cannington	R	1,339	1,378	39	3%
A39 south of Cannington	P	579	602	23	4%
A39 west of Cannington	Q	694	728	34	5%
High Street, Cannington	U	206	212	6	3%
Main Road, Cannington	ZD	818	821	3	0%
Rodway south of bypass	AC	530	538	8	2%
Rodway north of bypass	12	530	538	8	2%
Cannington bypass	Z1				
B3190	10	97	97	0	0%
Williton	2	453	485	32	7%

Table 10.11: 2009 Base vs. 2016 Reference Case Two-way PM Network Peak Vehicular Traffic Flows

Link	Link Ref.	2009 Base	2016 Ref Case	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	743	719	-24	-3%
M5 Junction 23 southbound off-slip	V2	919	857	-62	-7%
M5 Junction 23 northbound off-slip	V3	414	548	134	32%
M5 Junction 23 southbound on-slip	V4	618	634	16	3%
A39 spur east of Dunball	B	2,071	2,113	42	2%
A39 east of J23	L	1,317	1,336	19	1%
A38 north of Dunball	A	914	869	-45	-5%
A38 south of Dunball	G	2,057	2,153	96	5%
A38 between Wylds Road and The Drove	E	1,081	1,423	342	32%
A38 between The Drove and Cross Rifles	F	1,162	1,466	304	26%
A38 between Cross Rifles and St. John Street	J	1,673	1,841	168	10%
A38 between St. John Street and Taunton Road	O2	1,531	1,719	188	12%
A39 (Bath Road) north-east of Cross Rifles	N3	1,688	1,352	-336	-20%
St. John Street	SN	972	1,169	197	20%
The Clink	SF	1,624	1,413	-211	-13%
Wylds Road	AD	895	954	59	7%
The Drove	ZE	709	758	49	7%
Western Way (west of Chilton Street)	AA	1,309	1,275	-34	-3%
B3339 Wembdon Hill	T1	87	80	-7	-8%
M5 J24 northbound on-slip	ST2	324	437	113	35%
M5 Junction 24 southbound off-slip	ST3	435	496	61	14%
M5 Junction 24 northbound off-slip	ST4	525	511	-14	-3%
M5 Junction 24 southbound on-slip	ST5	523	562	39	7%
A38 spur east of Huntworth	ST1	1,833	2,048	215	12%
A38 Taunton Road south of Showground	I2	1,965	2,147	182	9%
A38 Taunton Road (south of Broadway)	I1	2,009	2,188	179	9%
A39 Broadway	K5	1,925	2,012	87	5%
A39 west of Quantock roundabout	S	1,391	1,375	-16	-1%
A39 south-east of Cannington	R	1,473	1,447	-26	-2%
A39 south of Cannington	P	576	572	-4	-1%
A39 west of Cannington	Q	677	677	0	0%
High Street, Cannington	U	209	197	-12	-6%
Main Road, Cannington	ZD	954	919	-35	-4%

Link	Link Ref.	2009 Base	2016 Ref Case	Increase (Numerical)	Increase (%)
Rodway south of bypass	AC	772	749	-23	-3%
Rodway north of bypass	12	772	749	-23	3%
Cannington bypass	Z1	0			
B3190	10	120	120	0	0%
Williton	2	440	474	34	8%

10.8.5 As can be seen there are general increases of flow on the network. Flows on the M5 Junction 23 southbound and northbound slip roads increase as do flows on the A38 south of Dunball. There are also increases albeit smaller at Junction 24 and Taunton Road.

10.9 Assessment of Impacts

10.9.1 As noted earlier in this chapter, the assessments have been undertaken for three assessment periods: 2013 when construction of the HPC development site would have commenced and the associated development sites would be under construction; 2016 which is the year of maximum construction impacts; and 2021 when the power station would be fully operational and some of the associated development sites would be being deconstructed. The assessment also includes the implementation of the transport strategy as described in the **Transport Assessment**.

a) 2016

10.9.2 As noted earlier in this chapter, the assessments have been undertaken assuming implementation of EDF Energy's transport strategy as summarised earlier in this chapter. In addition, the proposed highway improvement package as described in the Methodology (Impact Assessment) section is assumed to be in place.

10.9.3 **Tables 10.12** to **10.15** show the 2016 With Development and Mitigation scenario compared with the 2016 Reference Case daily and network peak hour flows are shown for All Vehicles. Daily flows are also shown for HGVs and buses. Further detailed information is included in the **Transport Assessment**.

10.9.4 As with the 2009 Base Case and 2016 Reference Case comparison above, flow changes are not only due to HPC traffic but also re-routing due to the highway improvements. For example, improvements to the Cross Rifles junction would lead to re-routing of traffic where the route is currently influenced by capacity constraints at the junction.

Table 10.12: 2016 Reference Case vs. 2016 With Development and Mitigation Daily (24 Hour AADT) Two Way All Vehicles Traffic Flows

Link	Link Ref.	2016 Ref Case	2016 With Dev	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	8,256	9,794	1,538	18.6%
M5 Junction 23 southbound off-slip	V2	8,057	9,487	1,429	17.7%
M5 Junction 23 northbound off-slip	V3	4,815	4,650	-165	-3.4%
M5 Junction 23 southbound on-slip	V4	4,701	4,459	-241	-5.1%

Link	Link Ref.	2016 Ref Case	2016 With Dev	Increase (Numerical)	Increase (%)
A39 spur east of Dunball	B	21,422	24,134	2,712	12.7%
A39 east of J23	L	14,427	13,165	-1,261	-8.7%
A38 north of Dunball	A	10,772	10,767	-5	0.0%
A38 south of Dunball	G	24,935	26,177	1,243	5.0%
A38 between Wylds Road and The Drove	E	15,904	14,807	-1,097	-6.9%
A38 between The Drove and Cross Rifles	F	18,764	18,361	-402	-2.1%
A38 between Cross Rifles and St. John Street	J	22,485	24,208	1,722	7.7%
A38 between St. John Street and Taunton Road	O2	20,802	22,124	1,322	6.4%
A39 (Bath Road) north-east of Cross Rifles	N3	15,740	17,788	2,048	13.0%
St. John Street	SN	12,638	11,815	-823	-6.5%
The Clink	SF	16,541	16,704	163	1.0%
Wylds Road	AD	11,145	13,016	1,870	16.8%
The Drove	ZE	7,666	7,664	-2	0.0%
Western Way (west of Chilton Street)	AA	12,649	14,494	1,845	14.6%
B3339 Wembdon Hill	T1	1,523	1,271	-252	-16.5%
M5 J24 northbound on-slip	ST2	4,600	4,514	-86	-1.9%
M5 Junction 24 southbound off-slip	ST3	5,202	4,980	-222	-4.3%
M5 Junction 24 northbound off-slip	ST4	5,034	5,850	816	16.2%
M5 Junction 24 southbound on-slip	ST5	5,364	6,281	917	17.1%
A38 spur east of Huntworth	ST1	20,018	21,399	1,381	6.9%
A38 Taunton Road south of Showground	I2	23,738	24,539	800	3.4%
A38 Taunton Road (south of Broadway)	I1	26,962	28,005	1,043	3.9%
A39 Broadway	K5	22,114	22,956	842	3.8%
A39 west of Quantock roundabout	S	13,293	16,875	3,582	26.9%
A39 south-east of Cannington	R	14,790	18,080	3,291	22.2%
A39 south of Cannington	P	6,638	13,338	6,700	100.9%
A39 west of Cannington	Q	7,969	8,589	620	7.8%
High Street, Cannington	U	2,175	1,879	-296	-13.6%
Main Road, Cannington	ZD	8,558	5,567	-2,992	-35.0%
Rodway south of bypass	AC	6,779	3,446	-3,333	-49.2%
Rodway north of bypass	11	6,779	8,316	1,537	22.7%
Cannington bypass	Z1	0	6,244	6,244	
B3190	10	1,412	1,619	207	14.7%
Williton	2	6,150	6,977	827	13.4%

10.9.5 As can be seen, flows increase on the main routes from Junction 23 and Junction 24 to HPC development site i.e. the A38 South of Dunball (G), Western Way (AA), A39 Taunton Road (I1), A39 Broadway (K5), A39 west of Quantock roundabout (S) and A39 south of Cannington (P). Flows then use the Cannington bypass (Z1) with consequent reductions through Cannington on Main Road (ZD), High Street (U) and Rodway (AC). The decreases are less on High Street partly because some buses remain using this route.

10.9.6 However, flows also increase on, for example, (Bath Road) (N3) even though little HPC traffic is expected to use this road. This is likely to be due to re-assignment of traffic because of capacity improvements at Cross Rifles. This is further corroborated by the reduction in flow on the A39 east of M5 Junction 23 (Link L).

10.9.7 Overall the highway improvement package increases capacity in Bridgwater. One consequence of this appears to be that some traffic that is currently using the M5 as a bypass of Bridgwater now uses the A38/39 through the town. This is shown in the reduction in flows on the south facing slip roads at Junction 23 and the north facing slip roads at Junction 24.

Table 10.13: 2016 Reference Case vs. 2016 With Development and Mitigation 2 Way AM Network Peak All Vehicles Traffic Flows

Link	Link Ref.	2016 Ref Case	2016 With Dev	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	821	862	40	4.9%
M5 Junction 23 southbound off-slip	V2	803	935	132	16.4%
M5 Junction 23 northbound off-slip	V3	442	452	9	2.1%
M5 Junction 23 southbound on-slip	V4	650	627	-23	-3.6%
A39 spur east of Dunball	B	2,089	2,208	119	5.7%
A39 east of J23	L	1,288	1,139	-150	-11.6%
A38 north of Dunball	A	907	912	5	0.6%
A38 south of Dunball	G	2,266	2,264	-2	-0.1%
A38 between Wylds Road and The Drove	E	1,431	1,362	-69	-4.8%
A38 between The Drove and Cross Rifles	F	1,481	1,617	136	9.2%
A38 between Cross Rifles and St. John Street	J	1,673	1,959	286	17.1%
A38 between St. John Street and Taunton Road	O2	1,712	1,936	225	13.1%
A39 (Bath Road) north-east of Cross Rifles	N3	1,481	1,795	314	21.2%
St. John Street	SN	1,060	936	-124	-11.7%
The Clink	SF	1,133	1,244	111	9.8%
Wylds Road	AD	990	1,045	55	5.6%
The Drove	ZE	617	581	-37	-5.9%
Western Way (west of Chilton Street)	AA	1,198	1,294	96	8.0%
B3339 Wembdon Hill	T1	66	53	-13	-19.2%
M5 J24 northbound on-slip	ST2	392	379	-13	-3.4%

Link	Link Ref.	2016 Ref Case	2016 With Dev	Increase (Numerical)	Increase (%)
M5 Junction 24 southbound off-slip	ST3	440	434	-7	-1.5%
M5 Junction 24 northbound off-slip	ST4	473	516	43	9.2%
M5 Junction 24 southbound on-slip	ST5	529	572	44	8.3%
A38 spur east of Huntworth	ST1	1,845	1,897	52	2.8%
A38 Taunton Road south of Showground	I2	1,915	2,031	116	6.1%
A38 Taunton Road (south of Broadway)	I1	1,984	2,123	139	7.0%
A39 Broadway	K5	1,844	1,941	98	5.3%
A39 west of Quantock roundabout	S	1,303	1,499	196	15.0%
A39 south-east of Cannington	R	1,378	1,569	191	13.9%
A39 south of Cannington	P	602	1,046	443	73.6%
A39 west of Cannington	Q	728	770	42	5.8%
High Street, Cannington	U	212	198	-14	-6.6%
Main Road, Cannington	ZD	821	597	-224	-27.3%
Rodway south of bypass	AC	538	278	-260	-48.4%
Rodway north of bypass	11	538	747	209	38.9%
Cannington bypass	Z1		439	439	
B3190	10	97	121	24	24.7%
Williton	2	485	530	450	9.3%0

Table 10.14: 2016 Reference Case vs. 2016 With Development and Mitigation 2 Way PM Network Peak All Vehicles Traffic Flows

Link	Link Ref.	2016 Ref Case	2016 with Dev	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	719	903	185	25.7%
M5 Junction 23 southbound off-slip	V2	857	910	53	6.1%
M5 Junction 23 northbound off-slip	V3	548	569	21	3.8%
M5 Junction 23 southbound on-slip	V4	634	631	-3	-0.5%
A39 spur east of Dunball	B	2,113	2,332	218	10.3%
A39 east of J23	L	1,336	1,249	-87	-6.5%
A38 north of Dunball	A	869	883	14	1.6%
A38 south of Dunball	G	2,153	2,317	164	7.6%
A38 between Wylds Road and The Drove	E	1,423	1,308	-115	-8.1%
A38 between The Drove and Cross Rifles	F	1,466	1,356	-110	-7.5%
A38 between Cross Rifles and St. John Street	J	1,841	2,032	190	10.3%
A38 between St. John Street and Taunton Road	O2	1,719	1,812	93	5.4%
A39 (Bath Road) north-east of Cross Rifles	N3	1,352	1,717	365	27.0%

Link	Link Ref.	2016 Ref Case	2016 with Dev	Increase (Numerical)	Increase (%)
St. John Street	SN	1,169	940	-229	-19.6%
The Clink	SF	1,413	1,582	169	12.0%
Wylds Road	AD	954	1,088	134	14.0%
The Drove	ZE	758	736	-22	-2.9%
Western Way (west of Chilton Street)	AA	1,275	1,456	181	14.2%
B3339 Wembdon Hill	T1	80	65	-15	-18.6%
M5 J24 northbound on-slip	ST2	437	444	6	1.5%
M5 Junction 24 southbound off-slip	ST3	496	436	-60	-12.1%
M5 Junction 24 northbound off-slip	ST4	511	538	27	5.3%
M5 Junction 24 southbound on-slip	ST5	562	678	116	20.7%
A38 spur east of Huntworth	ST1	2,048	2,129	81	3.9%
A38 Taunton Road south of Showground	I2	2,147	2,144	-2	-0.1%
A38 Taunton Road (south of Broadway)	I1	2,188	2,229	41	1.9%
A39 Broadway	K5	2,012	2,062	49	2.4%
A39 west of Quantock roundabout	S	1,375	1,648	273	19.9%
A39 south-east of Cannington	R	1,447	1,707	260	18.0%
A39 south of Cannington	P	572	1,228	657	114.8%
A39 west of Cannington	Q	677	730	53	7.8%
High Street, Cannington	U	197	191	-6	-3.2%
Main Road, Cannington	ZD	919	507	-413	-44.9%
Rodway south of bypass	AC	749	334	-415	-55.5%
Rodway north of bypass	11	749	924	175	23.3%
Cannington bypass	Z1		622	622	
B3190	10	120	148	28	23.3%
Williton	2	474	519	450	9.4%

Table 10.15: 2016 Reference Case vs. 2016 With Development and Mitigation 2 Way Daily (24 Hour AADT) HGV + Bus Flows

Link	Link Ref.	2016 Ref Case	2016 With Dev	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	981	1,154	173	17.6%
M5 Junction 23 southbound off-slip	V2	976	1,110	134	13.7%
M5 Junction 23 northbound off-slip	V3	461	396	-65	-14.0%
M5 Junction 23 southbound on-slip	V4	402	348	-54	-13.5%
A39 spur east of Dunball	B	2,298	2,439	141	6.1%
A39 east of J23	L	1,248	1,101	-147	-11.8%
A38 north of Dunball	A	715	653	-62	-8.7%
A38 south of Dunball	G	2,376	2,706	330	13.9%

Link	Link Ref.	2016 Ref Case	2016 With Dev	Increase (Numerical)	Increase (%)
A38 between Wylds Road and The Drove	E	1,026	1,342	316	30.8%
A38 between The Drove and Cross Rifles	F	887	969	82	9.3%
A38 between Cross Rifles and St. John Street	J	1,012	979	-33	-3.2%
A38 between St. John Street and Taunton Road	O2	935	938	3	0.3%
A39 (Bath Road) north-east of Cross Rifles	N3	655	710	55	8.4%
St. John Street	SN	413	383	-30	-7.4%
The Clink	SF	474	381	-93	-19.7%
Wylds Road	AD	450	696	246	54.6%
The Drove	ZE	296	698	402	135.9%
Western Way (west of Chilton Street)	AA	312	1,022	710	227.7%
B3339 Wembdon Hill	T1	47	28	-19	-40.4%
M5 J24 northbound on-slip	ST2	323	304	-19	-5.9%
M5 Junction 24 southbound off-slip	ST3	340	327	-13	-3.7%
M5 Junction 24 northbound off-slip	ST4	370	393	23	6.3%
M5 Junction 24 southbound on-slip	ST5	284	327	43	15.2%
A38 spur east of Huntworth	ST1	1,242	1,422	180	14.5%
A38 Taunton Road south of Showground	I2	1,037	1,258	221	21.3%
A38 Taunton Road (south of Broadway)	I1	1,231	1,489	258	20.9%
A39 Broadway	K5	460	849	389	84.6%
A39 west of Quantock roundabout	S	595	1,740	1,145	192.4%
A39 south-east of Cannington	R	641	1,768	1,127	175.8%
A39 south of Cannington	P	414	1,750	1,336	322.8%
A39 west of Cannington	Q	455	453	-2	-0.4%
High Street, Cannington	U	80	114	34	42.2%
Main Road, Cannington	ZD	242	129	-113	-46.6%
Rodway south of bypass	AC	201	137	-64	-31.7%
Rodway north of bypass	11	246	1398	1,152	468.2%
Cannington bypass	Z1		1,355	1,355	
B3190	10	365	445	80	22.0%
Williton	2	308	460	152	49.4%

10.9.8 In general the changes in HGV and bus flows due to the HPC Project reflect the total vehicle changes. Some buses are routed down Wylds Road (in order to reduce impacts in the sensitive hours on residential properties on Bristol Road) whilst HGVs use The Drove as requested by SCC.

10.9.9 On High Street Cannington there is a small increase in flow due to buses which remain routed through Cannington offsetting the small reduction in HGV flows since only a small number of HGVs use High Street in the Reference Case.

i. Severance

10.9.10 Only the A39 south of Cannington would experience an increase in daily traffic flows above 30% as a result of the HPC development. Therefore on the remaining links which experience an increase in traffic, the impact from all traffic flows is judged to be negligible.

10.9.11 The 101% increase in flows on the A39 to the south of Cannington would represent a substantial impact. This impact arises due to traffic diverting from Main Road Cannington to the A39 before using the bypass and from HPC traffic. The sensitivity of this route is minor (due to there being little pedestrian activity) leading to an initial appraisal of significance of moderate adverse. However, given the nature of the A39 at this point and the temporary nature of the peak impacts it is considered that the correct assessment is **minor adverse** impact.

10.9.12 Both Main Road and Rodway (south of Cannington bypass) experience reductions in daily traffic flow of between 30% and 60% as a result of the construction of the Cannington bypass as part of the HPC Project. This level of reduction represents a minor impact. These routes have substantial sensitivity receptors and therefore the significance of impact on both of these links is considered to be of **moderate beneficial** significance.

10.9.13 In terms of HGV's and buses, the only links that experience an increase in daily flows of between 30% and 60% are shown below. This is a minor magnitude of impact.

- A38 between Wylds Road and the Drove.
- Wylds Road.
- Williton.

10.9.14 Wylds Road and the A38 between Wylds Road and The Drove are judged to be minor in sensitivity and therefore the significance of the impact is **negligible.** Williton is judged to be substantial in sensitivity and therefore the significance of the impact is **moderate adverse**.

10.9.15 The only link to have an impact of between 60% and 90% is A39 Broadway. This is a moderate magnitude of impact and A39 Broadway is a moderate sensitivity receptor. Therefore the significance of the impact is **moderate adverse**.

10.9.16 The following links have a magnitude of impact of greater than 90% which is considered substantial and arises from the consideration that these links are on the HGV/bus routes to the site:

- The Drove.
- Western Way west of Chilton Street.
- A39 west of Quantock Road.
- A39 south-east of Cannington.
- A39 south of Cannington.
- Rodway north of Cannington bypass.

10.9.17 The Drove, and A39 south-east and south of Cannington and Rodway North of Cannington are all judged as minor receptors and therefore the significance of the impact is **moderate adverse**. In fact these links are either through industrial areas or are rural in nature with very little pedestrian activity and very few adjacent residential properties.

10.9.18 The assessment tables above include the link (Link 11 – Rodway North of Cannington) which covers the area to the north of the village. However, to the north of the Combwich freight laydown facility there would be some additional HGV movements transferring goods between the freight laydown facility and the HPC development site. These flows are estimated to be 300 movements per average day spread evenly through the day between 07.00 and 20.00 i.e. 27 movements per hour. Peak day movements could increase up to a maximum of 400 movements per day. However, there would also be days when the flow is considerably less than 300. Therefore the average flow of 300 HGVs per day has been used in the assessment.

10.9.19 Furthermore, there are some HGVs that would travel from the freight management facilities at either Junction 23 or Junction 24 and deliver goods to the Combwich freight laydown facility and return to the motorway without continuing to the HPC development site. This would tend to reduce the flow to the north of the freight laydown facility but this factor has not been taken into account in the analysis in order to give a robust assessment.

10.9.20 Therefore to the north of the freight laydown facility the total HGV plus bus flow would increase to 1,452 movements per day (1,152 + 300). The sensitivity of the receptor at this location is still minor and therefore the significance of the impact is **moderate adverse.**

10.9.21 Western Way, the A39 Broadway and the A39 to the west of Quantock roundabout are all moderate sensitivity receptors and therefore from an initial assessment the significance of the impacts is substantial. These links are examined in turn below.

Western Way:

10.9.22 This road already creates severance between the residential properties on either side. Properties do not front onto the road and this reduces the level of pedestrian activity. There are guardrails along sections of the road and pedestrian crossing of the road tends to be at controlled crossing points. It should be remembered that Western Way is an A road and the signed route from the A39 west of Quantock roundabout to the M5.

10.9.23 The figures reported in the table above are for HGVs and buses. It is considered that whilst buses still have an impact on severance, the perceived impact is less than for HGVs. Therefore the impact of just HGVs has also been considered.

10.9.24 For just HGVs, the increase over a day due to HPC is 330 per day which is an average of 22 vehicles per hour during the permitted hours for HGV operations (07.00 to 22.00) or approximately one HGV every three minutes.

10.9.25 It is also important to recognise the absolute level of HGVs. At present the proportion that HGVs represent of the total flow along Western Way is 1.7% which is a low percentage especially for an "A" road. The national average is 7% although it is around 5% if certain road categories are excluded. Even with the addition of HPC HGVs the proportion would only increase to 3.7%, still a low figure for this type of road.

10.9.26 If buses are also included then the proportion of HGVs plus buses is approximately 7% i.e. no greater than the national average.

10.9.27 On a peak day for HGVs, the HGV increase would be 495 HGVs per day (330 X 1.5). This is one vehicle every 2 minutes. HGVs would then represent 4.9% of the total flow, still below the national average. Taking all of the above into account including the nature of Western Way and the fact that the impacts assessed would be temporary in nature and the estimates are robust, it is considered that the significance of the impact is **moderate adverse.**

A39 west of Quantock Road:

10.9.28 At this point the HGV route from Junction 23 and that from Junction 24 combine. There would be 1145 extra HGVs and buses per day, which is an average of less than 1 vehicle per minute.

10.9.29 For just HGVs the increase would be 532 HGVs per day or one vehicle every 2 minutes.

10.9.30 Currently HGVs represent 3.3% of the total flow and this would increase to 5.8% which is below the national average of 7%.

10.9.31 With buses included, the future proportion that HGVs and buses represent of the total flow is 10.3%.

10.9.32 On a peak day for HGVs, the HGV increase would be limited to 750 movements since this is the limit that EDF Energy propose for the peak daily flow. This is equivalent to one vehicle every minute. In this case HGVs would represent 7% of the total flow.

10.9.33 Only approximately 20 houses front onto Quantock Road on this link and the houses on the north side do not front onto the road. Therefore, the level of pedestrian activity is likely to be low.

10.9.34 Taking the above factors into account and the temporary nature of the peak impacts the significance of the impact on this short stretch of Quantock Road is judged to be **substantial adverse**. Further to the west where there are virtually no properties close to the road, the significance of the impacts would reduce considerably.

10.9.35 Looking at severance in the round there would be some adverse impacts in Bridgwater but benefits in Cannington. The impacts are over a temporary period and the roads affected are all A roads which are expected to take HGV traffic. In general these roads have only a small number of residential properties fronting onto them. The estimated number of vehicles is a robust estimate, particularly for buses and the HGV numbers include Medium Goods Vehicles. Taking all of the above into account the overall impact on Severance is judged to be **moderate adverse.**

ii. Pedestrian Delay

10.9.36 Those highway links with a two-way flow greater than 1,400 vehicles per hour include The Clink and various locations on the A38 and A39 in and around Bridgwater. However, none of these links experience traffic flow increases of greater than 30% and therefore the magnitude of impact on all of these links as a result of the HPC development with respect to pedestrian delay is **negligible.**

10.9.37 On Cannington High Street, improvements to the pedestrian crossing facilities are proposed. These comprise re-siting the location of the existing zebra crossing nearer to the Memorial Junction and its conversion to a pelican crossing and installation of a new crossing on Rodway close to Bridgwater College. Furthermore, the traffic flows would reduce significantly due to the completion of the bypass. These changes would lead to a **moderate beneficial** impact on pedestrian delay.

iii. Pedestrian Amenity

10.9.38 Based on advice in the IEMA Guidelines, the change in flows at which pedestrian amenity changes become material are a doubling or halving in the flow of all traffic or HGVs.

10.9.39 Only the A39 south of Cannington experiences a general traffic flow increase of greater than 100% in association with the HPC site. However, the receptor sensitivity for the route is minor as the route has no frontage access or pedestrian activity. The overall effects are therefore concluded to be **negligible** in terms of significance.

10.9.40 In terms of HGV's and buses the links that experience a daily flow increase of greater than 100% and where the sensitivity of the receptors are other than minor are shown below along with the % change in HGVs only as a result of HPC shown in brackets:

- Western Way west of Chilton Street (161%).
- A39 west of Quantock Road (125%).

10.9.41 On a peak day HGVs would increase by 227% and 192% respectively. However the number of days of peak HGVs would be relatively small and the vast majority of time the flows would be less than the peak.

10.9.42 The existing level of pedestrian amenity also needs to be taken into account. All three roads are A roads carrying significant levels of traffic and the pedestrian amenity level is therefore already low.

10.9.43 In Cannington, whilst there is not a halving in traffic flows, the effects of the bypass in removing traffic are considered to be material and are judged to be **moderate beneficial.**

10.9.44 Taking the above into account, and the fact that the sensitivity of the receptors is judged to be moderate and the level of impact assessed is temporary, the significance of the impact is considered to be **moderate adverse** in Bridgwater and **moderate beneficial** in Cannington.

iv. Driver Delay

10.9.45 The **Transport Assessment** includes a detailed analysis of journey times on various routes in Bridgwater and surrounding areas and demonstrates that there is no material detriment to journey times within Bridgwater as a whole. Overall journey speeds are maintained. During the modelled hours (06:00 to 10:00 and 13:00 to 20:00 the average speed of a vehicle through the modelled network is 29.1 miles per hour in the 2016 Reference Case and 29.0 miles per hour in the With Development and Mitigation Case. Hence there is no material change.

10.9.46 The key routes for journey times are the two HGV routes from the M5 to the HPC site since these take the great majority of HPC generated traffic. Charts showing the changes in journey times on these two routes are shown below.

10.9.47 Journey Time 10 is the route from Huntworth roundabout (i.e. the access to Junction 24 site), via A38 Taunton Road, A39 Broadway, to Quantock roundabout.

10.9.48 The route from the Junction 23 facilities comprises two routes. Route 6 is from Junction 23 facilities to Cross Rifles whilst Route 1 is from the A38/The Drove junction to the Quantock roundabout.

10.9.49 Plans of the journey time routes are included in the **Transport Assessment**.

10.9.50 The red line on the graphs shows the 2016 Reference Case i.e. what happens without HPC but with other growth. The green line shows the journey times if HPC traffic is added but with no highway improvements. The blue line shows the situation if the highway improvements are added. Twenty model runs are undertaken to produce the results for each scenario. The range of results is shown by the dotted lines with the average being shown by the solid line. The range of results is known as the confidence interval. The period between 10.00 and 13.00 hours has not been modelled (as agreed with the transport authorities) and therefore the graphs should be ignored for these periods. A change is only considered statistically significant if the confidence intervals (i.e. the range of results from the multiple runs undertaken) between two scenarios do not overlap.

10.9.51 The first two graphs show the journey times for Route 10.

Plate 10.4: 2016 Journey Time Analysis: Route 10 – Southbound

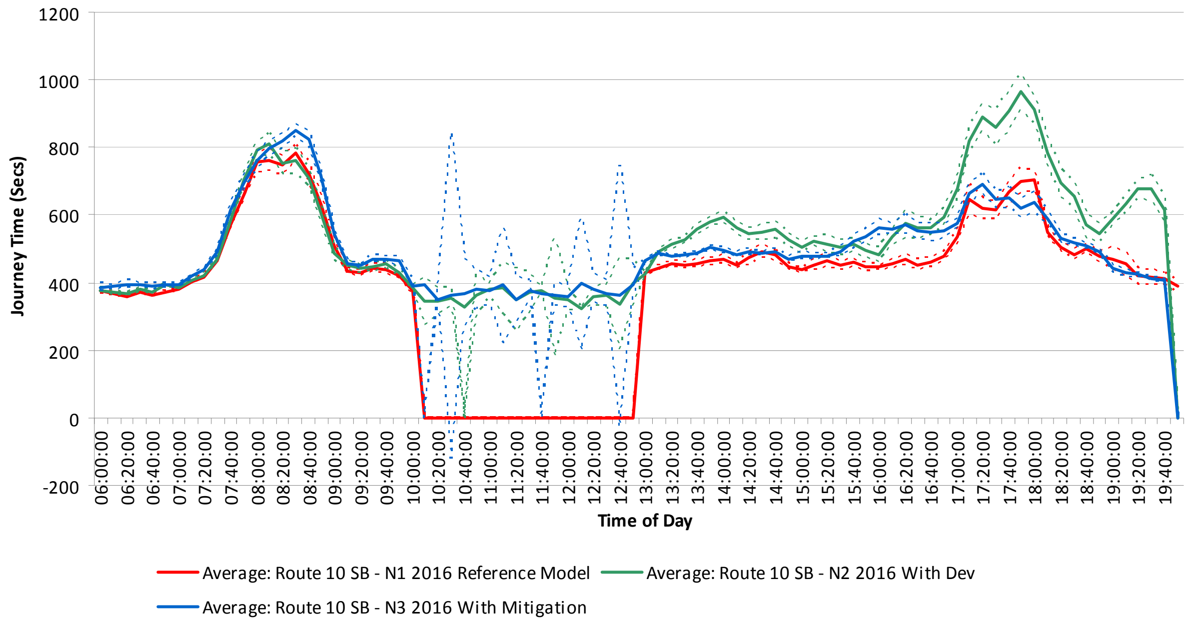
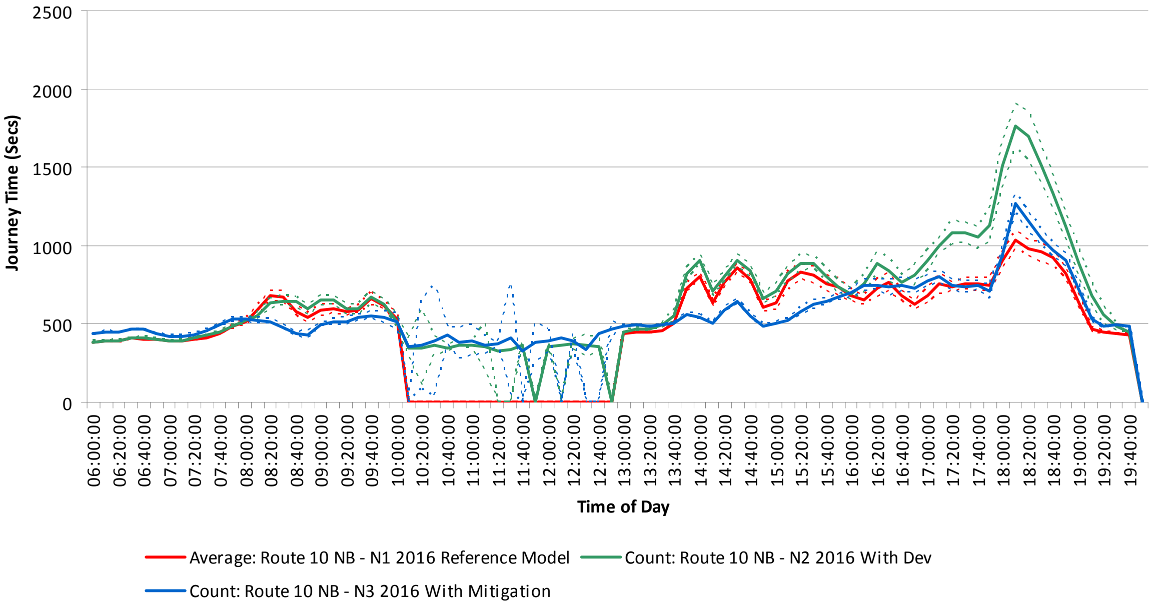


Plate 10.5: 2016 Journey Time Analysis: Route 10 – Northbound



10.9.52 As can be seen on the journey time analysis for Route 10, without any mitigation there is a significant detriment to journey times in both the southbound direction (i.e. away from HPC) and northbound direction in the evening peak period.

10.9.53 With the proposed highway improvements in place the southbound direction journey times are broadly neutral between the Reference Case and the With Development and Mitigation Case. In the northbound direction (towards HPC) there is an improvement in the morning peak and early afternoon but some detriment around 18.00 hours.

10.9.54 Shown below are the journey times for Routes 6 and 1.

Plate 10.6: 2016 Journey Time Analysis: Route 6 – Southbound

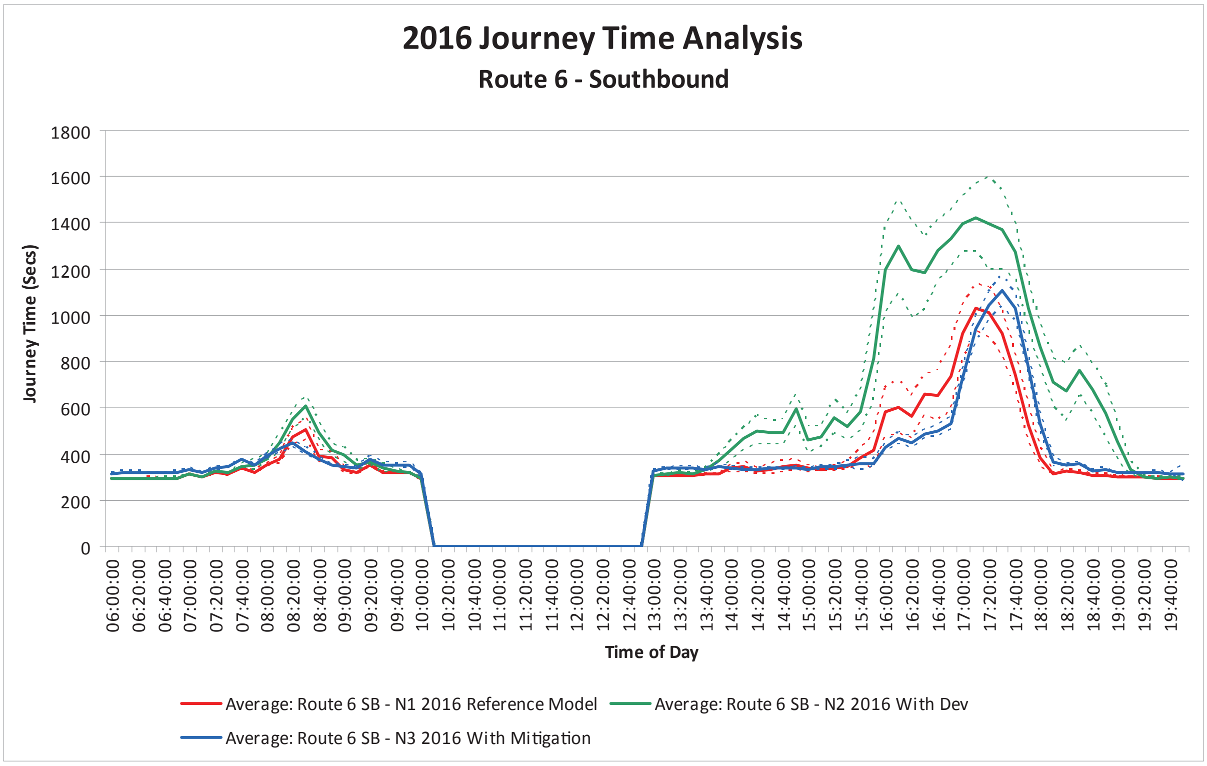


Plate 10.7: 2016 Journey Time Analysis: Route 6 – Northbound

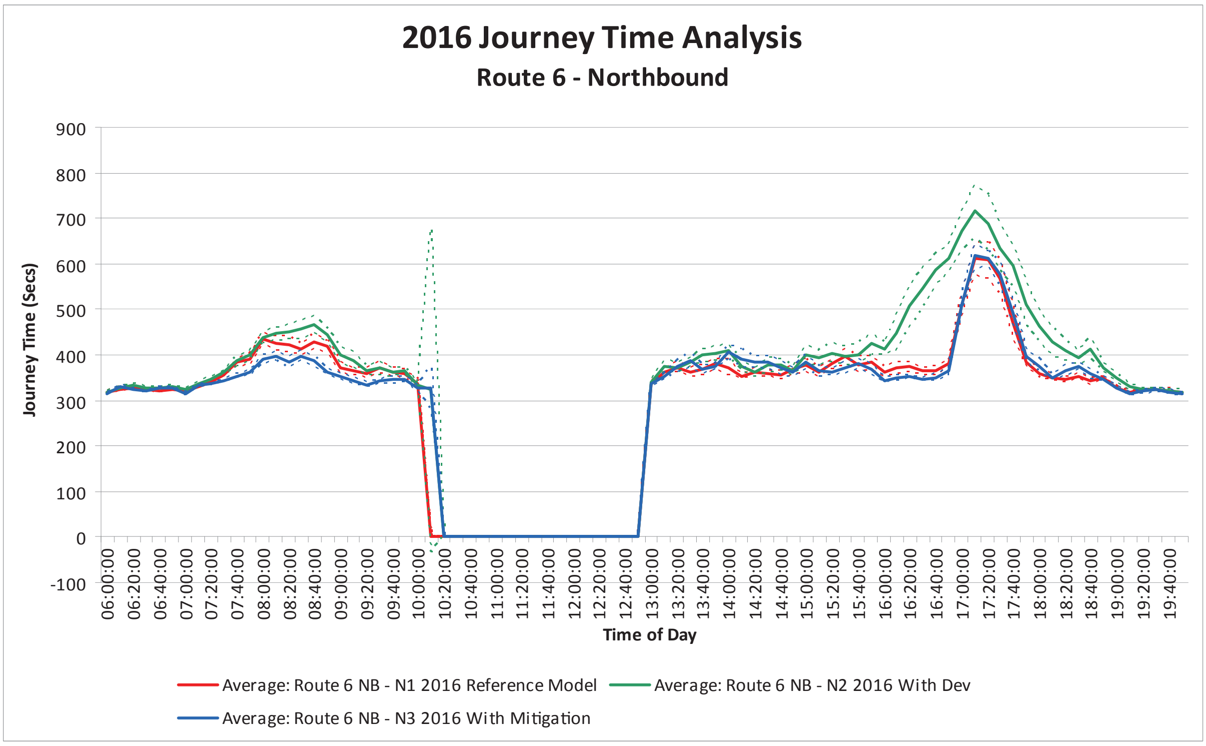


Plate 10.8: 2016 Journey Time Analysis: Route 1 – Eastbound

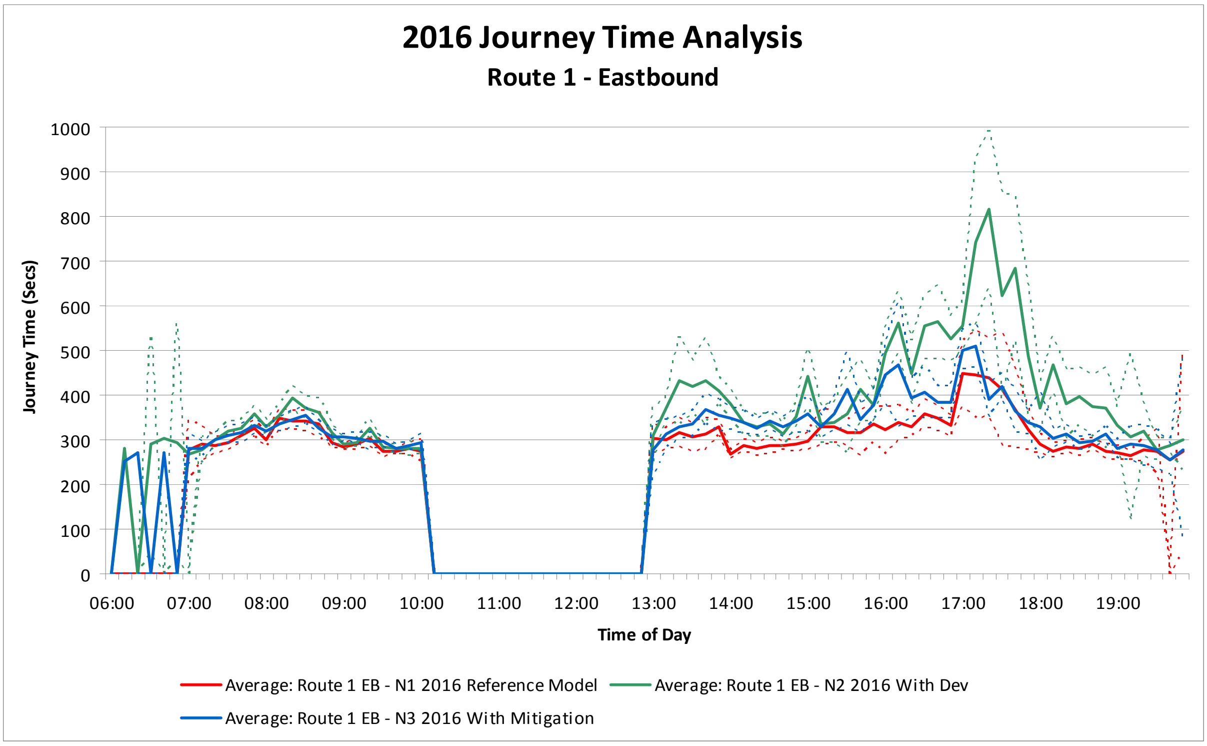
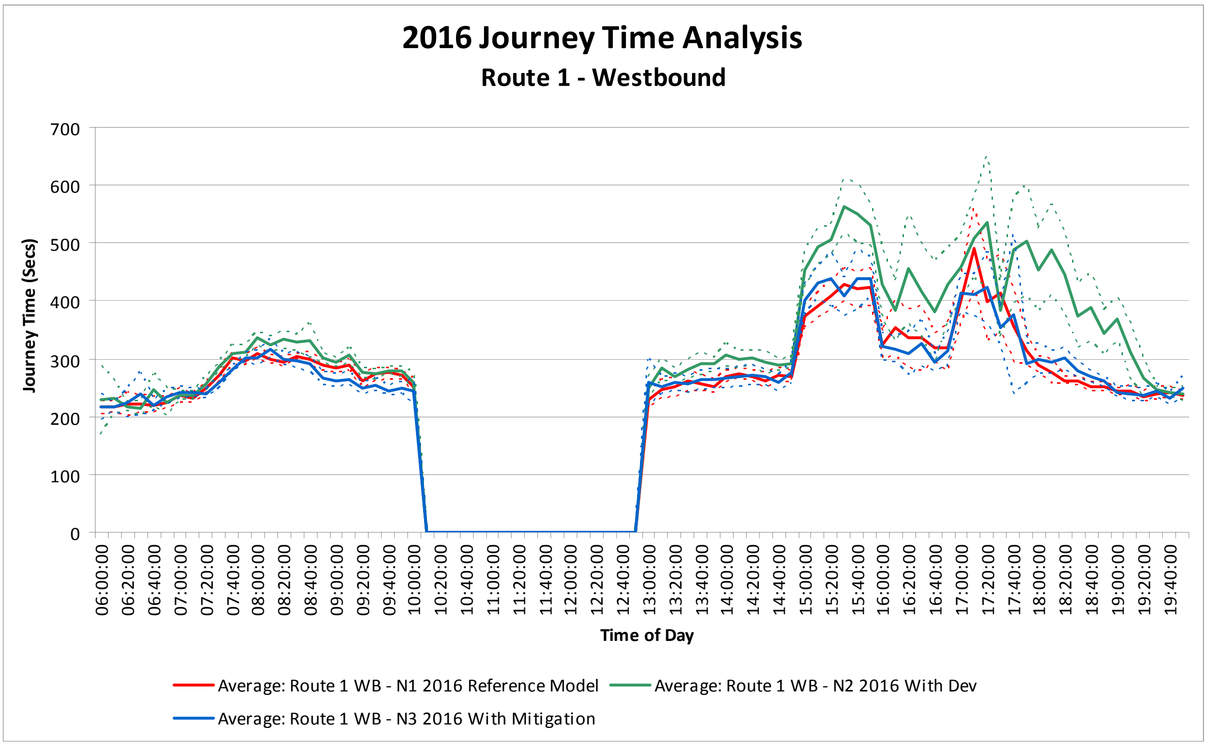


Plate 10.9: 2016 Journey Time Analysis: Route 1 – Westbound



10.9.55 On journey time Route 6 southbound, HPC traffic plus mitigation leads to a small increase in journey time in the morning peak and a small reduction in the evening peak. In the northbound direction there is a small improvement in the morning peak and no change in the evening peak.

10.9.56 On Route 1 there is no statistically significant change in journey times when the scenario with HPC traffic plus mitigation is compared with the Reference Case in either the eastbound or westbound directions.

10.9.57 On the basis of the above, the impact of HPC with highway mitigation on driver delay is considered to be **negligible**.

v. Accidents and Safety

10.9.58 As noted earlier in this chapter, a full safety study has been undertaken and the results are reported in the **Road Safety Strategy** appended to the **Transport Assessment.**

10.9.59 The study demonstrates that there are a number of accident clusters where traffic flows would increase due to committed development schemes and other traffic growth as well as HPC. Somerset County Council themselves have an ongoing safety improvement programme in Bridgwater which is looking at a number of the clusters.

10.9.60 The study demonstrates that a number of the highway improvements proposed by EDF Energy bring forward safety enhancements. In particular this is the case at A39 New Road/B3339 Sandford Hill roundabout, Taunton Road/Broadway and Wylds Road/The Drove junctions.

10.9.61 As noted earlier in this chapter the increases in total traffic flows through Bridgwater as a result of HPC are all less than 30% although HGV and bus flows increase by greater than 30% in some locations.

10.9.62 Taking all the above into account the potential impact on safety is judged to be **minor adverse**.

b) 2013

10.9.63 As noted earlier in this chapter, 2013 represents the early construction phase of the HPC Project before all the associated development sites would be operational. The park and ride site and freight management facility located at the Junction 24 site close to M5 Junction 24 would be operational but other associated developments would still be under construction. Some freight vehicles and buses would still be routed from Junction 24 up the M5 to Junction 23 and then along the northern HGV route via the Northern Distributor Road. As well as vehicle movements relating to the construction of the HPC development site, movements relating to the construction of associated developments have also been included in the analysis.

10.9.64 In terms of highway improvements, the analysis has been undertaken on the basis of only the site preparation works improvements plus Huntworth roundabout being in place. The Cannington bypass would not be operational until Quarter 4 2014.

10.9.65 Therefore the highway improvements assessed are:

- A39 Broadway/A38 Taunton Road junction.
- A39 New Road/B3339 Sandford Hill roundabout.
- Washford Cross roundabout.

- Huntworth roundabout.
- Claylands Corner junction.
- Cannington Traffic Calming Measures.
- C182 Farringdon Hill Lane horse crossing.

10.9.66 However, EDF Energy would seek to implement the entire highway improvement package as soon as possible and therefore some additional improvement measures may be in place before the assessment period of Quarter 3 2013.

10.9.67 The results of the analysis are shown in the **Tables 10.16** to **10.19**. These cover daily all vehicle flows, peak hour all vehicle flows and daily HGV and bus flows. More detailed information is included in the **Transport Assessment**.

Table 10.16: 2013 Reference Case vs. 2013 With Development and Mitigation Daily (24 Hour AADT) 2 Way All Vehicles Traffic Flows

Link	Link Ref.	2013 Ref Case	2013 With Dev	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	8,338	8,683	345	4.1%
M5 Junction 23 southbound off-slip	V2	8,051	8,185	134	1.7%
M5 Junction 23 northbound off-slip	V3	4,115	4,321	206	5.0%
M5 Junction 23 southbound on-slip	V4	4,236	4,269	33	0.8%
A39 spur east of Dunball	B	19,951	21,002	1,051	5.3%
A39 east of J23	L	14,994	15,306	312	2.1%
A38 north of Dunball	A	10,806	10,804	-3	0.0%
A38 south of Dunball	G	22,555	23,404	849	3.8%
A38 between Wylds Road and The Drove	E	14,299	14,807	508	3.6%
A38 between The Drove and Cross Rifles	F	18,017	18,032	14	0.1%
A38 between Cross Rifles and St. John Street	J	21,539	21,932	393	1.8%
A38 between St. John Street and Taunton Road	O2	19,876	20,278	402	2.0%
A39 (Bath Road) north-east of Cross Rifles	N3	18,846	18,771	-74	-0.4%
St. John Street	SN	11,937	12,076	139	1.2%
The Clink	SF	17,718	17,893	174	1.0%
Wylds Road	AD	10,436	10,699	263	2.5%
The Drove	ZE	7,265	7,769	504	6.9%
Western Way (west of Chilton Street)	AA	12,302	13,129	827	6.7%
B3339 Wembdon Hill	T1	1,546	1,400	-146	-9.5%
M5 J24 northbound on-slip	ST2	4,254	4,732	478	11.2%
M5 Junction 24 southbound off-slip	ST3	4,964	5,506	543	10.9%
M5 Junction 24 northbound off-slip	ST4	4,846	5,442	596	12.3%

Link	Link Ref.	2013 Ref Case	2013 With Dev	Increase (Numerical)	Increase (%)
M5 Junction 24 southbound on-slip	ST5	5,223	5,844	621	11.9%
A38 spur east of Huntworth	ST1	19,089	21,335	2,246	11.8%
A38 Taunton Road south of Showground	I2	22,482	23,676	1,194	5.3%
A38 Taunton Road (south of Broadway)	I1	25,593	26,994	1,401	5.5%
A39 Broadway	K5	21,246	22,128	882	4.2%
A39 west of Quantock roundabout	S	13,150	15,238	2,089	15.9%
A39 south-east of Cannington	R	14,690	16,602	1,912	13.0%
A39 south of Cannington	P	6,505	7,990	1,485	22.8%
A39 west of Cannington	Q	7,845	8,225	380	4.8%
High Street, Cannington	U	2,186	3,577	1,391	63.6%
Main Road, Cannington	ZD	8,619	9,068	449	5.2%
Rodway south of bypass	AC	6,801	8,568	1,768	26.0%
Rodway north of bypass	11	6,801	7,371	570	8.4%
Cannington bypass	Z1				
B3190	10	1,412	1,619	207	14.7%
Williton	2	6,150	6,977	39	0.6%

10.9.68 As can be seen the great majority of flow increases are less than in 2016. For example, on Western Way the increase in daily flows is 827 vehicles (6.7%) compared with 1,845 vehicles (14.6%) in 2016.

10.9.69 In Cannington, the bypass would not be in place and therefore there would be increases in flows on roads through the village. On High Street the daily all vehicles flow would increase by 1391 vehicles or 64% of the existing flow.

Table 10.17: 2013 Reference Case vs. 2013 With Development and Mitigation 2 Way AM Network Peak All Vehicles Traffic Flows

Link	Link Ref.	2013 Ref Case	2013 With Dev	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	851	856	5	0.6%
M5 Junction 23 southbound off-slip	V2	780	796	15	2.0%
M5 Junction 23 northbound off-slip	V3	397	395	-2	-0.4%
M5 Junction 23 southbound on-slip	V4	552	583	31	5.6%
A39 spur east of Dunball	B	1,923	2,007	84	4.4%
A39 east of J23	L	1,316	1,370	53	4.1%
A38 north of Dunball	A	907	911	4	0.4%
A38 south of Dunball	G	2,054	2,124	70	3.4%
A38 between Wylds Road and The Drove	E	1,243	1,277	34	2.7%
A38 between The Drove and Cross Rifles	F	1,457	1,472	15	1.0%

Link	Link Ref.	2013 Ref Case	2013 With Dev	Increase (Numerical)	Increase (%)
A38 between Cross Rifles and St. John Street	J	1,582	1,612	30	1.9%
A38 between St. John Street and Taunton Road	O2	1,666	1,734	68	4.1%
A39 (Bath Road) north-east of Cross Rifles	N3	1,643	1,613	-30	-1.8%
St. John Street	SN	959	987	27	2.9%
The Clink	SF	1,195	1,222	26	2.2%
Wylds Road	AD	924	951	27	2.9%
The Drove	ZE	513	543	30	5.8%
Western Way (west of Chilton Street)	AA	1,105	1,196	91	8.3%
B3339 Wembdon Hill	T1	69	53	-15	-22.2%
M5 J24 northbound on-slip	ST2	367	375	8	2.1%
M5 Junction 24 southbound off-slip	ST3	391	477	86	21.9%
M5 Junction 24 northbound off-slip	ST4	445	538	93	20.8%
M5 Junction 24 southbound on-slip	ST5	617	580	-37	-6.0%
A38 spur east of Huntworth	ST1	1,834	1,973	140	7.6%
A38 Taunton Road south of Showground	I2	1,986	2,057	71	3.6%
A38 Taunton Road (south of Broadway)	I1	2,059	2,147	88	4.3%
A39 Broadway	K5	1,790	1,847	57	3.2%
A39 west of Quantock roundabout	S	1,282	1,466	184	14.3%
A39 south-east of Cannington	R	1,357	1,529	172	12.6%
A39 south of Cannington	P	584	624	40	6.9%
A39 west of Cannington	Q	706	738	32	4.5%
High Street, Cannington	U	210	276	66	31.3%
Main Road, Cannington	ZD	827	968	141	17.1%
Rodway south of bypass	AC	537	689	152	28.3%
Rodway north of bypass	11	537	689	152	28.3%
Cannington bypass	Z1				
B3190	10	97	147	50	51.3%
Williton	2	485	485	0	0%

Table.10.18: 2013 Reference Case vs. 2013 With Development and Mitigation 2 Way PM Network Peak All Vehicles Traffic Flows

Link	Link Ref.	2013 Ref Case	2013 With Dev	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	734	764	30	4.1%
M5 Junction 23 southbound off-slip	V2	913	879	-34	-3.7%
M5 Junction 23 northbound off-slip	V3	448	510	61	13.6%
M5 Junction 23 southbound on-slip	V4	630	627	-2	-0.4%
A39 spur east of Dunball	B	2,084	2,160	76	3.7%
A39 east of J23	L	1,402	1,425	23	1.7%
A38 north of Dunball	A	911	917	6	0.7%
A38 south of Dunball	G	2,063	2,141	78	3.8%
A38 between Wylds Road and The Drove	E	1,187	1,215	28	2.3%
A38 between The Drove and Cross Rifles	F	1,289	1,288	-1	0.0%
A38 between Cross Rifles and St. John Street	J	1,748	1,828	79	4.5%
A38 between St. John Street and Taunton Road	O2	1,599	1,648	49	3.1%
A39 (Bath Road) north-east of Cross Rifles	N3	1,770	1,782	12	0.7%
St. John Street	SN	1,022	991	-31	-3.0%
The Clink	SF	1,590	1,637	47	2.9%
Wylds Road	AD	887	909	22	2.5%
The Drove	ZE	708	737	30	4.2%
Western Way (west of Chilton Street)	AA	1,301	1,341	40	3.1%
B3339 Wembdon Hill	T1	86	68	-18	-20.8%
M5 J24 northbound on-slip	ST2	357	459	102	28.5%
M5 Junction 24 southbound off-slip	ST3	453	468	14	3.1%
M5 Junction 24 northbound off-slip	ST4	508	490	-19	-3.7%
M5 Junction 24 southbound on-slip	ST5	549	652	103	18.8%
A38 spur east of Huntworth	ST1	1,900	2,100	200	10.5%
A38 Taunton Road south of Showground	I2	2,036	2,079	43	2.1%
A38 Taunton Road (south of Broadway)	I1	2,078	2,135	57	2.8%
A39 Broadway	K5	2,012	2,098	86	4.3%
A39 west of Quantock roundabout	S	1,409	1,537	128	9.1%
A39 south-east of Cannington	R	1,489	1,599	110	7.4%
A39 south of Cannington	P	582	701	118	20.3%
A39 west of Cannington	Q	691	718	26	3.8%
High Street, Cannington	U	211	315	104	49.4%
Main Road, Cannington	ZD	953	949	-4	-0.4%

Link	Link Ref.	2013 Ref Case	2013 With Dev	Increase (Numerical)	Increase (%)
Rodway south of bypass	AC	776	870	94	12.1%
Rodway north of bypass	11	776	870	94	12.1%
Cannington bypass	Z1				
B3190	10	120	170	50	41.8%
Williton	2	474	474	0	0%

Table 10.19: 2013 Reference Case vs. 2013 With Development and Mitigation 2 Way Daily (24 Hour AADT) HGV + Bus Flows

Link	Link Ref.	2013 Ref Case	2013 With Dev	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	1,054	1,284	230	21.8%
M5 Junction 23 southbound off-slip	V2	1,011	1,027	16	1.6%
M5 Junction 23 northbound off-slip	V3	425	505	80	18.8%
M5 Junction 23 southbound on-slip	V4	379	372	-7	-1.8%
A39 spur east of Dunball	B	2,021	2,598	577	28.6%
A39 east of J23	L	1,648	1,788	140	8.5%
A38 north of Dunball	A	734	750	16	2.2%
A38 south of Dunball	G	1,990	2,464	474	23.8%
A38 between Wylds Road and The Drove	E	1,045	1,388	343	32.8%
A38 between The Drove and Cross Rifles	F	931	923	-8	-0.9%
A38 between Cross Rifles and St. John Street	J	1,095	1,217	122	11.1%
A38 between St. John Street and Taunton Road	O2	1,033	1,189	156	15.1%
A39 (Bath Road) north-east of Cross Rifles	N3	825	973	148	17.9%
St. John Street	SN	434	461	27	6.2%
The Clink	SF	521	501	-20	-3.8%
Wylds Road	AD	458	602	144	31.4%
The Drove	ZE	306	719	413	135.0%
Western Way (west of Chilton Street)	AA	334	893	559	167.4%
B3339 Wembdon Hill	T1	49	44	-5	-10.2%
M5 J24 northbound on-slip	ST2	318	393	75	23.6%
M5 Junction 24 southbound off-slip	ST3	329	512	183	55.6%
M5 Junction 24 northbound off-slip	ST4	388	454	66	17.0%
M5 Junction 24 southbound on-slip	ST5	307	369	62	20.2%
A38 spur east of Huntworth	ST1	1,349	1,741	392	29.1%
A38 Taunton Road south of Showground	I2	1,093	1,653	560	51.2%
A38 Taunton Road (south of Broadway)	I1	1,289	1,962	673	52.2%

Link	Link Ref.	2013 Ref Case	2013 With Dev	Increase (Numerical)	Increase (%)
A39 Broadway	K5	484	1,050	566	116.9%
A39 west of Quantock roundabout	S	625	1,764	1,139	182.2%
A39 south-east of Cannington	R	674	1,808	1,134	168.2%
A39 south of Cannington	P	429	1,567	1,138	265.3%
A39 west of Cannington	Q	468	540	72	15.4%
High Street, Cannington	U	83	1,332	1,249	1504.8%
Main Road, Cannington	ZD	260	253	-7	-2.7%
Rodway south of bypass	AC	206	1,447	1,241	602.4%
Rodway north of bypass	11	206	1,483	1,277	619.9%
Cannington bypass	Z1				
B3190	10	365	2,517	152	41.6%
Williton	2	308	460	152	49.4%

10.9.70 The most significant change in HGV and bus flows compared to 2016 would be in Cannington where HGVs and buses would be routed along High Street until the bypass is complete.

i. Severance

10.9.71 Examining daily flows, there are no increases greater than 30% except on High Street Cannington. Therefore on this criteria, on all links other than High Street, the impacts are expected to be negligible.

10.9.72 In terms of HGV's and buses, the links that experience an increase in daily flows of between 30% and 60% are shown below. This is a minor magnitude of impact.

- A38 between Wylds Road and The Drove.
- A39 Taunton Road (south of Showground).
- A39 south of Broadway.
- Wylds Road.
- M5 Junction 24 southbound off-slip.

10.9.73 All of these links are judged to be minor or moderate in sensitivity and therefore the significance of the impact is **negligible or minor adverse**.

10.9.74 No links experience a magnitude of impact between 60% and 90%

10.9.75 The following have a magnitude of impact of greater than 90% which is considered substantial and arises from the consideration that these links are on the HGV/bus routes to the site :

- The Drove.
- Western Way west of Chilton Street.
- A39 Broadway.

- A39 west of Quantock Road.
- A39 south-east of Cannington.
- A39 south of Cannington.
- High Street Cannington.
- Rodway (north and south of Cannington bypass).

10.9.76 The Drove, and A39 south-east and south of Cannington and Rodway north of Cannington bypass are all judged as minor receptors and therefore the significance of the impact is **moderate adverse**. In fact these links are either through industrial areas or are rural in nature with virtually no pedestrian activity or adjacent residential properties.

10.9.77 For Western Way, the increase in HGVs and buses is 559 vehicles per day which is less than in 2016. The increase represents an average of 23 vehicles per hour or one every three minutes. If just HGVs are considered the increase is 333 per day or one vehicle every four minutes.

10.9.78 Taking into account the comments made in the 2016 analysis and the fact that the HGV plus bus increase is lower than in 2016, the significance of the impact is considered **moderate adverse**.

10.9.79 For Broadway, the impacts are similar to those in 2016 and therefore the significance is judged as **moderate adverse**.

10.9.80 On A39 west of Quantock roundabout, the increase in HGVs and buses is 1139 vehicles compared to 1145 in 2016. The increase represents one vehicle per minute. Looking at just HGVs the increase is 543 HGVs per day compared with 531 in 2016) which is 23 per hour or just over one vehicle every three minutes.

10.9.81 Overall the significance of the severance impact along the short stretch of Quantock Road with residential properties close by is similar to that in 2016 and is considered to be **substantial adverse**. Looking at severance in the round across the main HGV and bus routes through Bridgwater the impact overall is considered to be **moderate adverse**.

10.9.82 In Cannington, there are significant increases in HGV and bus flows on High Street and C182 Rodway. On High Street HGVs increase by 552 vehicles per day (up to 750 on a peak day) and buses increase by 698 vehicles per day. No such vehicles to/from the HPC development site would be permitted on Main Road and therefore there is no effective increase in such vehicles on that road.

10.9.83 The increases are substantial in magnitude and the receptor sensitivity is also substantial leading to a significance of impact that is considered **substantial adverse**. However, it should be remembered that HGVs as defined here include Medium Goods Vehicles and that bus numbers are likely to be significantly lower once detailed timetabling is undertaken.

10.9.84 EDF Energy recognises the impact that traffic travelling through Cannington would have and has therefore included provision of the Cannington bypass within its proposals. It is expected that the bypass would be open to traffic in Quarter 4 2014. As noted in the 2016 analysis, once the bypass is complete there would be a beneficial effect compared to existing and Reference Case conditions within Cannington.

10.9.85 Recognising the increases in traffic, EDF Energy has proposed traffic management measures within Cannington which would be implemented as part of the site preparation works. These works would control traffic and improve the pedestrian environment.

10.9.86 Notwithstanding the above, the impacts are still considered **substantial adverse** albeit for a temporary period.

10.9.87 Therefore, in overall terms the significance of the severance impacts are considered **moderate adverse** except in Cannington where they are considered **substantial adverse**.

ii. Pedestrian Delay

10.9.88 The analysis in 2013 is similar as in 2016 i.e. no links where the hourly flow is greater than 1400 vehicles per hour experience an increase in flow due to HPC of more than 30% Therefore the effects on pedestrian delay are considered negligible.

10.9.89 On Cannington High Street, the improvements to pedestrian facilities described earlier would assist pedestrians crossing the roads. However, due to the increases in flows there could be delays for those crossing elsewhere. Therefore the overall effect is judged to be **negligible**.

10.9.90 Therefore, the significance of the pedestrian delay impact is considered **negligible**.

iii. Pedestrian Amenity

10.9.91 Based on advice in the IEMA Guidelines, the change at which pedestrian amenity changes become material are a doubling or halving in the flow of all traffic or HGVs.

10.9.92 No link experiences a general traffic flow increase of greater than 100% in association as a result of the HPC Project.

10.9.93 In terms of HGV's and buses the links that experience a daily flow increase of greater than 100% and where the sensitivity of the receptors are other than minor are shown below along with the % change in HGVs as a result of HPC shown in brackets:

- Western Way west of Chilton Street (161%).
- A39 Broadway (70%).
- A39 west of Quantock Road (125%).
- Cannington High Street.
- C182 Rodway.

10.9.94 Other than in Cannington, the impacts are similar to or less than in 2016. However, the significance of the impacts are still **moderate adverse**.

10.9.95 In Cannington, on the High Street and Rodway the magnitude of the impacts is considered substantial. However, the proposed improvement scheme in Cannington would improve the pedestrian environment by creating wider footways, and improved crossing facilities. On this basis the significance of the impact is considered **moderate adverse.**

iv. Driver Delay

10.9.96 The basis of the assessment of driver delay is as in 2016. Overall through the network there is a small decrease in average speeds from 31.5 miles per hour to 30.3 miles per hour, a reduction of 4% which is not considered significant.

10.9.97 The results of the journey time analysis for Route 10 are shown below.

Plate 10.10: 2013 Journey Time Analysis: Route 10 – Southbound

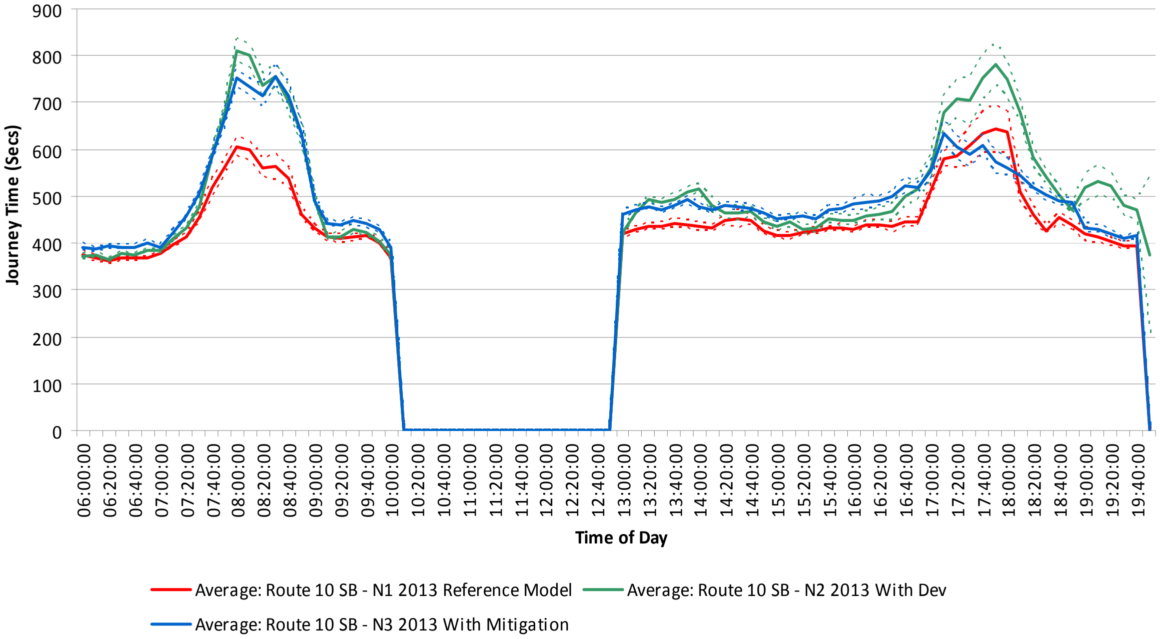
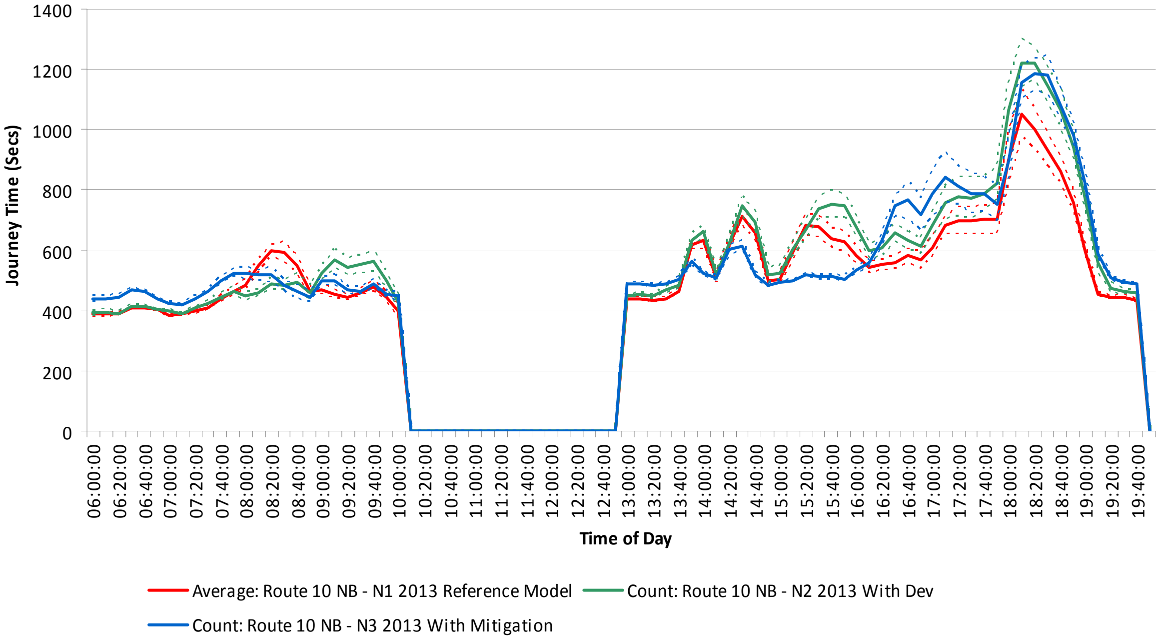


Plate 10.11: 2013 Journey Time Analysis: Route 10 – Northbound



10.9.98 As can be seen, in the southbound direction, there is some increase in journey time in the morning peak and a negligible effect in the evening peak.

10.9.99 In the northbound direction the effects of HPC are neutral in the morning peak and show an increase in journey times in the evening peak.

Plate 10.12: 2013 Journey Time Analysis: Route 6 – Southbound

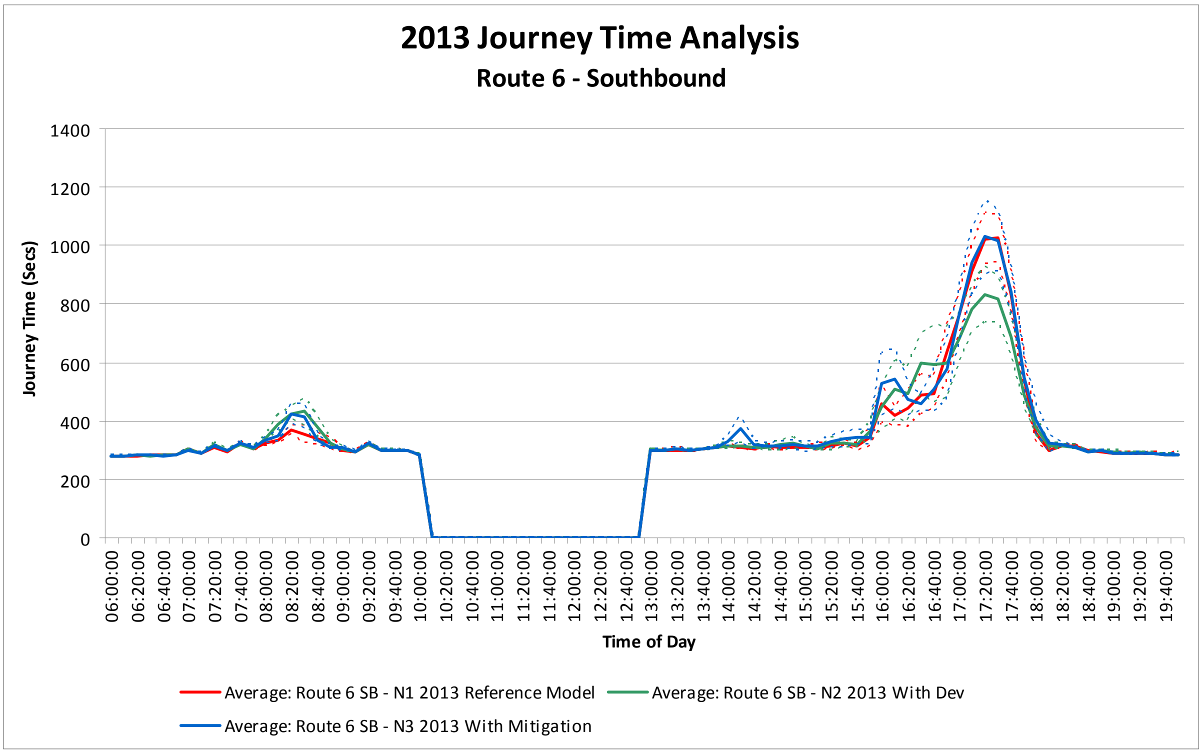


Plate 10.13: 2013 Journey Time Analysis: Route 6 – Northbound

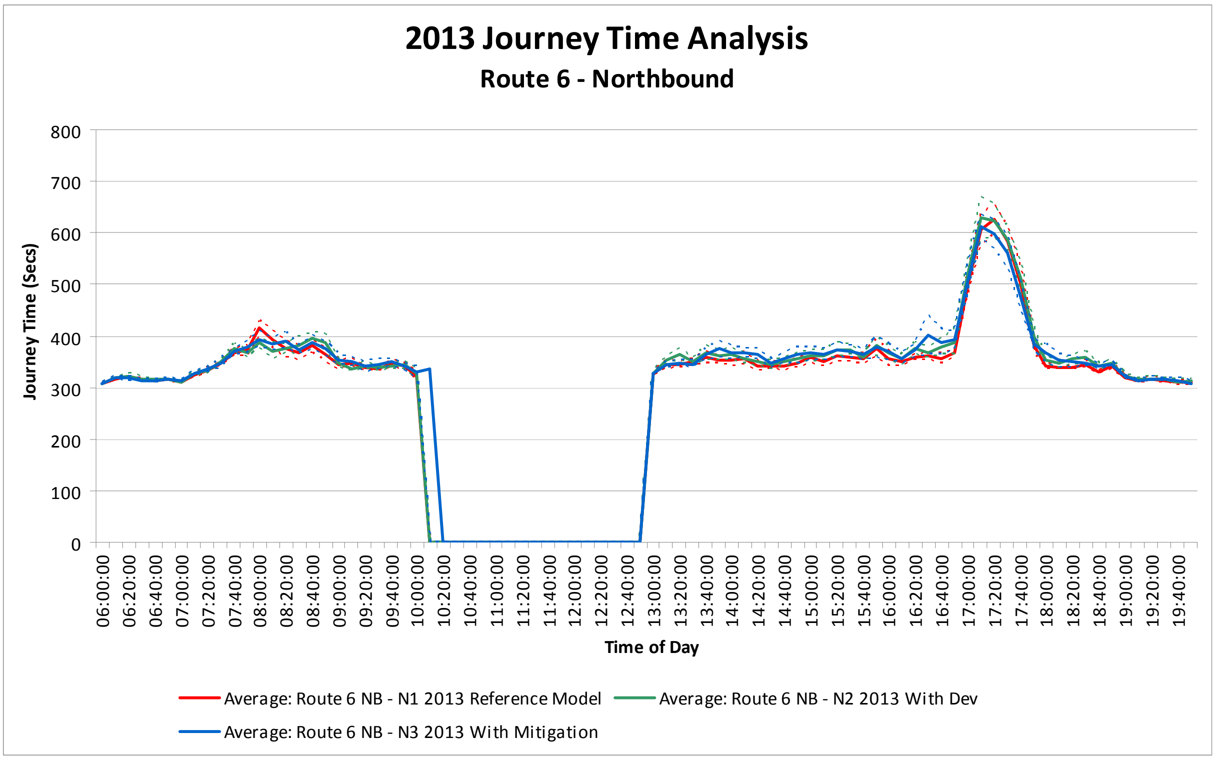


Plate 10.14: 2013 Journey Time Analysis: Route 1 – Eastbound

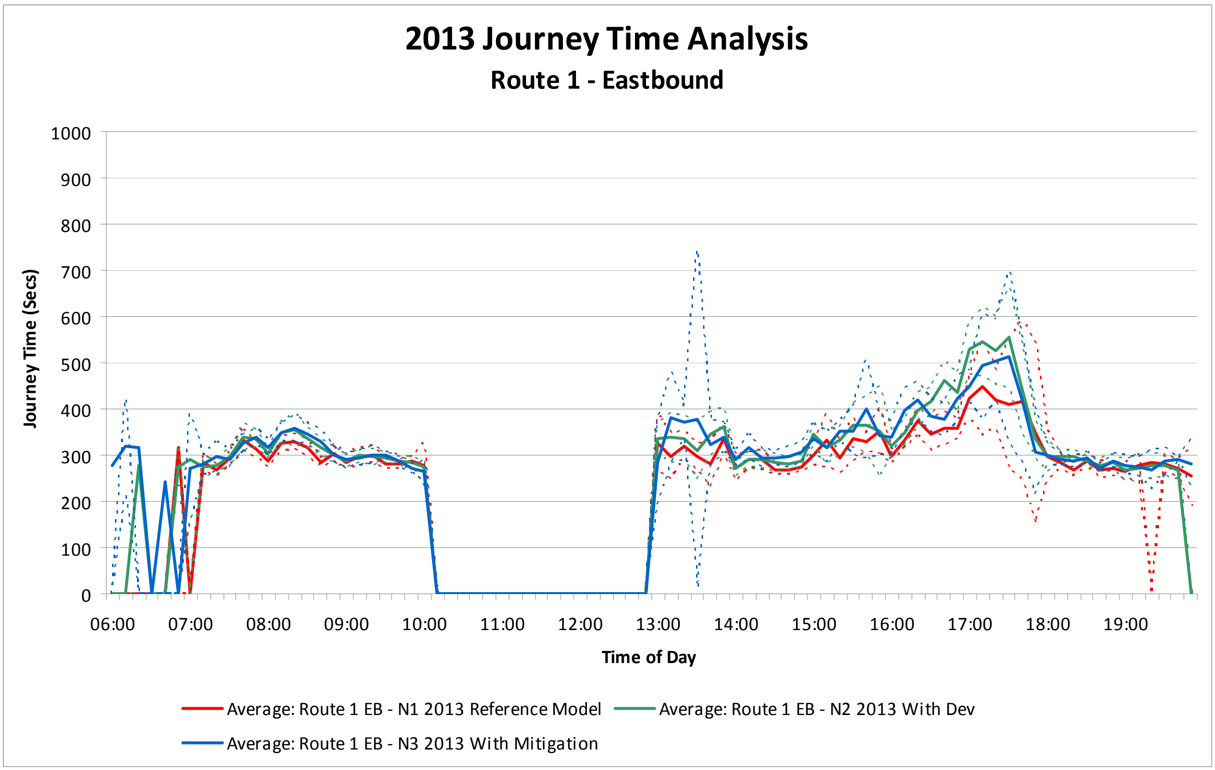
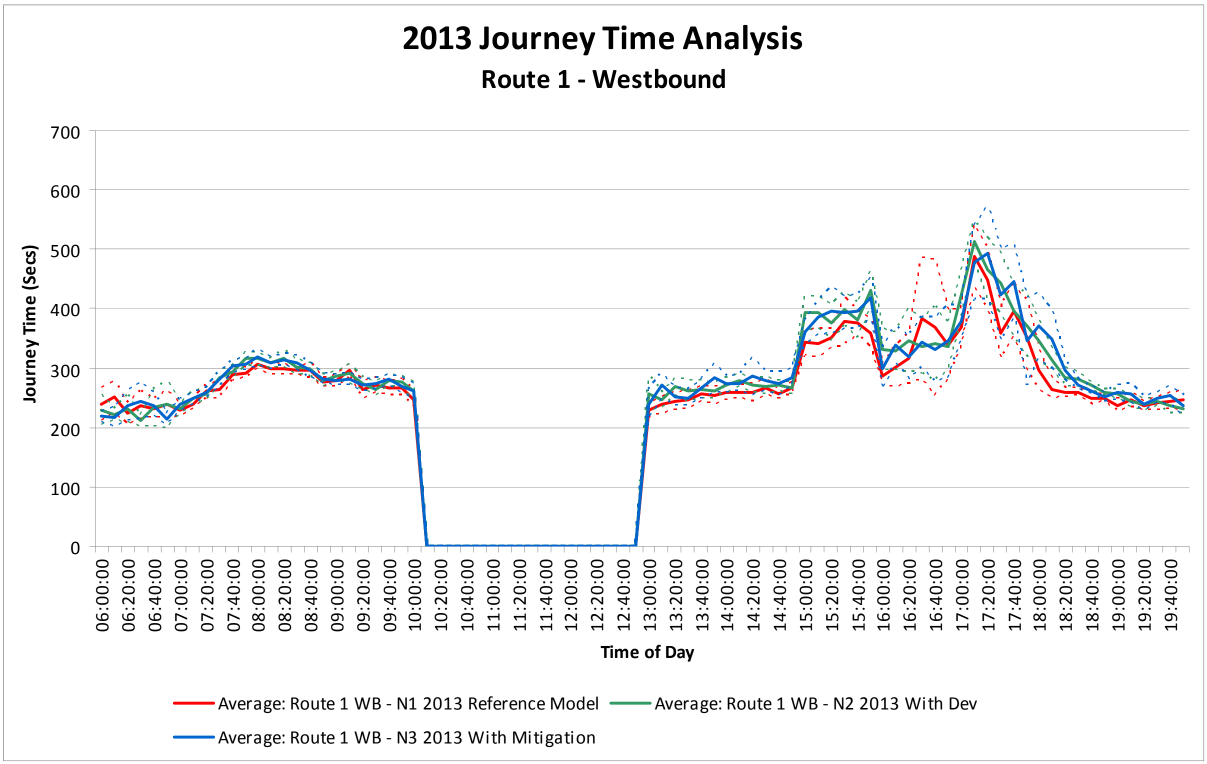


Plate 10.15: 2013 Journey Time Analysis: Route 1 – Westbound



10.9.100 On Routes 1 and 6 in both directions there are no statistically significant differences in journey times between the with HPC traffic plus mitigation scenario and the Reference Case. In all cases the confidence limits of the two scenarios overlap.

10.9.101 In overall terms the significance of the impact on driver delay is considered **minor adverse.**

v. Accidents and Safety

10.9.102 The accident and safety analysis in 2013 is very similar to that in 2016. The main difference would be in Cannington. Whilst the increases in flow are substantial, as noted above the improvement package is designed to control traffic and improve pedestrian amenity and safety. Therefore the significance of the safety impact is considered **minor adverse**.

c) 2021

10.9.103 In 2021 there would be a full complement of operational staff on site (900 personnel with a maximum of 810 on site on any one day). However, in addition there would still be some construction activity on the HPC development site (associated with the spent fuel store) and some of the associated development sites would potentially be being decommissioned. However, construction activity on the HPC development site would be modest compared with 2016. The Junction 24 park and ride and freight management facility would be operational in 2021 as would Cannington park and ride.

10.9.104 The results of the modelling are shown in the tables below. More detailed information is included in the **Transport Assessment**.

Table 10.20: 2021 Reference Case vs. 2021 With Development and Mitigation Daily (24 Hour AADT) 2 way All Vehicles Traffic Flows

Link	Link Ref.	2021 Ref Case	2021 With Dev	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	8,483	8,874	391	4.6%
M5 Junction 23 southbound off-slip	V2	8,118	8,481	363	4.5%
M5 Junction 23 northbound off-slip	V3	5,250	4,729	-521	-9.9%
M5 Junction 23 southbound on-slip	V4	5,362	4,759	-603	-11.2%
A39 spur east of Dunball	B	21,993	21,878	-115	-0.5%
A39 east of J23	L	16,061	14,224	-1,837	-11.4%
A38 north of Dunball	A	10,765	10,782	17	0.2%
A38 south of Dunball	G	24,864	25,309	445	1.8%
A38 between Wylds Road and The Drove	E	16,008	15,494	-514	-3.2%
A38 between The Drove and Cross Rifles	F	18,783	18,636	-148	-0.8%
A38 between Cross Rifles and St. John Street	J	23,146	25,263	2,117	9.1%
A38 between St. John Street and Taunton Road	O2	21,226	23,036	1,810	8.5%
A39 (Bath Road) north-east of Cross Rifles	N3	18,265	19,967	1,702	9.3%
St. John Street	SN	12,439	12,055	-384	-3.1%
The Clink	SF	17,222	16,921	-301	-1.7%

Link	Link Ref.	2021 Ref Case	2021 With Dev	Increase (Numerical)	Increase (%)
Wylds Road	AD	11,533	12,485	953	8.3%
The Drove	ZE	7,889	7,534	-355	-4.5%
Western Way (west of Chilton Street)	AA	12,776	13,494	717	5.6%
B3339 Wembdon Hill	T1	1,518	1,362	-157	-10.3%
M5 J24 northbound on-slip	ST2	4,899	4,673	-227	-4.6%
M5 Junction 24 southbound off-slip	ST3	5,877	5,550	-328	-5.6%
M5 Junction 24 northbound off-slip	ST4	5,026	5,512	487	9.7%
M5 Junction 24 southbound on-slip	ST5	5,453	5,981	528	9.7%
A38 spur east of Huntworth	ST1	21,045	21,498	453	2.2%
A38 Taunton Road south of Showground	I2	24,123	25,028	905	3.8%
A38 Taunton Road (south of Broadway)	I1	27,338	28,598	1,260	4.6%
A39 Broadway	K5	22,805	22,767	-37	-0.2%
A39 west of Quantock roundabout	S	13,414	15,021	1,607	12.0%
A39 south-east of Cannington	R	14,928	16,377	1,450	9.7%
A39 south of Cannington	P	6,840	11,805	4,965	72.6%
A39 west of Cannington	Q	8,140	8,572	432	5.3%
High Street, Cannington	U	2,182	1,795	-387	-17.7%
Main Road, Cannington	ZD	8,521	5,032	-3,489	-40.9%
Rodway south of bypass	AC	6,832	2,880	-3,952	-57.8%
Rodway north of bypass	11	6,832	7,873	1,041	15.2%
Cannington bypass	Z1		5,765	5,765	
B3190	10	1,412	1,413	1	0.1%
Williton	2	6,150	6,161	11	0.2%

10.9.105 As can be seen the flow increases are considerably less than in 2016. For example, on Western Way the increase in daily flows is 717 vehicles (5.6%) compared with 1,845 vehicles (14.6%) in 2016.

Table 10.21: 2021 Reference Case vs. 2021 With Development and Mitigation 2 Way AM Network Peak All Vehicles Traffic Flows

Link	Link Ref.	2021 Ref Case	2021 With Dev	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	845	857	12	1.4%
M5 Junction 23 southbound off-slip	V2	837	844	7	0.9%
M5 Junction 23 northbound off-slip	V3	476	443	-33	-6.9%
M5 Junction 23 southbound on-slip	V4	673	679	6	0.9%
A39 spur east of Dunball	B	2,099	2,058	-41	-2.0%
A39 east of J23	L	1,451	1,292	-159	-11.0%
A38 north of Dunball	A	930	931	1	0.1%

Link	Link Ref.	2021 Ref Case	2021 With Dev	Increase (Numerical)	Increase (%)
A38 south of Dunball	G	2,213	2,205	-8	-0.4%
A38 between Wylds Road and The Drove	E	1,414	1,566	152	10.7%
A38 between The Drove and Cross Rifles	F	1,490	1,639	149	10.0%
A38 between Cross Rifles and St. John Street	J	1,665	2,006	341	20.5%
A38 between St. John Street and Taunton Road	O2	1,712	1,968	256	15.0%
A39 (Bath Road) north-east of Cross Rifles	N3	1,740	2,002	262	15.0%
St. John Street	SN	1,039	1,000	-39	-3.8%
The Clink	SF	1,253	1,275	22	1.8%
Wylds Road	AD	957	900	-58	-6.0%
The Drove	ZE	644	698	54	8.3%
Western Way (west of Chilton Street)	AA	1,235	1,302	67	5.4%
B3339 Wembdon Hill	T1	68	57	-11	-15.7%
M5 J24 northbound on-slip	ST2	418	402	-16	-3.7%
M5 Junction 24 southbound off-slip	ST3	462	518	55	12.0%
M5 Junction 24 northbound off-slip	ST4	490	556	66	13.4%
M5 Junction 24 southbound on-slip	ST5	531	558	27	5.1%
A38 spur east of Huntworth	ST1	1,914	2,029	115	6.0%
A38 Taunton Road south of Showground	I2	1,966	2,107	141	7.2%
A38 Taunton Road (south of Broadway)	I1	2,026	2,197	171	8.4%
A39 Broadway	K5	1,882	2,008	125	6.7%
A39 west of Quantock roundabout	S	1,323	1,504	181	13.7%
A39 south-east of Cannington	R	1,399	1,577	178	12.7%
A39 south of Cannington	P	626	1,054	428	68.4%
A39 west of Cannington	Q	745	802	57	7.7%
High Street, Cannington	U	209	200	-9	-4.5%
Main Road, Cannington	ZD	827	578	-249	-30.1%
Rodway south of bypass	AC	545	269	-276	-50.6%
Rodway north of bypass	11	545	770	226	41.4%
Cannington bypass	Z1		492	492	0%
B3190	10	97	97	0	-0.4%
Williton	2	485	485	0	0%

Table 10.22: 2021 Reference Case vs. 2021 With Development and Mitigation 2 Way PM Network Peak All Vehicles Traffic Flows

Link	Link Ref.	2021 Ref Case	2021 With Dev	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	728	771	42	5.8%
M5 Junction 23 southbound off-slip	V2	809	883	74	9.1%
M5 Junction 23 northbound off-slip	V3	546	528	-18	-3.2%
M5 Junction 23 southbound on-slip	V4	671	619	-52	-7.7%
A39 spur east of Dunball	B	2,026	2,100	74	3.7%
A39 east of J23	L	1,398	1,315	-83	-6.0%
A38 north of Dunball	A	837	840	3	0.4%
A38 south of Dunball	G	2,057	2,157	101	4.9%
A38 between Wylds Road and The Drove	E	1,270	1,378	109	8.5%
A38 between The Drove and Cross Rifles	F	1,353	1,376	23	1.7%
A38 between Cross Rifles and St. John Street	J	1,847	2,023	175	9.5%
A38 between St. John Street and Taunton Road	O2	1,725	1,818	92	5.4%
A39 (Bath Road) north-east of Cross Rifles	N3	1,686	1,833	146	8.7%
St. John Street	SN	1,106	908	-198	-17.9%
The Clink	SF	1,486	1,532	46	3.1%
Wylds Road	AD	977	1,063	86	8.8%
The Drove	ZE	674	720	46	6.8%
Western Way (west of Chilton Street)	AA	1,212	1,333	121	10.0%
B3339 Wembdon Hill	T1	76	64	-12	-15.8%
M5 J24 northbound on-slip	ST2	400	418	18	4.5%
M5 Junction 24 southbound off-slip	ST3	591	464	-127	-21.5%
M5 Junction 24 northbound off-slip	ST4	456	469	14	3.0%
M5 Junction 24 southbound on-slip	ST5	525	638	113	21.6%
A38 spur east of Huntworth	ST1	2,008	2,034	26	1.3%
A38 Taunton Road south of Showground	I2	2,076	2,078	2	0.1%
A38 Taunton Road (south of Broadway)	I1	2,143	2,181	38	1.8%
A39 Broadway	K5	1,995	2,011	16	0.8%
A39 west of Quantock roundabout	S	1,337	1,564	227	17.0%
A39 south-east of Cannington	R	1,405	1,627	222	15.8%
A39 south of Cannington	P	556	1,221	665	119.5%
A39 west of Cannington	Q	654	772	118	18.1%
High Street, Cannington	U	197	184	-13	-6.4%
Main Road, Cannington	ZD	895	449	-447	-49.9%

Link	Link Ref.	2021 Ref Case	2021 With Dev	Increase (Numerical)	Increase (%)
Rodway south of bypass	AC	735	281	-453	-61.7%
Rodway north of bypass	11	735	1,026	292	39.7%
Cannington bypass	Z1		746	746	0%
B3190	10	120	120	0	0.4%
Williton	2	474	474	0	0.0%

Table 10.23: 2021 Reference Case vs. 2021 With Development and Mitigation 2 Way Daily (24 Hour AADT) HGV + Bus Flows

Link	Link Ref.	2021 Ref Case	2021 With Dev	Increase (Numerical)	Increase (%)
M5 Junction 23 northbound on-slip	V1	1,108	1,215	107	9.7%
M5 Junction 23 southbound off-slip	V2	1,026	1,000	-26	-2.5%
M5 Junction 23 northbound off-slip	V3	492	436	-55	-11.3%
M5 Junction 23 southbound on-slip	V4	434	397	-37	-8.5%
A39 spur east of Dunball	B	2,421	2,563	142	5.8%
A39 east of J23	L	1,401	1,222	-179	-12.8%
A38 north of Dunball	A	761	684	-76	-10.1%
A38 south of Dunball	G	2,447	2,770	323	13.2%
A38 between Wylds Road and The Drove	E	1,098	1,390	293	26.6%
A38 between The Drove and Cross Rifles	F	951	1,114	163	17.1%
A38 between Cross Rifles and St. John Street	J	1,057	1,051	-6	-0.6%
A38 between St. John Street and Taunton Road	O2	971	970	-1	-0.1%
A39 (Bath Road) north-east of Cross Rifles	N3	657	833	176	26.7%
St. John Street	SN	434	374	-60	-13.9%
The Clink	SF	491	387	-104	-21.3%
Wylds Road	AD	484	604	119	24.6%
The Drove	ZE	331	427	96	29.0%
Western Way (west of Chilton Street)	AA	343	634	291	84.8%
B3339 Wembdon Hill	T1	48	29	-19	-39.6%
M5 J24 northbound on-slip	ST2	353	327	-26	-7.3%
M5 Junction 24 southbound off-slip	ST3	381	475	94	24.7%
M5 Junction 24 northbound off-slip	ST4	367	399	32	8.8%
M5 Junction 24 southbound on-slip	ST5	304	339	34	11.3%
A38 spur east of Huntworth	ST1	1,412	1,547	136	9.6%

Link	Link Ref.	2021 Ref Case	2021 With Dev	Increase (Numerical)	Increase (%)
A38 Taunton Road south of Showground	I2	1,066	1,116	50	4.7%
A38 Taunton Road (south of Broadway)	I1	1,258	1,294	37	2.9%
A39 Broadway	K5	515	679	164	31.8%
A39 west of Quantock roundabout	S	643	1,171	528	82.1%
A39 south-east of Cannington	R	691	1,202	511	74.0%
A39 south of Cannington	P	443	1,109	666	150.5%
A39 west of Cannington	Q	486	448	-38	-7.9%
High Street, Cannington	U	88	83	-4	-4.7%
Main Road, Cannington	ZD	266	136	-130	-49.0%
Rodway south of bypass	AC	218	106	-112	-51.5%
Rodway north of bypass	11	218	773	555	254.6%
Cannington bypass	Z1		741		
B3190	10	269	270	1	0.2%
Williton	2	308	326	18	5.8%

i. Severance

10.9.106 Examining daily flows, there are no increases greater than 30% except on the A39 to the south of Cannington. The increase of 72.6% is moderate. However, the receptor is minor and so the significance of the impact is **minor adverse**.

10.9.107 In Cannington there is a reduction in flow on Main Road of 3,489 vehicles per day and on Rodway south of bypass of 3,952 vehicles per day. The reductions are classified as minor and the receptors as substantial leading to a significance of **moderate beneficial.** However, it is considered this may undervalue the relief provided to these roads by the bypass. Furthermore, it may be possible to introduce further traffic calming within Cannington once the bypass is complete including reducing the speed limit to 20mph. This would encourage more traffic to use the bypass and therefore further reduce the flows through the village.

10.9.108 In terms of HGV’s and buses, the only link in Bridgwater that experiences an increase in daily flows of between 30% and 60% is A39 Broadway. This is a minor magnitude of impact on a moderate sensitivity receptor and therefore the significance of the impact is **minor adverse**.

10.9.109 The following have a magnitude of impact of between 60-90% which is considered moderate:

- Western Way (west of Chilton Street).
- A39 west of Quantock Road.
- A39 south-east of Cannington.

10.9.110 The A39 south-east of Cannington, Western Way and the A39 west of Quantock Road are all judged as minor or moderate receptors and therefore the significance of the impact is **moderate adverse.**

10.9.111 For Western Way the total of the HGV plus bus increase is 291 vehicles per day which compares with an increase of 710 vehicles per day in 2016. Whilst the increase in HGV flows is less than in 2016, the impact is still considered to be **moderate adverse**.

10.9.112 For the A39 west of Quantock roundabout the increase in HGVs and buses is 528 vehicles which compares with 1145 in 2016. Again, whilst the increase is less than in 2016, the impact is still considered to be **moderate adverse**

10.9.113 The following have a magnitude of impact of greater than 90% which is considered substantial and arises from the consideration that these links are on the HGV/bus routes to the site:

- A39 south of Cannington.
- Rodway north of bypass.

10.9.114 The A39 south of Cannington and Rodway north of the bypass are judged as minor receptors and therefore the significance of the impact is **moderate adverse**, as in 2016.

10.9.115 For the C182 to the north of the Combwich freight laydown facility there may still be additional HGVs travelling between the freight laydown facility and the HPC development site. In 2016 these have been estimated to be 300 per average day. In 2021 there are likely to be fewer movements. However even if they were maintained at 300 per day this would not affect the assessment of the impact as being **moderate adverse**

ii. Pedestrian Delay

10.9.116 The analysis in 2021 is similar to that in 2016 i.e. there are no links where the hourly flow is greater than 1400 vehicles per hour and which experience an increase in flow due to HPC of more than 30% Therefore, the effects on pedestrian delay are considered **negligible**.

10.9.117 On Cannington High Street, the traffic flows would reduce significantly due to the completion of the bypass. These changes would lead to a **moderate beneficial** impact on pedestrian delay.

iii. Pedestrian Amenity

10.9.118 Based on advice in the IEMA Guidelines, the change at which pedestrian amenity changes become material are a doubling or halving in the flow of all traffic or HGVs.

10.9.119 No links experience a general traffic flow increase of greater than 100% as a result of the HPC Project and therefore there is no material impact.

10.9.120 In terms of HGV's and buses there are no links that experience a daily flow increase of greater than 100% and where the sensitivity of the receptors are other than minor. The significance of the impacts are considered to be **negligible**.

10.9.121 In Cannington, whilst there is not a halving in traffic flows, the effects of the bypass in removing traffic are considered to be material and are judged to be **moderate beneficial.**

iv. Driver Delay

10.9.122 The average speeds through the assessment network improve in 2021 due to the highway improvements introduced. In the morning peak, the average speed increases from 22.5mph to 24.7mph. In the evening peak the average speed increases significantly from 18.7mph to 25.6mph. Over the whole of the modelled period the average speed increases from 26.9mph to 29.9mph.

10.9.123 The outputs from the journey time analysis are shown below.

Plate 10.16: 2021 Journey Time Analysis: Route 10 – Southbound

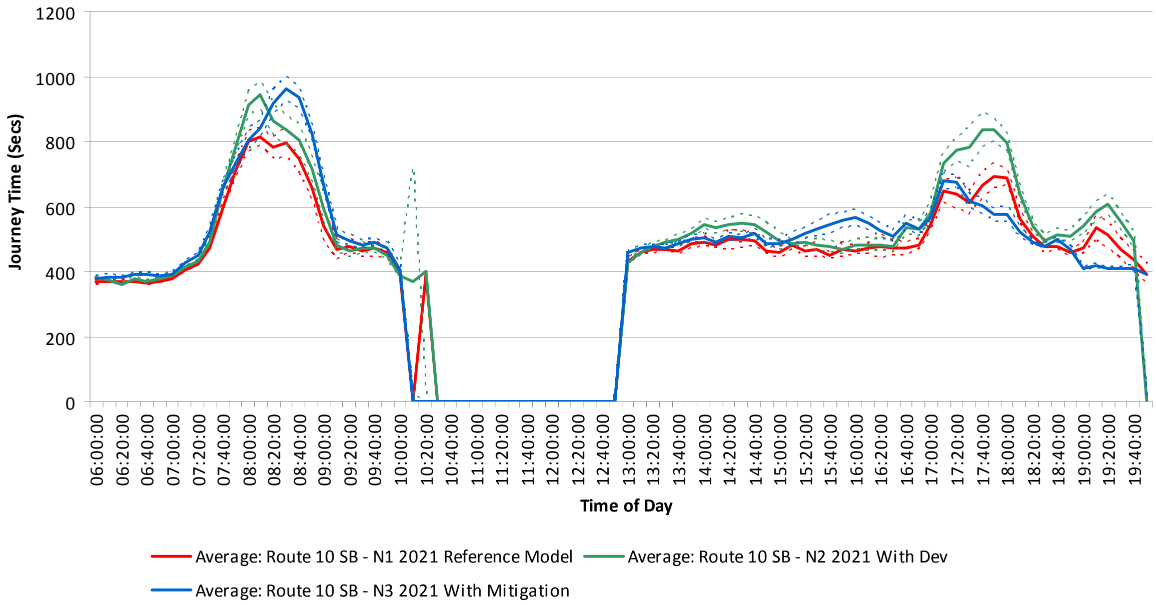
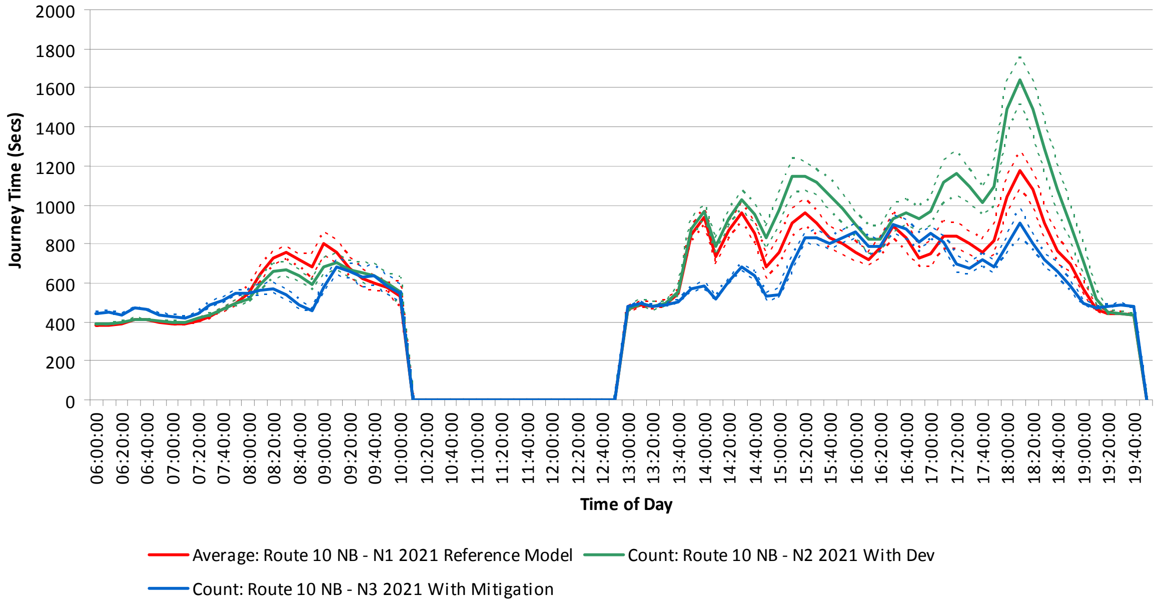


Plate 10.17: 2021 Journey Time Analysis: Route 10 – Northbound



10.9.124 As can be seen in the southbound direction on Route 10 there is a small increase in the journey time in the morning peak and a reduction in the evening peak.

10.9.125 In the northbound direction there are improvements in the morning and evening peaks.

Plate 10.18: 2021 Journey Time Analysis: Route 6 – Southbound

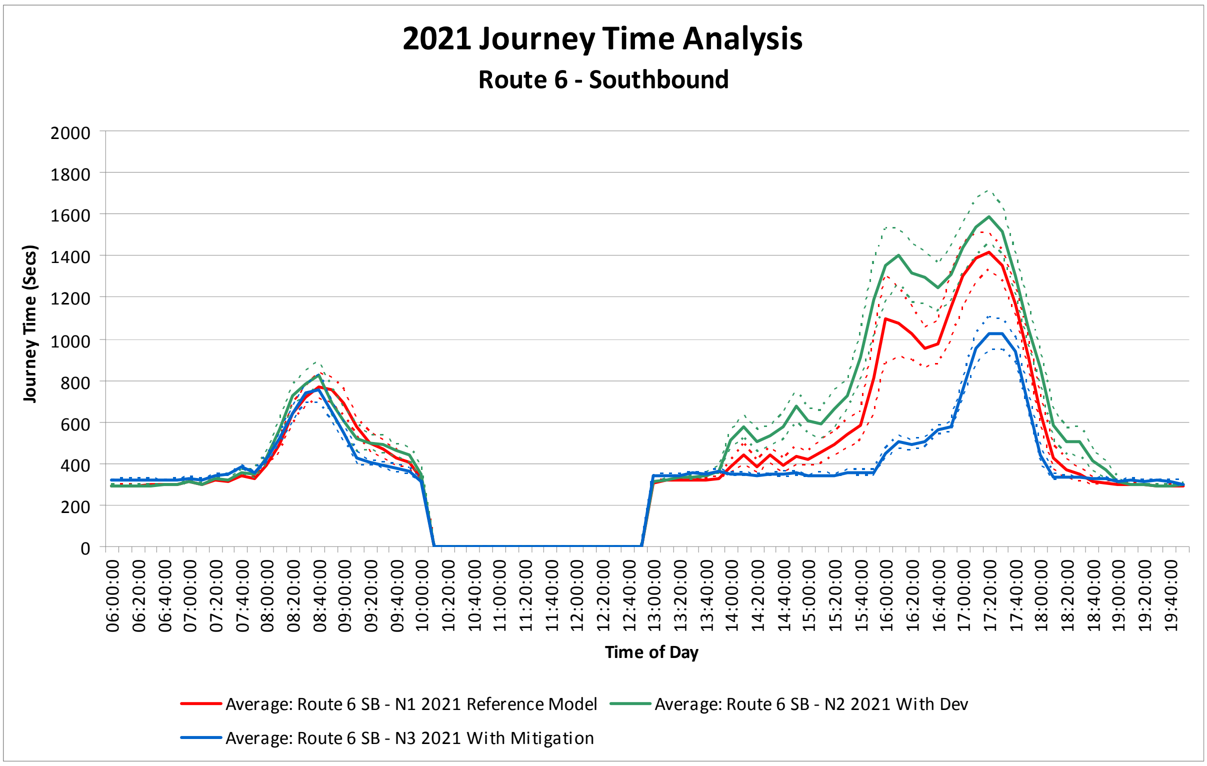


Plate 10.19: 2021 Journey Time Analysis: Route 6 – Northbound

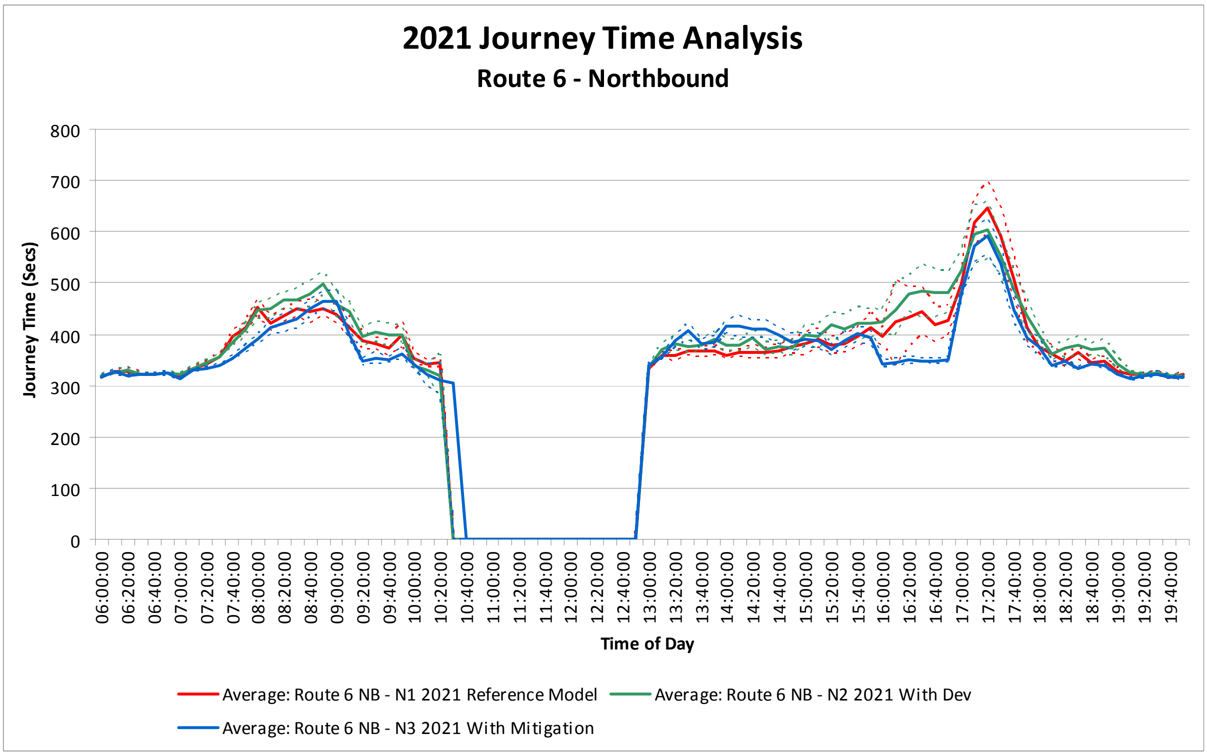


Plate 10.20: 2021 Journey Time Analysis: Route 1 – Eastbound

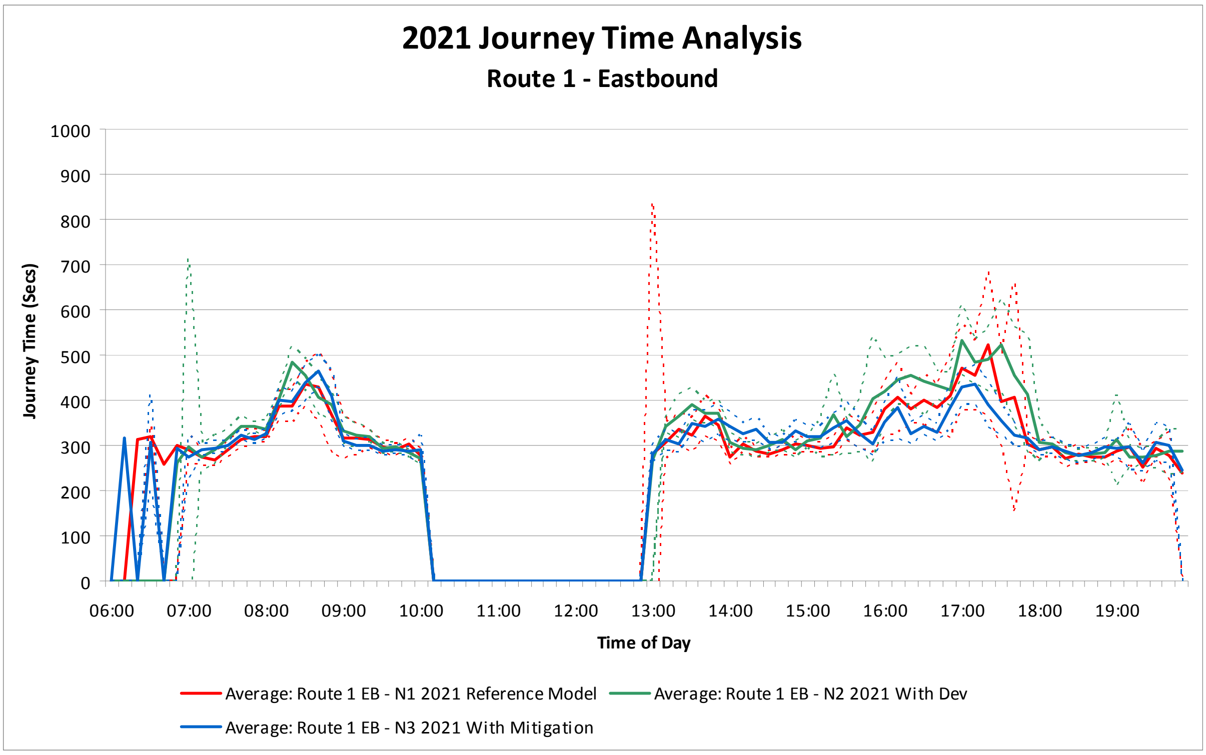
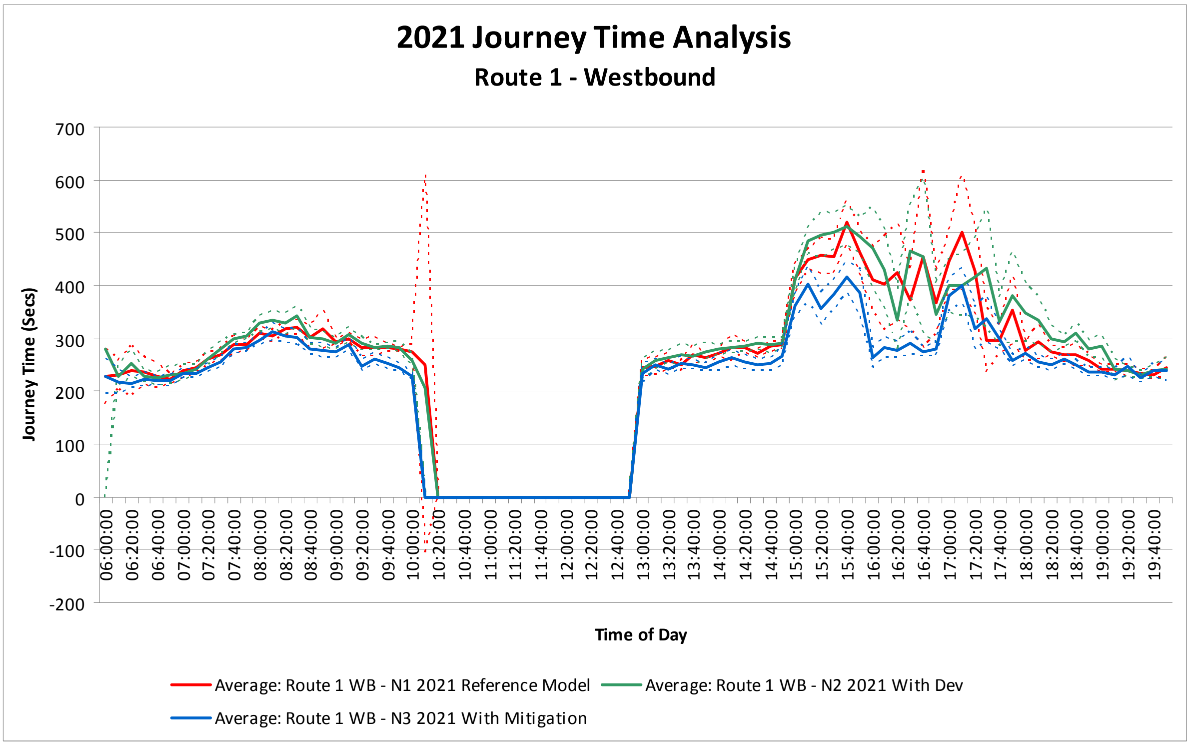


Plate 10.21: 2021 Journey Time Analysis: Route 1 – Westbound



10.9.126 On Route 6 southbound there is some improvement in the journey time around 09:00 with the HPC plus mitigation scenario compared with the Reference Case. In the evening peak there is a more significant improvement. In the northbound direction there is a small improvement around 08:00 and no change in the evening peak.

10.9.127 On Route 1 in the eastbound direction the comparison is neutral. In the westbound direction the comparison is neutral in the morning peak and there is a small improvement in journey time for the HPC plus mitigation scenario around 16:30.

10.9.128 Taking all the above into account and in particular the change in average speeds, there is judged to be a **moderate beneficial** effect on driver delay in 2021 as a result of the proposals.

v. Accidents and Safety

10.9.129 The accident and safety analysis in 2021 is very similar to that in 2016. The significance of the safety impact is considered **minor adverse**.

10.10 Mitigation of Impacts

10.10.1 As stated earlier in this chapter, the main part of the transport mitigation comprises the transport strategy and the highway improvements. These both form part of EDF Energy's application for development consent and have therefore been included in the "Assessment of Impacts".

10.10.2 In addition to the proposed highway improvements, EDF Energy propose to contribute to potential safety enhancements and pedestrian and cycle improvements within Bridgwater that Somerset County Council are progressing as part of their ongoing programme of improvements.

10.10.3 Junctions where potential safety improvements have been identified within the **Road Safety Strategy** are listed below. The junctions shown with an asterisk (*) are those where EDF Energy are promoting improvements as part of the application for development consent.

- A39
  - A39 Broadway/A38 Taunton Road*.
  - A39 Broadway/A372 St. John Street.
  - A39 North Street/Albert Street.
  - A39 North Street/West Street.
  - A39/A38 Dunball roundabout.
  - A39 Sandford Corner*.
- A38
  - A38 Bristol Road/A39 (Bath Road)/The Clink (Cross Rifles roundabout).
  - A38 Taunton Road/Rhode Lane.
  - The A38/M5 Junction 24 Huntworth roundabout*.
  - The A38 Taunton Road/Wills Road Junction.
- NDR
  - (Wylds Road/The Drove).

10.10.4 In addition, the effects of the construction of the HPC Project would be monitored throughout and if any unforeseen impacts are identified, EDF Energy would work with the authorities to mitigate their impact.

10.10.5 Whilst not strictly a mitigation, further traffic calming measures in Cannington could also be introduced which would encourage more traffic to use the bypass and thus increase the benefits in the centre of the village.

10.11 Residual Impacts

10.11.1 The additional mitigation measures identified above would further improve the safety in Bridgwater and the residual safety impact is therefore considered to be **negligible**. Similarly, the contribution towards pedestrian and cycle enhancements would improve pedestrian amenity. The impact is still considered to be **negligible.**

10.11.2 In Cannington it is considered that with additional traffic calming measures, the benefits of the bypass could become **substantial beneficial** in terms of Severance and Pedestrian Amenity

10.11.3 All other impacts remain as reported in the Assessment of Impacts section.

10.12 Summary of Impacts

10.12.1 A summary of the impacts and residual impacts for each of the three assessment years are provided in **Table 10.21**. When construction on the site is completed and there are just operational staff, it can be concluded that there would be no material adverse impact on the criteria considered within this chapter as a result of the operational phase of HPC. There would be substantial benefits in Cannington due to the introduction of the bypass and **moderate beneficial** impacts on journey times through Bridgwater.

10.12.2 **Table 10.24, Table 10.25** and **Table 10.26** below summarise the impact for each assessment year.

10.12.3 In Bridgwater, the tables demonstrate that for the key impacts of severance and pedestrian amenity, the residual impacts are generally **moderate adverse** since the roads affected are all A roads which already carry substantial volumes of traffic. The effect on pedestrian delay is considered **negligible** and most crossings of the A roads take place at controlled crossings. There are **negligible** changes to driver delay in 2016 and these become a **beneficial** effect in 2021. However, in 2013 there is a **minor adverse** impact on driver delay since it has been assumed in the analysis that not all of the highway improvement schemes are in place by Quarter 3 2013.

10.12.4 The impact on accidents is minor adverse but this becomes **negligible** when the funding from EDF Energy towards Somerset County Council's safety programme is taken into account.

10.12.5 In Cannington there are **substantial adverse** impacts in 2013 since the bypass would have not yet been completed and therefore construction traffic would be passing through the village. However, these impacts are for a limited period, prior to the bypass becoming operational in Quarter 4 2014. Once the bypass is operational then Cannington enjoys the benefits of significantly less traffic. These benefits are judged to be **moderate beneficial** rising to **substantial beneficial** if additional traffic calming is introduced in the village since more traffic would be diverted to the bypass.

10.12.6 When construction on the site is completed and there are just operational staff, it can be concluded that there would be no material adverse impact on the criteria considered within this chapter as a result of the operational phase of HPC. There would be **substantial benefits** in Cannington due to the introduction of the bypass and **moderate beneficial impacts** on journey times through Bridgwater.

10.12.7 In some instances the assessment for Cannington is different to that for Bridgwater. In such instances the Cannington assessment is shown in *italics* in the tables below.

Table 10.24: Summary of Impacts 2016

Description of Impact	Impact	Mitigation Measure	Residual Impact
Severance	Moderate Adverse *Moderate Beneficial*	Additional Traffic calming in Cannington	Moderate Adverse *Substantial Beneficial*
Driver Delay	Negligible	N/A	Negligible
Pedestrian Delay	Negligible *Moderate Beneficial*	N/A	Negligible *Moderate Beneficial*
Pedestrian Amenity	Moderate Adverse *Moderate Beneficial*	Contribution to SCC programme. Additional traffic calming in Cannington	Moderate Adverse *Substantial Beneficial*
Accidents and Safety	Minor Adverse	Contribution to SCC programme	Negligible

Table 10.25: Summary of Impacts 2013

Description of Impact	Impact	Mitigation Measure	Residual Impact
Severance	Moderate Adverse *Substantial Adverse*	N/A	Moderate Adverse *Substantial Adverse*
Driver Delay	Minor Adverse	N/A	Minor Adverse
Pedestrian Delay	Negligible	N/A	Negligible
Pedestrian Amenity	Moderate Adverse	Contribution to SCC programme.	Moderate Adverse
Accidents and Safety	Minor Adverse	Contribution to SCC programme	Negligible

Table 10.26: Summary of Impacts 2021

Description of Impact	Impact	Mitigation Measure	Residual Impact
Severance	Moderate Adverse *Moderate Beneficial*	Additional traffic calming in Cannington	Moderate Adverse *Substantial Beneficial*
Driver Delay	Moderate Beneficial	N/A	Moderate Beneficial
Pedestrian Delay	Negligible *Moderate Beneficial*	N/A	Negligible *Moderate Beneficial*
Pedestrian Amenity	Negligible *Moderate Beneficial*	Contribution to SCC programme. Additional traffic calming in Cannington	Negligible *Substantial Beneficial*
Accidents and Safety	Minor Adverse	Contribution to SCC programme	Negligible

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CHAPTER 11: NOISE AND VIBRATION

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11. NOISE AND VIBRATION

11.1 Introduction

11.1.1 This chapter of the Environmental Statement (ES) assesses the potential noise and vibration impacts associated with the construction and operation of Hinkley Point C (HPC) on human receptors. Potential noise and vibration impacts on marine and terrestrial ecological receptors are addressed in **Chapters 19** and **20** of this volume respectively. Detailed descriptions of the site, proposed development, construction and operational phases are provided in **Chapters 1** to **5** of this volume of the ES.

11.1.2 Potential sources of noise during the construction and operation of HPC include the following:

- site preparation and ground terracing activities (preliminary works);
- construction and operation of the temporary jetty (preliminary works);
- construction operations including the movement and operation of a wide range of mobile or stationary construction plant equipment, and specifically with regard to ground compaction, piling activities or blasting;
- on-site vehicular movements;
- off-site transport movements, including construction workforce and freight movements;
- operation of HPC; and
- off-site operational transport movements.

11.2 Scope and Objectives of Assessment

11.2.1 The scope of the assessment has been determined through a formal Environmental Impact Assessment (EIA) scoping process undertaken with the Infrastructure Planning Commission (IPC). It has also been informed by ongoing consultation with statutory consultees including Sedgemoor District Council (SDC), West Somerset Council (WSC), Somerset County Council (SCC), the local community and the general public in response to the formal pre-application consultation process.

11.2.2 The assessment of noise and vibration impacts has been undertaken adopting the methodologies described in **Volume 1**, **Chapter 7** and Section 11.4 below. This section is complemented by a baseline noise survey report, henceforth referred to as the 'Factual Noise Report' (see **Appendix 11A**), and a baseline and blasting trial vibration survey report, henceforth referred to as the 'Trial Blast Noise and Vibration Report' (see **Appendix 11B**). The Factual Noise Report includes details of background noise monitoring completed at representative receptor locations in the vicinity of the HPC development site as well as additional locations that could be affected during the development construction.

11.2.3 Noise and vibration impacts are presented in Section 11.6, and appropriate mitigation measures aimed at preventing, reducing or off-setting any potential adverse impacts that are identified to be of significance are identified in Section 11.7. An assessment of residual impacts following implementation of these mitigation measures is presented in Section 11.8.

11.2.4 **Volume 1**, **Chapter 7** of this ES refers to the methodology used to assess cumulative impacts. Additive and interactive effects between impacts generated within the site boundary and study area are assessed within this chapter. Construction and operational traffic noise impacts, as assessed in this chapter, considers all affected highways, for which the base scenarios include traffic generated by consented future developments. Cumulative impacts that consider on-site construction and operational activities associated with proposed HPC developments and proposed or reasonably foreseeable non-HPC developments are considered in **Volume 11** of this ES.

11.2.5 The objectives underlying the noise and vibration assessment were to:

- predict the noise and vibration generation and propagation during the site preparation, construction and operation of the temporary jetty, and construction of two UK EPR units (C1 and C2) and ancillary buildings;
- predict the potential noise impacts associated with road traffic at key stages of the construction phase; and
- predict, by computational modelling, noise propagation from the main components of HPC during the operational phase

11.2.6 It is unlikely that the construction and operation of the development will lead to immediate ‘acute’ noise or vibration effects, (i.e. hearing damage), as these are generally confined to work places with very high levels of noise and vibration. What effects there may be, will generally be associated with disturbance to living conditions and amenity value, either due to short-term (a few months) to long-term (greater than five years), temporary activities or permanent operational sources.

11.2.7 Noise impacts associated with helicopters travelling to and from the proposed helipad are not expected to be significant due to the infrequency of occurrence. It is expected that no more than three helicopter visits per year would occur, and these will be scheduled during weekday periods only. Whilst these fly-over, landing and take-off events are likely to be audible at residential receptors in neighbouring villages and hamlets, the impacts would be no more significant than the existing and historic situation associated with visits to the Hinkley Point A and B sites. Furthermore, naval and coastguard helicopter movements within the Bristol Channel area are relatively commonplace. No further detailed assessment of helicopter noise impacts has therefore been undertaken.

11.3 Legislation, Policy and Guidance

11.3.1 This section identifies and describes legislation, policy and guidance of relevance to the assessment of potential noise impacts associated with the construction, operation and post-operational phases of the proposed development.

11.3.2 As stated in **Volume 1**, **Chapter 4**, the Overarching National Policy Statement for Energy (NPS EN-1) when combined with the NPS for Nuclear Power Generation (NPS EN-6) provides the primary basis for decisions by the IPC on applications for nuclear power generation developments that fall within the scope of the NPSs.

11.3.3 Notwithstanding this, the IPC may consider other matters that are both important and relevant to its decision-making. This could include Planning Policy Statements (PPSs), Planning Policy Guidance Notes (PPGs), regional and local policy documents, although, if there is a conflict between these and the NPS, the NPS prevails for the purposes of IPC decision making.

11.3.4 Further, the Planning Act 2008 provides that the IPC must, in making its decision on an application, have regard to any Local Impact Report (LIR) prepared by relevant local authorities. It is anticipated that the LIRs will rely in part on PPSs, PPGs, regional and local policy to provide a context for their assessment. On this basis, regard has been given to these documents (where relevant to the technical assessment) since they are likely to inform the LIRs prepared by the relevant local authorities.

a) International

i. World Health Organization ‘Guidelines for Community Noise’ (WHO,1999)

11.3.5 The WHO ‘Guidelines for Community Noise’ (Ref. 11.1) provides health-based guidance on suitable noise levels in the form of ‘guideline values’, intended to avoid or minimise community annoyance by noise. Guidance is provided on noise levels for both indoor and outdoor areas.

11.3.6 **Table 4.1** of the WHO document recommends environmental daytime and evening limits of 55dB L_{Aeq} or less over the 16-hour daytime period (07:00-23:00) to avoid minimal serious annoyance, and 50dB L_{Aeq} *“to avoid minimal moderate annoyance”.*

11.3.7 However, it is important to note that the WHO recommendations represent the onset of health effects such as annoyance and sleep disturbance from such noise exposure, and that exposure in excess of these is not necessarily indicative of significant adverse impacts.

ii. World Health Organization ‘Night Noise Guidelines for Europe’ (WHO, 2009)

11.3.8 The ‘Night Noise Guidelines for Europe’ (Ref. 11.2) is again concerned with the potential health effects of environmental night noise, based on a review of available research by a working group of experts.

11.3.9 It recommends a target of 40dB $L_{night,outside}$ ‘at a residential façade (incident noise level) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly’. The $L_{night,outside}$ indicator relates to the annual average night-time noise level and takes account of the varying need to open windows at night throughout the year. An interim target of 55dB $L_{night,outside}$ was also recommended for countries where the 40dB $L_{night,outside}$ guideline is not achievable.

11.3.10 The night noise guidelines assume a sound insulation of 21dB for an average building envelope, allowing for those that wish to sleep with windows slightly open, and acknowledges that if noise levels increase, people may close their windows.

11.3.11 The guidelines provided indicate, from available research, the levels above which an effect starts to occur or shows itself to be dependent on the exposure level. However, these observed effect thresholds do not establish the significance of effects, which may not become significant until much higher degrees of noise exposure.

11.3.12 A 'National Noise Incidence Study' (Ref. 11.3) in 2000 identified through an ambient noise monitoring survey at 1160 locations that 95% of the properties in the UK exceeded the 40dB $L_{night,outside}$ level.

b) National

i. Noise Policy Statement for England (NPSE) 2010

11.3.13 The Noise Policy Statement for England (NPSE) (Ref. 11.4), published in March 2010, sets out the long-term aims of Government noise policy. The Noise Policy Aims, as presented within this document, are:

> *"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*
>
> - *avoid significant adverse effects on health and quality of life;*
> - *mitigate and minimise adverse effects on health and quality of life; and*
> - *where possible, contribute to the improvement of health and quality of life."*

11.3.14 The NPSE draws on two established concepts from toxicology that are currently being applied to noise effects, for example, by the World Health Organisation, namely NOEL – No Observed Effect Level and LOAEL – Lowest Observed Adverse Effect Level. The NPSE extends these concepts and introduces the concept of a Significant Observed Adverse Effect Level (SOAEL). This is the level above which significant adverse effects on health and quality of life are understood to occur.

11.3.15 The second aim of the NPSE refers to the situation where the effect lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (Paragraph 1.8 of the NPSE). This does not mean that such adverse effects cannot occur.

11.3.16 The third aim seeks, where possible, positively to improve health and quality of life through the pro-active management of noise while also taking into account the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.

ii. The Control of Pollution Act, 1974 (COPA)

11.3.17 Section 60 of the Control of Pollution Act, 1974 (Ref. 11.5) provides powers to local authority officers to serve an abatement notice in respect of noise nuisance from construction works, whilst Section 61 provides a method by which a contractor can avoid such action by applying for a consent to conduct construction activities in advance of their occurrence (a 'prior consent'). The prior consent is drawn up between the local authority and the contractor and may contain a range of agreed working conditions designed to minimise or prevent the occurrence of noise nuisance from construction activities. Application for Section 61 'prior consent' is a commonly used mitigation technique in respect of potential noise and vibration impacts from major construction works.

iii. Planning Policy Guidance 24: Planning and Noise (PPG 24) (1994)

11.3.18 PPG24 (Ref. 11.6) was introduced by the Department of the Environment (now the Department for Communities and Local Government) in 1994. Paragraph 1 on Page 1 of PPG 24 indicates that it was issued to:

> *"…provide advice on how the planning system can be used to minimise the adverse impact of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business. It outlines some of the main considerations which local planning authorities should take into account in drawing up development plan policies and when determining planning applications for development which will either generate noise or be exposed to existing noise sources".*

11.3.19 For new developments that will introduce noise into an area, PPG24 confirms (in Annex 3) that it is appropriate to use previously established assessment methodologies. Further guidance is given in relation to 'Noise from road traffic' (Annex 3, Paragraph 1), 'Noise from industrial and commercial developments' (Annex 3, Paragraphs 19-20) and 'Noise from construction sites' (Annex 3, Paragraph 21). The appropriate assessment methodologies are discussed in the relevant sections below.

c) Regional

11.3.20 The Government's revocation of regional strategies was quashed in the High Court on 10 November 2010. However, on that same date the Government reiterated in a letter to Chief Planners its intention to revoke regional strategies through the Localism Bill. This letter was also challenged but, on 7 February 2011, the High Court held that the Government's advice to local authorities that the proposed revocation of regional strategies was to be regarded as a material consideration in their planning development control decisions should stand. The decision of the High Court was upheld by the Court of Appeal on 27 May 2011. Therefore, the regional strategies remain in place but in the case of development control decisions it is for planning decision makers to decide on the weight to attach to the strategies (see **Volume 1, Chapter 4** for a full summary of the position regarding the status of regional planning policy).

i. Regional Planning Guidance 10 for the South +West 2001-2016 (RPG10) (2001)

11.3.21 RPG 10 (Ref. 11.7) sets out the broad development strategy for the period to 2016 and beyond. With specific reference to noise, RPG10 calls for Local Authorities and others to improve the local environment by reducing incidents of noise pollution (Paragraph 4.23) and reduce the impact of transport on the environment (which in turn can increase the occurrence of noise) (Paragraph 8.5). There is no specific guidance or policies for assessing noise for new developments.

ii. Draft Revised Regional Spatial Strategy (RSS) for the South West Incorporating the Secretary of State's Proposed Changes for Public Consultation (July 2008) (Ref. 11.8)

11.3.22 There are no specific policies relating to noise within the draft RSS.

iii. Somerset & Exmoor National Park Joint Structure Plan Review 1991-2011 (2000) (Policies 'saved' from 27 September 2007) (Ref. 11.9)

11.3.23 **Chapter 7** deals with transport and identifies noise as an occurrence of greater mobility (Paragraph 7.1). There are no specific policies relating to noise within the Structure Plan.

d) Local

i. West Somerset Local Plan (2006) (Policies 'saved' from 17 April 2009)

11.3.24 The West Somerset Local Plan forms part of the Development Plan for West Somerset. The Local Plan (Ref. 11.10) was adopted in April 2006 (with relevant policies 'saved' from 17 April 2009). The Proposals Map indicates that the site is not subject to any specific noise designations. The site lies outside of the defined Development Boundary.

11.3.25 The following saved policy is considered to be potentially relevant:

11.3.26 Policy PC/2 (Noise Pollution) states:

11.3.27 "Proposals for developments involving potential noise nuisance to existing occupiers of land or buildings will only be permitted when measures to minimise the impact of noise likely to be generated are incorporated as part of the development."

ii. West Somerset District Local Development Framework (LDF) Core Strategy (Options Paper) (January 2010)

11.3.28 The Core Strategy is at a preliminary stage of preparation and the Options Paper does not include any specific policies relating to environmental noise.

e) Supplementary Planning Guidance

11.3.29 Sedgemoor District Council and West Somerset Council have jointly prepared draft supplementary planning guidance in relation to the HPC Project. Public consultation on the Consultation Draft version of the Hinkley Point C Project Supplementary Planning Document (the draft HPC SPD) commenced on 1 March 2011 and concluded on 12 April 2011. EDF Energy has submitted representations which object to the draft HPC SPD. See **Volume 1**, **Chapter 4** for a full summary of the position regarding the status of the draft HPC SPD.

11.3.30 With regards to the approach to Main Site accommodation campus, Box 20 in the draft HPC SPD states that impacts on neighbouring residents of Shurton and Burton should be avoided, including noise (Page 38).

i. Sedgemoor District Local Plan 1991-2011 (2004) (Policies 'saved' from 27 September 2007)

11.3.31 The Sedgemoor District Local Plan forms part of the Development Plan for Sedgemoor. The Local Plan was adopted in September 2004 (with relevant policies 'saved' from 27 September 2007). The Proposals Map (Southern Sheet and Inset Map No. 20) indicates that the site is not subject to any specific noise designations. The site lies outside of the defined Development Boundary.

11.3.32 The following saved policy is considered to be potentially relevant:

11.3.33 Policy PCS15 (Noise Pollution) states:

"Noise generating development will not be permitted if it would:

(a) be liable to unacceptably increase the level or disruptive character of noise experienced in any area to the detriment of its character; or

(b) be liable to unacceptably increase the noise experienced by the users of existing or proposed noise sensitive development to the detriment of those users.

Noise sensitive development will not be permitted if its users will be unacceptably affected by noise generating uses."

ii. Sedgemoor District Council Local Development Framework (LDF) Core Strategy (Proposed Submission) (September 2010)

11.3.34 The Sedgemoor LDF Core Strategy (Proposed Submission) was consulted on from September to November 2010. Changes prior to submission proposed as a result of the consultation process were reported and endorsed by the Council's Executive Committee on 9 February 2011. The Core Strategy (Proposed Submission) was submitted to the Secretary of State on 3 March 2011 and an Examination in Public (EiP) was held in May 2011. Once adopted, the Core Strategy will form part of the Development Plan for Sedgemoor.

11.3.35 EDF Energy submitted representations objecting to the Core Strategy (Proposed Submission), relating to Chapter 4 'Major Infrastructure Projects' (and policies MIP1, MIP2 and MIP3 contained in that chapter) and those sections relating to housing and Hinkley Point. EDF Energy also participated at the relevant EiP hearings. See **Volume 1**, **Chapter 4** for a full summary of the position regarding the status of the Core Strategy.

11.3.36 The following Core Strategy (Proposed Submission) policies are of potential relevance:

11.3.37 Policy D4 deals (Renewable and Low Carbon Energy Generation) states that the Council will support such proposals provided that such installations would not have significant adverse impact taking into account, amongst other things, any unreasonable adverse impact on users and residents of the local area including the generation of noise.

11.3.38 Policy D9 (Sustainable Transport and Movement) states that proposals should contribute to reducing adverse environmental issues, including noise pollution and vibration.

11.3.39 Policy D10 (Managing the Transport Impacts of Development) states that development proposals that will have a significant transport impact should be supported by an appropriate Noise and Vibration Assessment.

11.3.40 Policy D16 (Pollution Impacts of Development and Protecting Residential Amenity) states:

> *"Development proposals that are likely to result in levels of air, noise, light or water pollution (including groundwater) vibration or soil contamination that would be harmful to other land uses, human health, tranquillity or the built and natural environment will not be supported.*
>
> *Where there are reasonable grounds to suggest that a development proposal may result in a significant adverse environmental impact, the Council will require planning applications to be supported by assessments relating to (amongst other things):*
>
> - *Noise pollution and/or vibration...*
>
> *Where it is demonstrated that it is possible to manage the potential adverse impacts of the development proposals through its design or mitigation measures, the Council will, by means of condition or legal agreement, seek to ensure such measures are effective, for example improving limitations on matters including hours of operation, emissions of fumes, noise and light, parking and servicing for both construction and operational stages…*
>
> *Development proposals that would result in the loss of land of recreational and/or amenity value or unacceptably impact upon the residential amenity of occupants of nearby dwellings and any potential future occupants will not be supported. Particular consideration will be given to the extent that the proposal could result in unacceptable noise and disturbance, overshadowing, overlooking and/or visual dominance."*

11.4 Methodology

a) Noise and Vibration Principles

11.4.1 The noise and vibration principles which have formed the basis of this noise and vibration impact assessment are detailed in **Appendix 11C**.

b) Study Area

11.4.2 The study area, including the location of sensitive receptors in the locality of the HPC Development which has been considered for the assessment construction and operational phases of HPC is illustrated in **Figure 11.1**. The purpose of the assessment was to determine the potential worst-case impacts associated with the proposed development. Therefore, it is reasonable to assume that the nearest (unscreened) receptor locations to the proposed development are those likely to experience the greatest noise and vibration impacts.

11.4.3 For the assessment of the off-site highway improvements schemes, the working areas within the site boundary, together with a study area of 600m around them were considered. As above, the purpose of the assessment was to determine the potential worst-case impacts associated with the proposed highway improvements. In general this was represented by assessments of potential noise and vibration impacts at the nearest residential dwelling or any sites of amenity value.

11.4.4 The study area assessed for impacts resulting from the movement of construction (including HGVs and buses) and operational traffic considers the designated public highway routes (see **Chapter 10** of this volume). In addition, other public roads included in the traffic forecast model were included for completeness.

c) Baseline Noise Monitoring

11.4.5 A combination of short-term attended and unattended environmental noise measurements were undertaken at the following locations:

- North of the HPC development site on the site boundary adjacent to the coastal path to assist the determination of potential impacts to this public amenity;
- Knighton Farm approximately 450m to the south-west of the HPC development site for the assessment of potential impacts from predicted noise levels to residents in Knighton and Burton;
- Doggetts approximately 30m to the south-east of the HPC development site for the assessment of potential impacts from predicted noise levels to residents in Shurton;
- Wick House approximately 810m to the east of the HPC development site for the assessment of potential impacts from predicted noise levels to residents in Wick;
- South of the HPC development site on the site boundary, approximately 180m north of the nearest residential receptor location (Bishops Farm House) for the assessment of potential impacts from predicted noise levels to residents in Shurton; and

- Hinkley Point Power Station Visitor Centre at the HPC development site eastern boundary to assist the determination of potential impacts to public amenity at Pixies Mound.

11.4.6 Further details on the monitoring programme and details of the microphone positions, as well as a commentary of the significant noise sources at each location are provided in the Factual Noise Report provided in **Appendix 11A**.

d) Consultation

11.4.7 Consultations have been undertaken with Environmental Health Officers (EHOs) of West Somerset Council (WSC) and Sedgemoor District Council (SDC). A scoping consultation meeting with both parties was held in December 2008. During this meeting the specific requirements for the assessment of noise impacts were discussed. This included agreements regarding the choice of noise sensitive reference positions to be used for determining noise impacts at residential and public amenity locations closest to the proposed HPC development site.

11.4.8 A second consultation meeting was held with WSC and SDC in October 2009. At this meeting, the progress of the impact assessment was described and a presentation of a summary of the baseline noise monitoring survey was given. The proposed construction noise limits as detailed in **Table 11.2** were presented to the consultees, as well as the proposed operational noise threshold (amended since this meeting). The methodology and scenario assumptions for the operational noise prediction modelling for the HPC development (presented in detail in **Appendix 11F**) were also discussed.

11.4.9 Following the second consultation meeting, WSC and SDC requested further clarification on the derivation of the proposed noise threshold values for the construction and operational phases of HPC. This further detail was provided in March 2010 (see **Appendix 11G**).

11.4.10 The following advice and direction was provided by WSC and SDC, which has been taken into account within this assessment:

- baseline noise survey scope and methodology were agreed (refer to Factual Noise Report in **Appendix 11A**);
- impacts of plant noise during the operational phase should be assessed in accordance with BS 4142:1997, with a target criterion of 5dB above the prevailing background not to be exceeded; and
- due to the large separation distance, vibration due to construction and operation was considered by the consultees to be unlikely to significantly affect the nearest residential locations. It was agreed that a baseline vibration assessment was not required.

11.4.11 In February 2011, a third consultation meeting was held with WSC and SDC. The purpose of this meeting was to:

- present additional work undertaken since Stage 2 Consultation;
- set out the scope of further work to be undertaken;
- identify consultation undertaken to date;
- review consultation comments received at Stage 2 Consultation and how these had been, or were intended to be addressed; and
- review proposed mitigation measures, and management and monitoring procedures.

11.4.12 At this meeting, the rationale for the proposed change to the operational noise limit from 43dB $L_{Aeq,T}$ as presented at the Stage 2 Consultation to a limit of 38dB $L_{Aeq,T}$ (façade) was discussed. It was also confirmed that the limit value should represent the 'Rating Level', in accordance with BS4142 (Ref. 11.23), and therefore a +5dB penalty should be applied to the predicted noise level if such noise emission from the operational nuclear power station comprises distinct acoustic features.

11.4.13 The methodology for the determination of the effects of varying wind conditions on noise propagation within the model was also discussed. This methodology was changed from the CONCAWE methodology to the method within ISO 9613-2 (see **Appendix 11F**). A technical note was provided to SDC and WSC accompanying the minutes to the meeting outlining this change as well as a summary of the significant changes to the operational noise model since the Stage 2 Consultation (see **Appendix 11H**).

11.4.14 A noise impact assessment for the HPC development was included within the submitted Stage 2 Consultation documentation. Following this, considered responses to the noise and vibration assessments were provided by the following consultees:

- WSC and SDC;
- Somerset County Council (SCC);
- Stogursey Parish Council (SPC);
- The Environment Agency (EA);
- The Highways Agency (HA);
- Countryside Council for Wales (CCW);
- Fairfield Estate;
- North Petherton Town Council;
- Otterhampton Parish Council; and
- Stringston Parish Council.

11.4.15 Comments received have been reviewed and, where appropriate, additional clarification has been provided within this chapter. For further information, detailed responses to all comments are provided in the **Consultation Report**.

e) Assessment Methodology

i. Value and Sensitivity

11.4.16 With regard to noise and vibration effects, the standard impact assessment methodology, as set out in **Volume 1**, **Chapter 7**, is not readily applicable. This is largely due to the fact that noise and vibration effects are assessed in relation to quantitative noise level criteria and thresholds (see sections below). However, for the purposes of this assessment the overall sensitivity and value, relating to human beings living in proximity to either the HPC development site or affected highways, have been nominally rated.

11.4.17 The potential for noise disturbance has also been considered in outdoor public places, such as footpaths or historical features (such as 'Pixies Mound', south of the Hinkley Point A nuclear power station). **Table 11.1** below provides a summary of the sensitivity of receptors to predicted noise levels, used to determine the significance of potential noise and vibration impacts.

Table 11.1: Summary of Receptor Sensitivity

Receptor	Exposure	Sensitivity
Permanent		
Residents at Doggetts (private dwelling)	Continuous long-term	Medium
Residents of Shurton Village	Continuous long-term	Medium
Residents of Shells Cottages, Williton	Continuous, Short-term (highway improvements)	Medium
Schools (Brymore School)	Continuous long-term	High
Non-Permanent		
Users of footpaths and PRoWs (Casual walkers and hikers)	Transient short-term	Low
Visitors to Pixies Mound	Transient short-term	Low
Visitors to Tropiquaria Zoo and child play area	Transient short-term	Low
Visitors to places of worship/cemeteries	Transient short-term	Medium

11.4.18 Private residential properties are categorised as being of 'Medium' sensitivity, with 'High' sensitivity reserved for locations where very good communication and resting conditions are essential (schools, hospitals, care homes for the elderly or people with learning disabilities). This is based upon guidance provided by the WHO (Ref. 9.1). Outdoor public amenity receptor locations were categorised as 'Low' due to the transient presence of human receptors in these locations, and the options that such receptors would have available allowing them to select other locations at any given time.

11.4.19 The significance of identified impacts can therefore be related to the Impact Significance Matrix presented in **Volume 1**, **Chapter 7**, once the magnitude of each impact has been predicted in accordance with the relevant guidance methodologies described below.

ii. Magnitude

11.4.20 The magnitude of impact has been based on the consequences that the proposed development would have based upon predicted noise and vibration levels, and has been considered in terms of high, medium, low and very low. The magnitude criteria used in this assessment are detailed in the methodology sections below for each phase of the proposed development.

iii. Construction – Noise from On-Site Construction Activities

11.4.21 Construction site noise is assessed differently from noise from permanent installations, as it is recognised that the former is an inevitable by-product of required works and its effects are limited in duration. As defined in **Volume 1, Chapter 7**, the durations of temporary impacts are categorised as:

- short-term – less than one year;
- medium-term – one to five years; and
- long-term – greater than five years.

11.4.22 Advice is contained within British Standard BS 5228: 2009 'Noise and vibration control on construction and open sites' – Part 1 'Noise' (Ref. 11.11). This document contains a database of the noise emissions from individual items of equipment and certain activities to allow the prediction of noise from construction (and demolition) works to identified receptors. The prediction method provides guidance on the effects of different types of ground and barrier attenuation and on how to assess the impact of fixed and mobile plant. Whilst not mandatory, Annex E of this document provides informative advice to aid the development of noise assessment criteria based on previous published guidance and methodologies adopted successfully for other planning applications.

11.4.23 In assessing the requirement for noise limits, or operating period controls relating to construction works, Government Agencies and Local Authorities generally give consideration to the following aspects of the planned works, all of which have a bearing on the 'significance' of the impact:

- duration of planned activities (weeks, months, years);
- whether activities are planned for the night-time period;
- proximity of development to residential areas; and
- predicted source-term noise levels and noise impacts at residential areas.

11.4.24 The proposed noise magnitude criteria for construction works on the development site, in general, offer tighter control over noise emissions than recommended in BS 5228-1: 2009 (Ref. 11.11), Annex E, in light of the proposed duration of construction works. Recommended criteria for construction works are typically referenced to longer time periods (i.e. 12-hour daytime, 4-hour evening or 8-hour night), which allow for more intensive, and more noisy work over shorter periods if the working schedule is well managed. The shorter reference period of 1-hour for all periods as proposed would therefore provide better control on construction noise emissions throughout the long-term (up to 10 years) construction schedule. This takes account of the recommendation, in BS 5228-1: 2009 Annex E, for a 1-hour reference period to be adopted for long-term earthworks (i.e. for working periods greater than 6-months).

11.4.25 The proposed noise emission limits for construction activities undertaken within the HPC development site are presented in **Table 11.2** below. This includes proposed construction noise limits outside of typical daytime working periods, including preparatory and maintenance works to be undertaken during the reduced night-shift.

Table 11.2: Proposed Noise Limits for Site Preparation and Construction Works Associated with Hinkley Point C

Assessment Period		**Construction Noise Threshold (Free-Field)***
Day of Week	**Time of Day**	**dB $L_{Aeq,1hour}$**
Monday – Friday	07:00 – 19:00 19:00 – 23:00 23:00 – 07:00	65 60 45
Saturday	07:00 – 19:00 19:00 – 23:00 23:00 – 07:00	65 60 45
Sunday and Bank Holidays	07:00 – 19:00 19:00 – 23:00 23:00 – 07:00	60 55 45

Notes: dB re: 20µPa

** Determined at a noise sensitive receptor location (free-field). Predicted construction noise levels should include the typical existing ambient noise level (dB $L_{Aeq,T}$), as advised in BS5228-1, Annex E.*

Where L_{Aeq} = the equivalent continuous A-weighted sound pressure level, being the single number that represents the total sound energy measured over that period

Noise levels may be permitted up to 75dB $L_{Aeq,1hour}$ for specific works of short duration (such as blasting) where 'best practicable means' have been demonstrated to WSC and noise sensitive premises have been informed at least 48-hours in advance.

11.4.26 It should be noted that the noise levels presented in **Table 11.2** are limits rather than target values. As the majority of works will occur at a significant distance from receptors in the locality of the HPC development site, construction noise levels are, on the whole, predicted to be well below the proposed threshold values.

11.4.27 Based on these values, the noise magnitude scale for use in the prediction of potential impacts has been determined as presented in **Table 11.3**.

Table 11.3: Noise Magnitude Scale for Construction of Hinkley Point C

Assessment Period		**Construction Noise Magnitude – (Associated with UK Epr Development Site) dB $L_{Aeq,1hour}$ (Free-Field)**			
Day of Week	**Time of Day**	**Very Low**	**Low**	**Medium**	**High**
Monday – Friday	07:00 – 19:00 19:00 – 23:00 23:00 – 07:00	<55 <50 <35	55-65 50-60 35-45	65-70 60-65 45-50	>70 >65 >50
Saturday	07:00 – 19:00 19:00 – 23:00 23.00 – 07:00	<55 <50 <35	55-65 50-60 35-45	65-70 60-65 45-50	>70 >65 >50
Sunday and Bank Holidays	07:00 – 19:00 19:00 – 23:00 23:00 – 07:00	<50 <45 <35	50-60 45-55 35-45	60-65 55-60 45-50	>65 >60 >50

Notes: dB re: 20µPa

Two separate approaches have been adopted for the prediction of construction noise using the BS5228 (Ref. 11.17) methodology. These include worst-case calculations of noise from individual activities, such as construction of the Nuclear Island as well as detailed computational modelling which considers numerous activities being undertaken concurrently.

11.4.28 The individual activities assessed include:

- site preparation works (preliminary works);
- construction of temporary jetty and aggregates handling facility (preliminary works);
- upgrade of roads at the northern site access;
- sea wall construction;
- construction of emergency access road including the bridge over Bum Brook;
- deep excavation and concrete substitution to form Nuclear Island building foundations;
- construction of temporary and permanent buildings (non-nuclear);
- tunnelling (cooling water intake and outfall infrastructure);
- construction of nuclear island buildings;
- construction of temporary accommodation campus;
- construction of the National Grid 400kV substation;
- early landscaping; and
- final landscaping.

11.4.29 The detailed noise prediction calculations presented in **Appendix 11D** and summarised below consider each activity independently. In reality, many of these activities will occur concurrently, and therefore an additional noise prediction modelling exercise has been undertaken to enable a prediction of the effects of these concurrent activities. Details and outputs from this modelling study are provided in **Appendix 11E**. The following five discrete modelling scenarios (each representing a point in time during the HPC preliminary works and construction programme) were considered (Scenarios A-D represent daytime works):

- Scenario A – two months into site preparation works;
- Scenario B – six months into site preparation works;
- Scenario C – deep excavation (approx. Q3 2013);
- Scenario D – UK EPR construction (approx. Q4 2014); and
- Scenario E – night-time construction/maintenance activities (approx. Q4 2014).

11.4.30 **Table 11.4** provides detail of the assumed activities being undertaken for each construction noise modelling scenario.

Table 11.4: Assessed Construction-related Activities for Each Model Scenario

Activity	Scenario				
	A	B	C	D	E
Residual vegetation removal (hedges and trees)	✓	×	×	×	×
Stripping of topsoil	✓	×	×	×	×
Topsoil stockpiling at both the southern operational extent of the Southern Construction Phase Area (latitude 144750mN) and at the western boundary of the Southern Construction Phase Area	✓	×	×	×	×
Preparation works for construction of the northern roundabout close to Pixies Mound	✓	×	×	×	×
Deep (rock) excavation at UK EPR Units 1 and 2	×	✓	✓	×	×
Transporting of excavated materials to the stockpiles within the Southern Construction Phase Area using western haul road	×	✓	×	×	×*
Dump truck using circular haul route between northern and southern land areas	×	✓	✓	✓	×
Site levelling at the site of the proposed southern access roundabout	×	✓	×	×	×
Construction of temporary and permanent (non-nuclear) buildings	×	×	✓	✓	✓
Operation of temporary jetty	×	×	✓	✓	✓
Tunnelling and construction of the cooling water inlet and outlets	×	×	✓	✓	✓
Construction of the National Grid 400kV substation	×	×	✓	✓	
Construction of the on-site accommodation campus	×	×	✓	×	×
Construction of nuclear island buildings	×	×	×	✓	✓
Occupation of the on-site accommodation campus	×	×	×	✓	✓

*Note: * Transportation of excavated spoil during tunnelling operations at night would be limited to the fresh rock stockpile area, north of 145100mN.*

11.4.31 Construction plant and equipment type and numbers assumed for each modelled scenario were in accordance with the equipment list for the respective activities presented in **Table 11D.9** of **Appendix 11D**.

iv. Construction – Noise from Off-Site Traffic

11.4.32 There is no specific guidance for assessing the noise impact of construction traffic on public highways. However, given the duration of the proposed construction programme, an assessment has been undertaken using the methodology usually employed for permanent operational road traffic noise impacts.

11.4.33 The Design Manual for Roads and Bridges (DMRB) **Volume 11**, Section 3, Part 7 (HD 213/11) 'Noise and Vibration' (Ref. 11.12) provides an appropriate method for evaluating both the immediate and long-term impact of changes in the 18-hour traffic flow (06:00-24:00) in terms of the impacts on people and, principally, occupiers of residential property.

11.4.34 DMRB requires that an assessment is undertaken where an increase in a road traffic flow of 25% or greater is predicted (equivalent to an increase or decrease in road traffic noise of approximately 1dB L_A), implying that road traffic flow increases of up to 25% result in no significant impacts in environmental noise terms.

11.4.35 It is generally accepted that changes in road traffic noise levels of up to 3dB L_A are not widely perceptible. This is equivalent to a road traffic flow increase or reduction of 100%. Confirmation is provided in Department of Transport 'Transport Analysis Guidance' (2007 update) (Ref. 11.13), where it is stated:

> *"For freely flowing traffic, a difference of about 3dB in noise level is required before there is a statistically significant change in the average assessment of nuisance. The assessment of nuisance however could still be affected even if there is only a 1dB change in the noise level if the change is associated with changes in the view of traffic, or if the change occurs suddenly."*

11.4.36 In order to assess the level of community disturbance from potential changes in local road traffic characteristics during the construction phase of the proposed development, an assessment has been undertaken based on the principles of the DMRB Simple Assessment methodology. Although this methodology is designed for the assessment of permanent operational traffic impacts, it is also considered the most appropriate tool available for the assessment of the relatively long construction phase proposed for HPC.

11.4.37 The change (either an increase or decrease) in basic noise level (BNL), calculated according to the methods given in Calculation of Road Traffic Noise (CRTN) (Ref. 11.14), for each road section affected (refer to **Table 11I.1** of **Appendix 11I**) can then be compared with noise impact criteria presented in **Table 11.5**.

Table 11.5: Guidelines for the Assessment of Magnitude for 18-hour Traffic Noise

Magnitude	Guidelines
High	Considerable increase in the perceived noise levels typified as a difference of more than 5dB $L_{A10,T}$ from the existing ambient level.
Medium	Significant change in the perceived noise levels, typified as a difference of 3 to 4.9dB $L_{A10,T}$ from the existing ambient level.
Low	Change in the perceived noise levels, typified as a difference of 1 to 2.9dB $L_{A10,T}$ from the existing ambient level.
Very low	Generally imperceptible change in the perceived noise levels typified as a difference of 0.1 to 0.9dB $L_{A10,T}$ from the existing ambient level.

11.4.38 The traffic data used for the road traffic noise impact assessment has been taken from the Paramics micro-simulation traffic model built to assess the effects of the HPC Project proposals. The Paramics model includes Cannington and Bridgwater and Junctions 23 and 24 of the M5 motorway. The bus and Heavy Goods Vehicle (HGV) trips are fixed to the network and the remaining development trips are dynamically assigned through the network. For each modelling scenario the output traffic data from the Paramics model was factored using Automatic Traffic Count data to provide 18-hour Annual Average Weekly Traffic (AAWT) data.

11.4.39 In order to determine the overall potential road traffic noise impacts of construction of the HPC Project, the following assessment scenarios have been examined:

- 2009 ‘Baseline Year’ **(09BY)**;
- 2013 ‘Do-Nothing’ **(13DN)**, including:
  - forecast traffic growth including committed development only.
- 2016 ‘Do-Nothing’ **(16DN)**, including:
  - forecast traffic growth including committed development only.
- 2013 ‘Do-Something’ **(13DS)**, including:
  - forecast traffic growth including committed development;
  - construction of HPC power station (peak HGV trip generation);
  - operation of proposed park and ride, freight management facilities and temporary courier consolidation facility and induction centre at Junction J24 of the M5; and
  - construction of other associated development sites.
- 2016 Do-Something **(16DS)**, including:
  - forecast traffic growth including committed development;
  - construction of HPC power station (peak workforce demand);
  - operation of a western bypass of Cannington; and
  - operation of associated development sites.

11.4.40 The year 2009 was chosen as the baseline year for the assessment as this is the most recent year for which full traffic data was available. The years 2013 and 2016 were selected to represent the worst-case construction years (i.e. the years with peak construction traffic relating to the HPC Project).

11.4.41 For use in this assessment, the forecast daily (18-hour AAWT) traffic data in 2013 considers the **average day**, during the **peak quarter** of the **peak year** for HGV movements.

11.4.42 Comparison of impacts determined for each of the scenarios described above will therefore represent an assessment of the overall impacts of construction traffic relating to the HPC Project.

11.4.43 The forecast 2016 'Do-Something' (16DS) scenario uses data from the 'with development' road traffic scenario (**Table 11I.2** of **Appendix 11I**) provided from the transport studies. This assumes that a number of travel plan measures are in place during the construction phase of the HPC Project. These additional measures (which include certain of the associated developments) have been designed to alleviate impacts on the local highway network. As well as reducing traffic congestion, these measures will help to reduce noise and vibration impacts from road traffic during the proposed HPC construction phase. The relevant associated developments include:

- J23 Park and ride facility and freight management facility close to Junction 23 of the M5 Motorway;
- J24 Park and ride facility and freight management facility close to Junction 24 of the M5 Motorway;
- Cannington Park and ride facility located off the A39, south of Cannington village;
- Williton Park and ride facility located off the B3190, west of Williton;
- Combwich upgrade of the existing wharf, and construction of a water-borne freight set-down and storage area;
- HPC development site contractor accommodation campus including associated residential facilities for construction workers within the Southern Construction Phase Area (SCPA); and
- Western bypass of Cannington Village, connecting the A39/High Street roundabout with the C182 (Rodway), south of Putnell Barn.

11.4.44 In addition to the above sites, a number of road congestion mitigation measures (see 'Construction – Noise from Highway Improvements' in Section 11.6b) are assumed to be in place. Whilst these measures help to reduce congestion issues, they can encourage higher traffic flows in some locations as driver patterns change. Subsequently, changes (increases or decreases) in road traffic noise may result directly from these improvements.

11.4.45 Short-term noise and vibration impacts during peak hours for construction workforce movements (particularly early morning between 05:00 and 07:00 hours) have been assessed separately, due to the greater sensitivity to noise during these periods. This assessment is also based upon forecast traffic data for the scenarios identified above.

11.4.46 The assessment of hourly road traffic noise resulting during the daytime is considered to be an absolute worst-case, taking the forecast **peak day** for HGV movements in each of the assessment years (2013 and 2016), including the **peak year** (2016) for HGV traffic. This was assessed in this way primarily so that the transport assessment could ensure that junctions had the capacity to cope throughout the HPC construction phase. For the large majority of the HPC construction phase, hourly noise impacts (particularly those assessed during the night-time period) will be less significant than has been assessed.

11.4.47 The magnitude criteria presented in **Table 11.5** are only relevant for 18-hour traffic data, as these criteria are influenced by a number of factors, such as: the time of the day, the hourly traffic volume and ultimately, the absolute noise levels.

11.4.48 As undertaken for 18-hour traffic data, the change in hourly basic noise level (BNL), again calculated according to the methods given in CTRN (Ref. 11.14), for each road section affected, has been used to assess the potential impacts. However, it should be noted that CRTN is less reliable for low traffic flows (less than 200 vehicles per hour).

11.4.49 A range of noise impact magnitude scales, presented in **Table 11.6**, were therefore adopted taking into account the actual number of predicted vehicle movements (the resultant change can be an increase or decrease of noise).

Table 11.6: Guidelines for the Assessment of Magnitude for 1-hour Traffic Noise

Magnitude	Change in Predicted Noise Level, dB $L_{A10,1\ hour}$	
	Predicted with Development Traffic <200 Vehicles per Hour	Predicted with Development Traffic >200 Vehicles per Hour
High	> 10	> 5
Medium	5 – 9.9	3 – 4.9
Low	2 – 4.9	1 – 2.9
Very low	0.1 – 1.9	0.1 – 0.9

11.4.50 The magnitude changes presented in **Table 11.6** for road sections with predicted 'with development' traffic flows in excess of 200 vehicles per hour are as advised in DMRB (Ref. 11.12), and correlate with those presented in

11.4.51 **Table 11.5:** Given the limitations of the CRTN (Ref. 11.14) methodology, further magnitude change criteria have been adopted for road sections with predicted 'with development' traffic flows below 200 vehicles per hour. In the absence of published guidance, this criteria is designed to reflect the change in frequency of vehicle movements (an average of less than four vehicles per minute), and the perception by the receiver in terms of absolute noise exposure levels.

11.4.52 Therefore, the absolute road traffic noise level has also been considered in relation to published guidance values. With reference to potential road traffic noise impacts during the night, DMRB recognises the current limitations of research into the dose-response relationship for exposure. It therefore recommends that *"…only those sensitive receptors predicted to be subject to a $L_{night,outside}$ of 55dB should be considered"*. This level corresponds to the Interim Target level specified in the WHO NNGE (Ref. 11.2), and is an incident level (free-field) at the façade of a dwelling, presented as an annual average.

11.4.53 Based on this principle, road traffic noise impacts along highway sections for which the BNL is predicted to be below 55dB $L_{Aeq,1hr}$ (free-field), during HPC construction, should be assessed as being of minor significance, regardless of the predicted noise change. The level of 55dB $L_{Aeq,T}$ corresponds with the interpretation of the earlier WHO guidance (Ref. 11.15) by the National Physical Laboratory (NPL) together with the Institute of Sound and Vibration Research (ISVR) at Southampton University (Ref. 11.16), as requested by the UK Department of Environment (DETR) in 1998.

11.4.54 The NPL/ISVR report states that:

> *"In essence, the WHO guidelines (Ref. 11.15) represent a consensus view of international expert opinion on the lowest threshold noise levels below which the occurrence rates of particular effects can be assumed to be negligible. Exceedances of the WHO guideline values do not necessarily imply significant noise impact and indeed, it may be that significant impacts do not occur until much higher degrees of noise exposure are reached. One difficulty here is the true importance of the different noise effects considered when placed in an overall context relating to quality of life, and the extent to which noise control might have excessive consequences in other areas of human experience."*

11.4.55 Therefore, by applying the principle that greater levels of exposure are required to result in a significant impact, it is considered that noise levels of at least 10dB higher than the WHO guideline of 45dB $L_{Aeq,1\ hour}$ should be required before a receptor would experience *"…much higher degrees of noise exposure"*. The NPL/ISVR continues:

> *"As such, it would be unwise to use the WHO guidelines as targets for any form of strategic assessment, since, given the prevalence of existing noise exposure at higher noise levels, there might be little opportunity for and little real need for any across the board major improvements. On the other hand, the most constructive use for the WHO guidelines will be to set thresholds above which greater attention should be paid to the various possibilities for noise control action when planning new developments. It is important to make clear at this point that exceedances do not necessarily imply an over-riding need for noise control, merely that the relative advantages and disadvantages of noise control action should be weighed in the balance. It is all a question of balance and mere exceedance of the WHO guidelines just starts to tip the scales."*

11.4.56 Elsewhere in the NPL/ISVR document it explains that the limit of unacceptability is essentially a political decision. However, the document does identify a zone of intermediate impact which lies above the WHO criteria (below which the effects of noise are considered to be negligible), and below the level that noise effects are considered to be significant. Within this region, it is reasonable to conclude that, whilst attenuation measures should be considered, the actual noise impacts are not a restrictive factor to development.

11.4.57 In order to determine a representative road traffic noise level for each assessed road section, a simplified calculation methodology was adopted, using individual sound exposure levels (SEL) for each assigned vehicle movement. The traffic flows were divided into two categories in accordance with CRTN (Ref. 11.14): cars and other light vehicles with an assumed SEL of 67dB L_{AE} at 10m (based on previous measurements); and, heavy vehicles (HGVs and buses) with an assumed SEL of 80dB L_{AE} at 10m (based on previous measurements and data provided in BS 5228-1 (Ref. 11.11).

v. Construction – Noise from Highway Improvement Works

11.4.58 Construction noise calculations were also undertaken for significant highway improvement schemes on the local highway network (i.e. those that involve works beyond the existing highway boundary), using the BS 5228-1 (Ref. 11.11) methodology described above.

11.4.59 The proposed noise magnitude criteria for highway improvement works are presented in **Table 11.7**. The limits are based on advice provided in BS 5228-1.

11.4.60 It should be noted that no highways improvement works are proposed during the evening (19:00-23:00) or night-time periods (23:00-07:00), on Saturday afternoons (13:00-23:00), Sundays or public holidays.

Table 11.7: Guidelines for the Assessment of Magnitude for Highway Improvements Noise

Magnitude	Guideline
High	Generation of daytime façade noise levels (predicted construction noise plus measured ambient noise) in excess of 75dB(A) $L_{eq,12hr}$
Medium	Generation of daytime façade noise levels (predicted construction noise plus measured ambient noise) that are in the range of 65 to 75dB(A) $L_{eq,12hr}$
Low	Generation of daytime façade noise levels (predicted construction noise plus measured ambient noise) that are in the range of 55 to 65dB(A) $L_{eq,12hr}$
Very low	Generation of daytime façade noise levels (predicted construction noise plus measured ambient noise) that are below 55dB(A) $L_{eq,12hr}$

vi. Construction – Vibration from On-Site Construction Activities and Highway Improvement Works

11.4.61 Guidance on the assessment of the potential vibration impacts associated with construction activities is provided within British Standard BS 5228: 2009 ‘Code of practice for the control of noise and vibration on construction and open sites’ – Part 2 ‘Vibration’ (Ref. 11.17). This document refers to the measurement and assessment guidance provided in BS 6472 ‘Guide to evaluation of human exposure to vibration in buildings’ – Part 1: 2008 ‘Vibration sources other than blasting‘ (Ref. 11.18) and BS ISO 4866 ‘Mechanical vibration and shock – Vibration of fixed structures – Guidelines for measurement of vibrations and evaluation of their effects on structures’ (Ref. 11.19) (supersedes BS 7385-1: 1990), and BS 7385: Part 2: 1993 ‘Guide to damage levels from ground-borne vibration’ (Ref. 11.20).

11.4.62 For the type of development proposed, plant such as piling equipment, compressors, pumps, generators and HGVs are likely to be the most significant sources of low frequency noise with the potential to cause resonance in nearby buildings, which is often perceived as vibration by occupants.

11.4.63 Bulk earthworks and construction activities generally give rise to impulsive and intermittent vibration. In such circumstances, it is necessary to be able to quickly compare levels against simple criteria to give an immediate evaluation of the likelihood of a problem without recourse to complex post-processing of results. Under these conditions, assessment criteria based on peak particle velocities (PPVs) are most appropriate.

11.4.64 Based on Table B.1 of BS 5228-2 (Ref. 11.17), the proposed PPV significance criteria for typical demolition and construction activities (excluding blasting), measured at a sensitive receptor location, are presented in **Table 11.8**.

Table 11.8: Construction Vibration Magnitude Criteria (excludes blasting)

Magnitude	Vibration Level (mm/s PPV)	Impact
High	10.00	Vibration is likely to be intolerable for any more than a very brief exposure to this level
Medium	1.00	It is likely that vibration of this level in residential environment will cause complaint, but can be tolerated if prior warning and explanation has been given to residents
Low	0.30	Vibration might be just perceptible in residential environments
Very Low	0.14	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.

11.4.65 In the case of ripping and blasting (the latter of which may be required) operations that will be undertaken during the deep foundation excavations for the Nuclear Island and other deep structures, the potential impacts have been assessed in accordance with British Standard BS 6472 ‘Guide to evaluation of human exposure to vibration in buildings’ – Part 2: 2008 ‘Blast-induced vibration’ (Ref. 11.21). This document provides a methodology for the prediction of the likely vibration magnitude based on the Maximum Instantaneous Charge (MIC) in kg, and the slant distance from the blast to the receptor in metres.

11.4.66 Based on Table 1 of BS 6472-2, the proposed PPV significance criteria for blasting operations, measured at a residential receptor location, are presented in **Table 11.9**.

Table 11.9: Vibration Magnitude Assessment Criteria (blasting operations)

Magnitude	Guidelines
High	Generation of PPV in excess of 24mm/s
Medium	Generation of PPV in the range of >10 to <24mm/s
Low	Generation of PPV in the range of >6 to <10mm/s
Very Low	Generation of PPV below 6mm/s

11.4.67 The above assumes that blasting and ripping will only be undertaken during daytime hours (08:00-18:00 Monday-Friday, 08:00-13:00 Saturday), and that there will be no more than three blast events per day.

vii. Construction – Vibration from Off-Site Traffic

11.4.68 Air-borne vibration from traffic is generally produced by the engines or exhausts of road vehicles and these are dominant in the audible frequency range (50Hz to 100Hz). Ground-borne vibration is more often in the 8Hz to 20Hz range and is produced by the interaction between rolling wheels and the road surface as well as by the jolting of HGVs over surface irregularities.

11.4.69 The potential impact of airborne vibration resulting from the change in traffic levels on other affected highways was assessed using guidance in the DMRB (Ref. 11.12). The DMRB identifies that the annoyance from vibration correlates well to $L_{A10\ (18\text{-hour})}$ levels. However:

11.4.70 *"For a given level of noise exposure the percentage of people bothered very much or quite a lot by vibration is 10% lower than the corresponding figure for noise nuisance."*

11.4.71 At predicted road traffic noise exposure below 58dB $L_{A10\ (18\text{-hour})}$ DMRB states the percentage of people bothered by vibration should be considered to be zero.

11.4.72 With respect to ground-borne vibration which is only likely to result if there are significant surface irregularities in the road surface, DMRB identifies that:

> *"Such vibrations are unlikely to be important when considering disturbance from new roads and an assessment will only be necessary in exceptional circumstances."*

viii. Operation – Industrial Noise

11.4.73 The propagation of operational noise emissions from sources on the proposed HPC development site (including: machinery; building vents; and building façades) has been predicted in accordance with the International Standards Organisation (ISO) 9613: 'Attenuation of sound during propagation outdoors' – Part 2 'General method of calculation' (Ref. 11.22). The operational noise emissions have been modelled using Cadna computational predictive software.

11.4.74 This section provides a summary of the modelling undertaken and full details, including assumptions made. Input and output data are provided in **Appendix 11F**. Cadna noise modelling has been used to predict the levels of environmental noise at a distance from a variety of sources. Parameters used within the noise modelling include:

- Topography: The existing topography within the site boundary was modelled using 1m LiDAR (Light Detection and Ranging) data and beyond this area, 10m Ordnance Survey contours were imported into the model. The local topography of the HPC development site was adjusted to reflect the proposed platform levels. Landforms associated with final landscaping in the southern section of the SCPA (south of 144750mN) have also been incorporated into the model.
- Buildings and other topography: Proposed and existing buildings and cylinders (including chimney stacks) were incorporated within the model. The height of buildings located within the existing Hinkley Point A and B nuclear power generation sites have been estimated, whilst the height of all sensitive receptor buildings has been set to 6m, allowing for properties up to two storeys.
- Noise sources (emission points): Three types of noise sources were included in the model including point sources, area sources and line sources. The directivity of noise emissions was based upon the source type (e.g. chimney stack exit or building façade) and the source location (openings in building façades).
- Ground absorption: All land outside of the HPC development site and the existing Hinkle Point power station complex was assigned a sound absorption factor of 1.00 (soft ground) for the purpose of noise propagation calculations. The remaining ground was assigned a ground absorption factor of 0.20, to account for hard surfaces and small obstacles (machinery, vehicles). Areas supporting EDF Energy pylons and electrical plant on the proposed National Grid 400kV substation site were assigned a ground absorption factor of 0.5 as these will be covered by stone chippings.
- Meteorological conditions: Annual hourly sequential meteorological data which was generated using the United Kingdom Meteorological Office (UKMO) Numerical Weather Prediction Model for the Hinkley Point site was used to define meteorological conditions in the noise propagation model. The industrial noise calculation utilises the ISO 9613-2 (Ref. 11.22) methodology for the determination of meteorological correction (C_{met}).
- Foliage/woodland areas: Areas of existing foliage have been identified within the model. However, these areas have no acoustic features and are therefore not accounted for within noise propagation calculations.
- Reflections: Given the distance separation between the built development areas and the nearest noise sensitive receptors, a single order of reflection was permitted within the model.
- Noise sensitive locations: Noise sensitive receptors included Knighton Farm, Doggetts, and Wick Farm (see **Figure 11.1**). The baseline noise conditions for these receptors are described in the Factual Noise Report in **Appendix 11A**.

11.4.75 British Standard BS 4142: 1997 'Method for rating industrial noise affecting mixed residential and industrial areas' (Ref. 11.23) provides a method of assessing the likelihood of complaint from a noise source by comparing the rating level of that source with the background noise level L_{A90} at noise-sensitive receptors affected by noise from existing or proposed fixed developments including factories and commercial/industrial units.

11.4.76 In Section 9 of BS4142: 1997 'Assessment Method' it is stated that an excess above the existing background noise level L_{A90} of up to 5dB L_A due to the rating noise level from fixed plant at a new development is of 'marginal significance'. This has been interpreted since the introduction of the Standard in 1967, that a 5dB L_A excess due to new, fixed plant noise sources is, in general, acceptable. For this reason, Environmental Health Officers of WSC and SDC recommended this assessment criterion for this assessment.

11.4.77 For the calculation of noise propagation from the built plant, three meteorological scenarios were used:

- average wind speed and direction based on hourly data (2004-2008);
- downwind conditions; and
- neutral (no wind).

11.4.78 However, BS 4142 does not specify how wind effects should be accounted for in propagation predictions, only that the calculation method should be reported and reasoned appropriately. Operational noise propagation has been determined based upon all three scenarios to provide an indication of the meteorological effects.

11.4.79 Furthermore, BS 4142 is not suitable for assessing the noise impacts when the background and rating noise levels are both very low (below 30$L_{A90,T}$ and 35dB $L_{Aeq,T}$ respectively), as occurs around the HPC development site (refer to Factual Noise Report in **Appendix 11A**). Given the rural setting, it is proposed to set a fixed target criterion for all plant at the façade of nearest noise sensitive receptors, taking into account meteorological conditions that are likely to promote noise propagation from the site to the receptors. Operational noise impacts have been assessed based upon the average wind direction and the worst-case downwind scenario for comparison with the proposed criterion.

11.4.80 The assessed noise emissions from the operational HPC site were assumed to be constant; therefore the determined impact during the night-time will dictate the overall operational noise impact. The proposed target noise level should minimise the potential for sleep disturbance in accordance with guidance provided in the World Health Organisation (WHO) document 'Guidelines for Community Noise' (1999) (Ref. 11.1) and British Standard BS 8233: 1999 'Sound insulation and noise reduction for buildings – Code of practice' (Ref. 11.24), even with windows open.

11.4.81 In 2009, the WHO published its 'Night Noise Guidelines for Europe' (NNGE) (Ref. 11.2) in which it recommends a target of 40dB $L_{night,outside}$ at a residential façade ('free-field' incident level) to protect the public, including the most vulnerable groups such as children, the chronically ill and the elderly. The $L_{night,outside}$ indicator relates to the annual average night-time noise level and takes account of the varying need to open windows at night throughout the year. This parameter is therefore comparable with the operational noise rating level predicted using the average wind conditions.

11.4.82 It is therefore proposed that a rating noise criterion of 38dB $L_{Aeq,T}$ (façade) is adopted. With the façade correction, this level is 5dB below the annual average value recommended in WHO NNGE document and would result in an internal noise level of less than 30dB $L_{Aeq,night}$ within bedrooms. The WHO Guidelines for Community Noise (Ref. 11.1) indicate that this represents the noise level at which it is possible to start detecting sleep disturbance and below which effects can be assumed to be negligible. In this regard, the advice provided by the NPL/ISVR interpretation report (Ref. 11.16), as discussed above is relevant.

11.4.83 In terms of potential daytime disturbance, this proposed threshold criterion is 12dB below the level at which the WHO considers there to be the onset of moderate annoyance in a small minority (10%) of the population (50dB $L_{Aeq,16hours}$).

11.4.84 **Table 11.10** shows the proposed operational noise magnitude assessment criteria (as adopted in this assessment), determined at a residential receptor location.

Table 11.10: Operational Noise Magnitude Assessment Criteria

Magnitude	Sound Pressure Level (Façade) Under Annual Average Wind Conditions, Db L_{at}(Lt) – Assumes Continuous Noise Emissions Throughout The Day and Night
High	> 40
Medium	38 – 40
Low	35 – 38
Very Low	<35

ix. Operation – Noise from Off-Site Traffic

11.4.85 An assessment of the road traffic noise impacts during the early operational phase of HPC has been undertaken using the same methodology as described for construction-related traffic above. The relevant criteria for 18-hour and 1-hour traffic noise magnitude levels presented in **Table 11.5** and **Table 11.6**, respectively, were used.

11.4.86 In order to determine the overall potential road traffic noise impacts of early operation of HPC, the following assessment scenarios have been examined:

- 2009 'Baseline Year' **(09BY);**
- 2021 'Do-Nothing' **(21DN)**, including:
  - forecast traffic growth including committed development only.
- 2021 'Do-Something' **(21DS)**, including:
  - forecast traffic growth including committed development;
  - ongoing construction of the Interim Spent Fuel Store (ISFS) building;
  - deconstruction of temporary associated developments;
  - early operation of HPC power station; and
  - operation of a western bypass of Cannington.

11.4.87 The traffic data used for the road traffic noise impact assessment has been taken from the validated Paramics micro-simulation traffic model built to assess the effect of the HPC Project (see **Chapter 10** of this volume). For each modelling scenario, the output traffic data from the Paramics model were factored using Automatic Traffic Count data to provide 18-hour AAWT data.

x. Significance of Impacts

11.4.88 Within this chapter, the generic descriptions used to define the level of impact significance and the likelihood of occurrence are the same as those provided in **Volume 1**, **Chapter 7**, where an Impact Assessment Matrix (IAM) is presented which compares the magnitude of an impact with the sensitivity of the receptor to determine the level of impact significance.

11.4.89 For the purpose of this assessment, mitigation measures have been proposed where there is an adverse impact of greater than minor significance and the impact magnitude, spatial scope and temporal nature make it appropriate to do so.

xi. Cumulative Impacts

11.4.90 Cumulative impacts of the HPC development are considered in **Volume 11**. This includes potential cumulative effects of construction works associated with the HPC development site and concurrent construction and operation of proposed associated development sites and/or other planned or reasonably foreseeable projects.

11.4.91 The cumulative assessment of all HPC construction and operation traffic is detailed in this chapter. All traffic noise impact assessments have assessed the 'Do-Something' scenario with future base ('Do-Nothing') scenarios. Future base (Reference Case) scenarios have included additional road traffic resulting from committed development. Individual road traffic noise impacts associated with these committed developments are therefore excluded from the cumulative assessment process detailed in **Volume 11**.

11.4.92 An assessment of potential in-combination effects of different noise sources during construction (road traffic on public highways and on-site construction machinery) is presented in this chapter.

f) Limitations, Constraints and Assumptions

11.4.93 Assumptions have been made about the type of equipment and machinery to be used during the construction works based upon likely methods to be adopted and previous development project experience, but contractors may adopt different working methods to reach execute the works. The assessment presented herein has therefore adopted a worst-case scenario wherever possible.

11.4.94 The use and number of fixed mechanical service plant associated with on-site accommodation campus buildings was informed by design details. Individual plant model and type were assumed, with typical sound power output data obtained from manufacturer publications.

11.4.95 A general noise emission rate (65dBA/m^2) was assumed for use of the two 5-a-side football pitches, based upon previous measurements, and use of these facilities prohibited between the hours of 08:00 and 22:00.

11.4.96 The permanent operational road traffic noise impacts associated with the HPC Project were assessed in 2021, when some residual activities associated with its construction would still be ongoing (deconstruction of associated development site, and construction of the ISFS building). Whilst this therefore does not represent a true operational scenario, it provides a worst-case assessment, following which the impacts would be reasonably assessed to be of lower significance.

11.4.97 It should be noted that CRTN is less reliable for low traffic flows. However, in the absence of an appropriate alternative standard with which to assess 'low flow traffic segments', CRTN was used. The magnitude criteria in **Table 11.6** have been developed to allow some consideration of this limitation in the methodology.

11.5 Baseline Environmental Characteristics

a) Introduction

11.5.1 This section presents the baseline environmental characteristics for the proposed HPC development site and surrounding area with specific reference to noise and vibration.

11.5.2 Eleven off-site highway improvements schemes will be included in the HPC Project DCO application. They are presented in the project description in **Volume 1**, **Chapter 2** of this ES. The schemes concern land that is presently within the highway, on highway land, such as verges, limited areas of hard surfacing and urban greenspace. Only two of the schemes (construction of new roundabouts at Washford Cross near Williton, and Sandford Corner, south of Cannington) have any potential to generate significant noise and vibration impacts and these are included within this baseline section. The location of the proposed works at Washford Cross, including the receptor locations is shown on **Figure 11.2a** with Sandford Corner shown on **Figure 11.2b**.

b) Noise Sensitive Receptors

11.5.3 A noise sensitive receptor is identified as a location where significant changes in environmental noise levels have potential to cause either detrimental or beneficial impacts. Considered effects typically include influence on the amenity of an area or location, potential disturbance to sleep, comfortable conversation or entertainment; degradation of an educational environment; or interruption of a religious ceremony.

11.5.4 Noise sensitive receptors in the vicinity of the HPC development site have principally been selected according to the likelihood of the impacts listed above to occur, and also to represent a group of locations, on a 'worst-case' basis, where similar impacts may occur.

11.5.5 Receptor locations are free-field (i.e. greater than 3.5m from any reflecting surface other than the ground) at three residential receptor locations and four public amenity locations (footpaths, permissive routes and Pixies Mound). The coastal footpath (the West Somerset Coast Path – see **Chapter 25** of this volume of the ES, Amenity and Recreation) baseline noise monitoring location is also considered to be representative of the intertidal zone for the assessment of the potential impacts to marine ecology and terrestrial ecology and ornithology discussed in **Chapters 19** and **20** of this volume of the ES.

11.5.6 The locations of noise sensitive receptor locations are identified in **Plates 11F.6** and **11F.8** of **Appendix 11F**.

11.5.7 The area around the HPC development site is primarily farmland, punctuated by scattered residences, farmhouses, and a number of small hamlets. Three noise sensitive receptors were selected from these, each at a distance greater than 1km from the nearest proposed UK EPR reactor unit. However, it is proposed that land within the operational extent of the SCPA (north of 144750mN) is used to enable construction, including spoil and rock storage areas, contractor works areas and a contractors accommodation campus. Activities in these locations will be at a closer approach (up to 80m to the nearest residential dwelling).

11.5.8 A summary of the key elements of each phase with respect to potential noise impacts on nearby receptor locations is provided below so that appropriateness of monitoring location selection is apparent.

c) Baseline Noise and Vibration Surveys

11.5.9 An initial baseline noise survey was undertaken between 27 April and 7 May 2009. The survey methodology and the identification of appropriate monitoring locations were agreed with EHOs of WSC and SDC prior to the survey.

11.5.10 The baseline noise survey was undertaken to establish the baseline acoustic climate at the nearest noise sensitive receptors. Full details of the survey are provided in the Factual Noise Report in **Appendix 11A** along with a complete set of monitoring data. **Table 11.11** below provides a summary of the range in measured daytime and night-time L_{Aeq} and L_{A90} sound level data.

Table 11.11: Summary of the Range in Baseline Noise Measurements at Key Noise Sensitive Receptors (Baseline noise survey April – May 2009)

Monitoring Location	Sound Pressure Level, dB (Free-Field)					
	Day (07:00-23:00)		Evening (19:00-23:00)		Night (23:00-07:00)	
	$L_{Aeq,T}$	$L_{A90,T}$	$L_{Aeq,T}$	$L_{A90,T}$	$L_{Aeq,T}$	$L_{A90,T}$
Northern HPC development site boundary (Coastal footpath)	42 – 45	36 – 37	45	41	47	42
Knighton Farm (residential)	44 – 48	30 – 33	37 – 41	26 – 31	43 – 46	26 – 31
Doggetts (residential)	40 – 59	32 – 45	35 – 63	30 – 37	35 – 52	27 – 45
Wick Farm (residential)	46 – 60	37 – 46	41 – 45	35 – 41	44 – 47	36 – 38
Southern boundary of the Southern Construction Phase Area	40 – 50	32 – 35	37	29	39	29
Hinkley Point power station – visitors centre	49 – 50	46 – 48	50	48	56	50

11.5.11 Baseline noise measurements were undertaken at a height of between 1.2m and 1.5m above ground level, in free-field conditions, in accordance with BS 7445:2003 Part 1 'Description and measurement of environmental noise – Guide to quantities and procedures' (Ref. 11.25). All measurements were undertaken during suitable meteorological conditions, conducive to obtaining reliable and accurate baseline data, in accordance with the relevant guidance documents.

11.5.12 Monitoring locations were selected to be representative of the nearest noise sensitive receptors, which are primarily residential dwellings in a rural setting. In addition, baseline noise measurements were also undertaken at a location in proximity to the coastal public footpath immediately to the north of the HPC development site, to assess the potential impacts on this public amenity.

11.5.13 The dominant noise sources identified during the baseline noise survey included local road traffic, birdsong and surf movement (at the coastal monitoring location). The determined ambient noise levels were typical of a rural environment, dropping very low during the night-time, and wind noise masking having an observable effect.

11.5.14 Although distant road traffic was occasionally audible due to the very low background noise levels, it is not considered a significant contributor to the acoustic environment at these rural locations. (Doggetts and Wick House are located over 5km north of the A39.) The baseline survey at Doggetts and Wick House included a bank holiday week-end, however, the measured ambient noise levels at these receptor locations were not notably dissimilar from those measured at Knighton Farm or in proximity to Bishops Farm House (southern boundary of the SCPA). The exception to this was elevated noise levels due to decking construction at Doggetts on the Saturday and Sunday (2 and 3 May 2009). It is therefore considered that neither school holiday nor bank holiday traffic is likely to significantly affect the acoustic climate at Doggetts or Wick House.

11.5.15 Increased wind speeds (up to 5-8m/s) occurred between 23:30 and 10:30 on the 4-5 May 2009 during the measurement survey at Doggetts and Wick House. Noise from the movement of nearby foliage in the wind is likely to have contributed to these measured noise levels, which are therefore represented by the upper night-time values in **Table 11.11** for the locations.

11.5.16 Further details of baseline noise levels and existing localised noise sources can be found in the Factual Noise Report (**Appendix 11A**).

11.5.17 In addition to the ambient noise monitoring locations identified in **Table 11.11**, a 24-hour survey was also undertaken at Mamsey House residential care home in Williton, located adjacent to the A39. The ambient noise levels at this location were therefore considered representative of the baseline conditions at Tropiquaria Zoo, which represents the closest potential noise sensitive receptor to the proposed Washford Cross roundabout construction. The ambient daytime noise level at this location was determined to be 62dB $L_{Aeq,16hr}$ (63dB $L_{Aeq,07:00\text{-}19:00}$).

11.5.18 **Table 11.12** provides typical existing daytime ambient noise level at each monitoring location, derived from the logarithmic average of the measured $L_{Aeq,15min}$ values between 07:00 and 19:00 hours. This data were used to determine predicted ambient noise levels during the construction phase (see **Table 11.18** and **Table 11.19**).

Table 11.12: Typical Existing Daytime Ambient Noise Level at Each Baseline Monitoring Location (Baseline noise survey April – May 2009)

Monitoring Location	Typical* Daytime Ambient Noise Level, dB $L_{Aeq,T}$
Northern development site boundary (Coastal footpath)	43
Knighton Farm (residential)	46
Doggetts (residential)	45
Wick Farm (residential)	46
Southern boundary of the Southern Construction Phase Area	41
Hinkley Point power station – visitors centre	49
Benhole Lane (south)	41
Benhole Lane (north)	43
Coastal footpath	43
Pixies Mound	49
Tropiquaria Zoo	63

Note: ** Derived from the arithmetic average of the measured $L_{Aeq,15min}$ values between 07:00 and 19:00 hours.*

11.5.19 Given the rural setting, the baseline noise monitoring data obtained at the southern boundary of the SCPA (see **Table 11.11** and **Table 11.12**) are assumed to be representative of the ambient noise climate at Bishops Farm House in Shurton (approximately 210m to the south of the monitoring location).

11.5.20 Further noise and vibration surveys were undertaken between 20 and 29 April 2010 in relation to trials to determine noise and vibration levels that might be associated with blasting works. The survey comprised continuous monitoring at Bayleys Brook House, approximately 1.6km south of the trial blasting pits within the Built Development Area West as illustrated in **Appendix A** to **Appendix 11B (**see **Figure A.1**). A second continuous monitoring location was approximately 800m east of the trial blasting pits and approximately 30m west of the Hinkley Point A boundary fence and access gate.

11.5.21 Throughout the monitoring period, the weather was generally dry and with above average temperatures for the time of year. On the day of the blasting tests (22 April 2010), an easterly wind prevailed at a speed of 2-7mph; the ambient temperature just exceeded the average maximum high (13˚C); and, there was no rainfall.

11.5.22 The results of this noise monitoring survey are presented in **Table 11.13** and **Table 11.14** and the results of the vibration measurements are presented in **Table 11.15** and **Table 11.16.**

Table 11.13: Summary of Ambient Noise Levels during Blasting Trials – Bayleys Brook House

Monitoring Period (Start Date)	Measurement Duration (T)	Sound Pressure Level, dB (Fast Time-Weighting)		
		$L_{Aeq,T}$	$L_{A90,T}$ *	$L_{Amax,T}$
Night (20/04/10)	8 hours	43.2	35.7	72.1
Day (21/04/10)	16 hours	53.8	37.5	93.7
Night (21/04/10)	8 hours	44.9	36.7	80.0
Day (22/04/10)	16 hours	45.9	37.1	80.0
Night (22/04/10)	8 hours	43.5	35.1	65.4
Day (23/04/10)	16 hours	46.5	35.3	86.9
Night (23/04/10)	8 hours	43.9	34.0	73.5
Day (24/04/10)	16 hours	63.8	36.1	103.9
Night (24/04/10)	8 hours	43.8	33.9	67.8
Day (25/04/10)	16 hours	48.2	37.1	83.5
Night (25/04/10)	8 hours	45.8	33.7	75.7
Day (26/04/10)	16 hours	46.1	37.6	78.9
Night (26/04/10)	8 hours	45.2	35.9	74.5
Day (27/04/10)	16 hours	49.9	36.4	80.5
Night (27/04/10)	8 hours	44.0	31.9	68.0
Day (28/04/10)	16 hours	45.1	36.5	74.7
Night (28/04/10)	8 hours	49.4	33.2	82.6

Notes: *All values are in dB re 20µPa, Free-field.*

**L_{A90} values are arithmetic averages of individual 15-minute measurements*

Table 11.14: Summary of Ambient Noise Levels during Blasting Trials – North of Hinkley Point B Training and Visitors Centre

Monitoring Period (Start Date)	Measurement Duration (T)	Sound Pressure Level, dB (Fast Time-Weighting)		
		$L_{Aeq,T}$	$L_{A90,T}$ *	$L_{Amax,T}$
Night (20/04/10)	8 hours	47.3	45.7	66.2
Day (21/04/10)	16 hours	47.0	44.3	72.3
Night (21/04/10)	8 hours	48.8	47.4	69.4
Day (22/04/10)	16 hours	46.8	44.8	72.6
Night (22/04/10)	8 hours	48.9	46.4	85.0
Day (23/04/10)	16 hours	48.2	46.5	71.0
Night (23/04/10)	8 hours	47.5	46.1	69.2
Day (24/04/10)	16 hours	47.7	46.0	74.2
Night (24/04/10)	8 hours	47.5	46.1	68.8
Day (25/04/10)	16 hours	46.3	43.8	71.9
Night (25/04/10)	8 hours	47.8	45.8	69.1

Monitoring Period (Start Date)	Measurement Duration (T)	Sound Pressure Level, dB (Fast Time-Weighting)		
Day (26/04/10)	16 hours	48.1	45.5	81.8
Night (26/04/10)	8 hours	49.0	46.7	66.5
Day (27/04/10)	16 hours	49.1	47.3	70.7
Night (27/04/10)	8 hours	48.7	47.2	67.0

Notes: All values are in dB re 20µPa, Free-field.

** L_{A90} values are arithmetic averages of individual 15-minute measurements.*

Table 11.15: Summary of Measured Vibration Levels during Blasting Trials – Bayleys Brook House

Monitoring Period (Start Date)	Measurement Duration (T)	Maximum Vibration Level, mm/s PPV	
		Average*	Maximum
Night (20/04/10)	8 hours	0.156	0.161
Day (21/04/10)	16 hours	0.158	0.281
Night (21/04/10)	8 hours	0.157	0.161
Day (22/04/10)	16 hours	0.159	0.201
Night (22/04/10)	8 hours	0.155	0.161
Day (23/04/10)	16 hours	0.159	0.161
Night (23/04/10)	8 hours	0.157	0.161
Day (24/04/10)	16 hours	0.160	0.763
Night (24/04/10)	8 hours	0.160	0.161
Day (25/04/10)	16 hours	0.160	0.201
Night (25/04/10)	8 hours	0.160	0.161
Day (26/04/10)	16 hours	0.160	0.402
Night (26/04/10)	8 hours	0.156	0.161
Day (27/04/10)	16 hours	0.160	0.161
Night (27/04/10)	8 hours	0.160	0.161
Day (28/04/10)	16 hours	0.160	0.161
Night (28/04/10)	8 hours	0.160	0.161

*Notes: * Average of the '30-second maximum' recorded values.*

Table 11.16: Summary of Measured Vibration Levels during Blasting Trials – North of Hinkley Point B Training and Visitors Centre)

Monitoring Period (Start Date)	Measurement Duration (T)	Maximum Vibration Level, mm/s PPV	
		Average*	Maximum
Night (20/04/10)	8 hours	0.110	0.161
Day (21/04/10)	16 hours	0.090	0.402
Night (21/04/10)	8 hours	0.118	0.161
Day (22/04/10)	16 hours	0.086	0.402
Night (22/04/10)	8 hours	0.113	0.161
Day (23/04/10)	16 hours	0.084	0.161
Night (23/04/10)	8 hours	0.119	0.161
Day (24/04/10)	16 hours	0.079	0.161
Night (24/04/10)	8 hours	0.098	0.361
Day (25/04/10)	16 hours	0.091	0.241
Night (25/04/10)	8 hours	0.104	0.161
Day (26/04/10)	16 hours	0.075	0.161
Night (26/04/10)	8 hours	0.111	0.361
Day (27/04/10)	16 hours	0.073	0.161
Night (27/04/10)	8 hours	0.097	0.161
Day (28/04/10)	16 hours	0.079	0.161

*Notes: * Average of the '30-second maximum' recorded values.*

11.5.23 The baseline noise levels used in the assessment of off-site traffic impacts have been calculated according to the CRTN methodology and are provided in **Appendix 11I**.

11.6 Assessment of Impacts

a) Introduction

11.6.1 For the proposed development, the impact assessment with respect to noise and vibration on the existing environment covers the following aspects:

- Potential increase in noise during the construction works associated with HPC (including site preparation and construction and operation of the temporary jetty);
- Potential vibration generated by the construction works associated with HPC (including site preparation and construction and operation of the temporary jetty);
- Potential change in off-site road traffic noise and vibration during the construction phase of HPC including the construction, operation and post-operation of associated development sites, and early operation of the HPC project; and
- Potential increase in noise from the operational HPC site.

11.6.2 Due to the typically low vibration levels that are likely to be generated (primarily by on-site vehicle movements), it is expected that operational activities would not result in perceptible vibration impacts on any of the sensitive receptors. Therefore, no further assessment of this operational vibration was undertaken. This was agreed in consultation meetings held with the EHO at WSC (see Section 11.4d).

b) Best Practice

11.6.3 Best practice measures will be undertaken and are considered to form part of the proposed development. They will be based on the principles set out in the **Environmental Management and Monitoring Plan** (**EMMP)** with further information provided within the **Subject Specific Management Plan: Noise and Vibration (SSMP)**. Measures forming part of the proposed development have been taken into account in the assessment of impacts. Measures will include the following.

i. Construction and Post-Operational Noise

11.6.4 The standard of good practice outlined in BS 5228-1 (Ref. 11.11) would be followed. This includes:

- continuous noisy plant to be housed in acoustic enclosures (where practicable);
- use of electrical items of plant instead of diesel plant in especially sensitive locations (where practicable);
- exhaust silencing and plant muffling equipment to be maintained in good working order;
- avoid unnecessary revving of engines and switch off equipment;
- minimise drop heights of materials; and
- start up plant sequentially rather than all together.

11.6.5 In addition, a formal system would be put in place during the works which identifies the roles and responsibilities of site staff regarding a noise and vibration complaint action procedure. Site logs will be maintained; detailing all complaints received relating to noise and/or vibration disturbance impacts and the corresponding action taken including the response made to each complainant. Liaison would be undertaken with the local community ensuring they have advance notice of the schedule of works.

ii. Construction Vibration

11.6.6 BS 5228-2 (Ref 11.17) gives detailed advice on standard good construction practice for minimising impacts from construction vibration. It would be a requirement of any construction contract that the constructors comply with the recommendations in these standards, in order to achieve specific vibration emissions criteria for the site.

11.6.7 Measures to reduce the predicted impact from piling activities on site would include:

- pre-boring of the upper strata; and
- informing residents in advance of piling operations.

iii. Operational Noise

11.6.8 The 'rating' of a noise automatically increases when tones, whines or impulses are noticed in the audible noise. Care will therefore be taken, both in identifying particular tonal and impulsive sources on the plant and to ensure that these will be adequately silenced by design. The most significant sources of tonal energy are likely to be fans, which will produce tonal noise typically at blade passing frequency. Transformers will also contain middle to low frequency tonal energy at the second and fourth harmonics (100Hz and 200Hz).

11.6.9 Sound attenuation, in the form of acoustic barriers and enclosures, will be considered where safety and other operational requirements permit. This will include enclosures to the refrigeration units mounted at roof level on nuclear island buildings. Other noise control treatments that will be considered during detailed design and installation are listed below:

- acoustic attenuators on exhaust stacks, ventilation intakes and discharge points;
- steam vents to be fitted with vent silencers; and
- lagging of steam pipes and control valves.

c) Construction Impacts

11.6.10 The assessment of construction activities was undertaken with regard to potential noise and vibration impacts to local residential properties, and noise-sensitive public amenity receptors.

i. Construction – Noise from On-Site Construction Activities

11.6.11 The primary noise and vibration sources during the HPC construction phase are those typical of an industrial construction site. Potential impacts will vary through the following major stages of the development:

- mobilisation;
- excavation, levelling and preparation of working platforms;
- construction of a temporary jetty;
- construction of temporary and permanent access roads and parking areas;
- construction of the sea wall defences;
- deep excavations and tunnelling;
- construction of a workers accommodation campus;
- building construction;
- construction of the National Grid 400kV substation; and,
- EPR commissioning.

11.6.12 Throughout the construction phase the volume of construction traffic on the road network will vary considerably, with the potential to affect noise sensitive receptors along the roads connecting the HPC development site with the M5 motorway to the south-east.

11.6.13 In addition to the above construction activities, noise resulting from occupation of the proposed workers accommodation campus on the SCPA will have the potential to impact upon existing nearby dwellings.

11.6.14 In order to evaluate the noise generation during the HPC construction phase it is necessary to define the various activities that will be undertaken. Construction contractors may use different working methods and plant. However, it is possible to undertake a generic construction assessment of noise and vibration impacts based on expected methods of working gained from experience with previous similar developments.

11.6.15 For the purpose of predicting construction noise levels a series of typical activities have been assessed based on likely closest approach and typical plant working.

11.6.16 As detailed in **Appendix 11D**, typical construction plant that are likely to be used on-site include the following:

- excavators;
- cranes;
- earthmoving plant;
- batching plant;
- compressors;
- diesel generators;
- road-going HGVs removing spoils and delivering material (to be minimised by the construction of a jetty to be used for aggregates and cement delivery);
- hand held tools such as disc cutters, grinders and nut runners;
- piling plant;
- concrete pumping plant and trucks;
- rock breakers and crushing plant;
- dewatering pumps; and
- tunnel boring plant.

11.6.17 In addition to the above, blasting of fresh rock may be required during excavations. Whilst blasting might generate significant noise emissions, they will be very short-term. Provided that local residents are given prior notification of blasting events, thereby reducing the potential startle effect, the overall significance in terms of noise impacts is far less significant than longer term activities, assessed below.

11.6.18 The detailed noise prediction calculations presented in **Appendix 11D** and summarised below consider each activity independently. In reality, many of these activities will occur concurrently, and therefore an additional noise prediction modelling exercise has been undertaken to enable a prediction of the effects of these concurrent activities. Details and outputs from this modelling study are provided in **Appendix 11E**. As described above, the following five discrete modelling scenarios (each representing a single point during the HPC site preparation works and construction programme) were considered (see **Table 11.4** for details of assumed activities in each scenario):

- Scenario A – Approximately two months into the site preparation works;
- Scenario B – Approximately six months into the site preparation works;
- Scenario C – Deep excavation (anticipated to commence 2013);
- Scenario D – UK EPR reactor unit construction (anticipated to commence 2014); and
- Scenario E – Night-time construction/maintenance activities (anticipated to commence Q4 2014).

11.6.19 For each scenario, a full complement of assumed plant and equipment, associated sound power level (SWL) and prediction routines, to the requirements of BS 5228-1 (Ref. 11.11), is included in the tables in **Appendix 11D**.

11.6.20 The BS 5228-1 prediction method uses the shortest distance from the receptor to the construction activities. The nearest edge of the relevant construction works site has been used as the calculation point for equipment/plant classed as 'mobile' (loaders and excavators) and similarly the edge of the site has been used as the calculation point for equipment/plant classed as 'fixed' (generators and compressors.).

11.6.21 Predictions of construction activity noise levels at the receptor locations has taken account of features that may affect propagation, such as ground absorption; and, screening by the natural and/or formed topography. Other factors, such as the length of the working traverse and the machinery 'on-time' are also included within the calculations.

Construction Noise from Individual Activities

11.6.22 Predicted noise levels, detailed in **Appendix 11D** and summarised in **Table 11.17**, are therefore worst-case and in practice, the actual noise levels may not attain those predicted. It should be noted that predicted noise levels are based upon the assumption that standard good construction practice measures will be applied. Such measures to control noise impacts are outlined in BS 5228-1:2009. Therefore, source noise data, used in the construction noise calculations, for specified plant (provided in BS 5228-1:2009) is based upon well-maintained equipment, and where appropriate integral acoustic enclosures.

Table 11.17: Summary of Worst-case Predicted Construction Noise Levels at the Nearest Receptor Locations to Hinkley Point C Construction Works based on BS 5228 Calculations (excluding existing ambient noise)

Predicted Worst-Case Daytime Noise Levels#, dB $L_{Aeq,1h}$								
Construction Phase (see key)	Receptor Location							
	Knighton Farm (R9)	Doggetts (R7)	Bishops Farm House (R10)	Wick Farm (R6)	Benhole Lane (south) (R5)	Benhole Lane (north) (R4)	Coastal Footpath (R1)	Pixies Mound (R3)
1	32	41	31	30	30	41	43	73
2	23	26	23	22	28	52	60	38
3	46	46	56	28	38	28	25	27
4	45	44	70	27	37	27	24	26
5	46	44	41	38	62	53	58	54
6	30	40	31	30	39	57	56	61
7	24	26	24	22	28	34	56	35
8	34	38	34	33	39	51	55	52
9	29	58	43	40	32	28	26	33
10	29	32	37	34	36	36	47	56
11	45	69	48	41	70	70	65	58
12	47	70	57	37	50	29	26	32
13	44	37	41	28	63	73	64	39

Notes: Key for construction phases:

1 Upgrade of roads
2 Sea defence construction (using current design)
3 Construction of bridge over Bum Brook
4 Construction of emergency access road
5 Deep excavation and concrete substitution
6 Construction of temporary and permanent buildings (non-nuclear)
7 Tunnelling
8 Construction of Nuclear Island buildings
9 Construction of accommodation campus
10 Construction of the National Grid 400kV substation
11 Final landscaping
12 Early landscaping
13 Construction of temporary jetty and aggregates handling facility

Predicted construction noise levels do not include existing ambient noise levels

Receptor (R) locations shown in Figure 11.1

11.6.23 The predicted construction noise levels do not include existing ambient noise levels at the respective receptor locations and are therefore not measurable for comparison with the proposed noise limits in **Table 11.3**. Baseline ambient noise levels have therefore been added to the predicted construction noise levels above, and presented in **Table 11.18** below. The baseline ambient values used are the arithmetic mean of the measured daytime (07:00-19:00) $L_{Aeq,15min}$ values.

Table 11.18: Summary of Worst-case Predicted Daytime Construction Noise Levels at the Nearest Receptor Locations to Hinkley Point C Construction Works based on BS 5228 Calculations

Predicted Worst-Case Daytime Noise Levels#, dB $L_{Aeq,1h}$								
Construction Phase (See Key)	Receptor Location							
	Knighton Farm (R9)	Doggetts (R7)	Bishops Farm House (R10)	Wick Farm (R6)	Benhole Lane (south) (R5)	Benhole Lane (north) (R4)	Coastal Footpath (R1)	Pixies Mound (R3)
1	46	46	41	46	41	45	46	73
2	46	45	41	46	41	53	60	49
3	49	48	56	46	43	43	43	49
4	48	48	70	46	42	43	43	49
5	49	47	44	47	62	53	59	55
6	46	46	41	46	43	57	56	61
7	46	45	41	46	41	44	56	49
8	46	46	42	46	43	51	55	54
9	46	58	45	47	42	43	43	49
10	46	45	42	46	42	44	49	57
11	48	69	49	47	70	70	65	58
12	50	70	57	47	50	43	43	49
13	48	46	44	46	63	73	64	49

Notes: Key for construction phases:

1 Upgrade of roads
2 Sea defence construction (using current design)
3 Construction of bridge over Bum Brook
4 Construction of emergency access road
5 Deep excavation and concrete substitution
6 Construction of temporary and permanent buildings (non-nuclear)
7 Tunnelling
8 Construction of Nuclear Island buildings
9 Construction of accommodation campus
10 Construction of the National Grid 400kV substation
11 Final landscaping
12 Early restoration landscaping
13 Construction of temporary jetty and aggregates handling facility

Predicted construction noise levels do not include existing ambient noise levels (see **Table 11.12**)

Receptor (**R**) locations shown in **Figure 11.1**

11.6.24 From **Table 11.17** and **Table 11.18** and the calculations in **Appendix 11D**, it can be seen that, during short-term activities associated with construction of the emergency access road, close to Bishops Farm House, the daytime 65dB $L_{Aeq,1h}$ criterion is likely to be exceeded.

11.6.25 Similarly, worst-case predicted noise levels during early landscaping and final landscaping operations at the closest approach to the southern boundary of the SCPA are likely to exceed the adopted 65dB $L_{Aeq,1h}$ daytime criterion at Doggetts. Due to their proximity to residential dwellings, these activities will be restricted to normal working daytime only.

11.6.26 As a result of this worst-case assessment with all plant working at the closest approach, the overall impact of construction noise during daytime construction of the emergency access road and for short periods during the final landscaping operations is assessed as being of **major adverse** significance at the assessed residential receptor locations.

11.6.27 The noise impact at the assessed residential receptor locations of all other construction activities, individually, associated with the HPC development site is assessed as being of **minor** to **moderate adverse** significance due to a combination of the additional distance attenuation and physical screening by the natural and formed topographical features. This assessment is applicable for both daytime and evening periods, as defined in **Table 11.13**. It is evident however, that some activities would result in more significant impacts at residential dwellings if undertaken at night. Based on this, the following activities would be prohibited at night (23:00-07:00 hours):

- construction of the emergency access road and its bridge over Bum Brook;
- landscaping works south of the 144750mN site boundary;
- some activities associated with deep excavation works (rock ripping and crushing); and
- construction of the temporary accommodation campus.

11.6.28 At the assessed public amenity receptor location at Pixies Mound, short-term high magnitude construction noise levels are predicted during the nearby upgrade of roads (two to three months). The significance of this noise magnitude to an outdoor amenity location is assessed as being of **moderate adverse** significance, using the magnitude criteria and sensitivity defined in **Table 11.3** and **Table 11.1**, respectively. Similarly, at the assessed coastal footpath location during construction of the temporary jetty, high magnitude noise levels are predicted. As a worst-case assessment, the significance of this noise magnitude is also assessed as **moderate adverse**.

11.6.29 Due to the availability of suitable tide levels, it is proposed that construction of the jetty in the marine environment would continue during the night. The predicted construction noise level presented in **Table 11.18** includes earthworks associated with the landward aggregates handling facility (daytime only), and therefore does not represent the night-time noise impacts of jetty construction. At night, seaward jetty construction, which would be a further 700m north of the nearest residential dwellings (approximately 1.9km) than the assessed works at the aggregates handling facility, with significant noise screening provided by the coastal cliffs (up to 15m high). The night-time jetty construction noise would therefore be well below the threshold criterion of 45dB $L_{Aeq,1hr}$ (refer to **Table 11.2**), and the impact significance is therefore assessed as **minor adverse**.

11.6.30 During final landscaping activities close to the site boundary, short-term noise impacts of **moderate adverse** significance are also predicted at all three assessed public footpath receptors. However, it should be noted that, for the majority of this phase of works, when plant are operating further within the site boundary, the noise impacts will be less significant.

11.6.31 The magnitude assigned to public amenity receptors is given as if the receptors at these locations would be stationary. However, human receptors at these amenity locations will be transient and are therefore very unlikely to be subject to the same exposure duration as defined for fixed property receptor locations. Therefore, whilst the predicted noise levels might result in short-term disturbance, the impact on a person's enjoyment of these amenities is likely to be less significant than has been assessed.

11.6.32 At each of the assessed outdoor public amenity receptor locations, during all other assessed phases of works, the noise magnitude will vary between very low and medium. Therefore the impact significance is predicted to be **negligible** to **minor adverse**, using the magnitude criteria and sensitivity defined in **Table 11.3** and **Table 11.1**.

Construction Noise from Concurrent Activities

11.6.33 The prediction of noise from individual construction activities in the section above provides a robust assessment of acute impacts with all respective noise-generating sources located at the shortest distance to respective sensitive receptors. In order to better understand what the long-term construction noise impacts are likely to be, a detailed noise prediction model was developed (**Appendix 11E**) which assumed all anticipated operational construction plant and equipment at a given time. For each assessed scenario, the location of operational construction plant was therefore not necessarily at the closest possible working area to individual receptors.

11.6.34 **Table 11.19**, below, provides a summary of the predicted ambient noise levels during concurrent construction activities. By their nature, scenarios that assess later phases of the construction works take into account earlier construction works which effect noise propagation. This includes the formation of landscape features, including early restoration south of the 144750mN boundary and the formation of a boundary earth bund, west of the aggregates handling facility. These design features therefore provide additional acoustic screening to later construction phases.

11.6.35 As presented in **Table 11.18**, the predicted construction noise levels in **Table 11.19**, determined by detailed noise propagation modelling, include typical baseline ambient noise levels (see **Table 11.12**). Predicted noise contours, which exclude baseline ambient noise levels, for the assessed scenarios are shown in **Figures 11.3** to **11.7**.

Table 11.19: Summary of Predicted Ambient Noise Levels at Identified Sensitive Receptor Locations during Combined Hinkley Point C Construction Activities (including existing ambient noise)

Receptor Location	Type	Predicted $L_{Aeq,T}$ Sound Pressure Level#, dB (Free-Field)				
		Scenario (See Notes Below)				
		A	B	C	D	E*
Knighton Farm (R9)	Private residential	51	51	49	49	39
Bishops Farm House (R10)	Private residential	48	49	46	45	38
Doggetts (R7)	Private residential	53	56	54	49	39
Benhole Lane (south) (R5)	Outdoor amenity – Public footpath/PRoW	61	61	54	59	50
Benhole Lane (north) (R4)	Outdoor amenity – Public footpath/PRoW	65	57	59	62	58
Coastal footpath (R1)	Outdoor amenity – Public footpath/PRoW	60	53	55	58	52
Pixies Mound (R3)	Outdoor amenity – Historical feature	69	58	59	61	52

Notes: *# Including typical ambient daytime noise level (see **Table 11.12**)*

** Night-time works excluding ambient noise levels*

Scenario A includes site preparation activities (second month).

Scenario B includes site preparation activities (sixth month).

*Scenario C includes construction activities 5, 6, 7, 9 and 10 (Ref. **Table 11.18**), and operation of the aggregates jetty.*

*Scenario D includes construction activities 6, 7, 8 and 10 (Ref. **Table 11.18**), and operation of the aggregates jetty.*

*Scenario E includes construction activities 6, 7 and 8 (Ref. **Table 11.18**), and operation of the aggregates jetty.*

*Receptor (R) locations shown in **Figure 11.1***

11.6.36 The predicted noise levels represent the coincidence of five discrete and specific moments in time assumed during the site preparation works and main HPC construction phases. They were selected to assess the most substantial works activities (in terms of duration) on the site, such as deep excavation and power station construction. Some activities identified in **Table 11.18** were not, however, captured in the modelled assessments due to their short-term nature (early landscaping will be less than six months duration). In addition, later works phases, including internal mechanical and electrical plant installation, were not considered significant noise sources in contrast with the assessed earthworks and building construction phases.

11.6.37 Activities associated with construction of the proposed aggregates jetty were also not included within the assessed detailed noise prediction model. It is anticipated that these works would commence after the assessed 'Scenario B' (6-months into the site preparation works) and would be complete prior to 'Scenario C' when the site preparation works are complete and the deeper excavations and other main construction works are underway. The potential noise impacts of the construction activities associated with the jetty during the day would be most significant at the coastal footpath receptor location. At other assessed locations, noise from other ongoing activities associated with the site preparation works would be of far greater significance.

11.6.38 Construction of the jetty would be the only night-time activity undertaken during the preliminary works, and therefore the individual construction noise assessment presented in the section above is applicable. Jetty construction at night would result in an impact of **minor adverse** significance to the nearest residential properties.

11.6.39 At residential dwellings, the detailed modelling predicts low to very low magnitude ambient noise levels during these substantial construction works phases (note that Scenarios A and B assess only site preparation works undertaken during daytime periods only). This is assessed to result in a noise impact of **minor adverse** significance at all assessed residential receptors locations.

11.6.40 Similarly, during the night-time (Scenario E only) the predictions in **Table 11.19** indicate a low construction noise magnitude at all assessed residential dwellings. The significance of noise from night-time construction activities is therefore assessed as **minor adverse**.

11.6.41 At the assessed public amenity receptor locations at Benhole Lane (north) and at Pixies Mound, medium magnitude site preparation works noise levels (daytime only) are predicted for 'Scenario A'. These result from earthworks close to the site boundary, comprising cutting and forming of the working platforms in the northern Built Development Areas. The significance of the noise impact to these public amenity locations during these periods is assessed as **minor adverse**, using the magnitude criteria and sensitivity defined in **Table 11.13** and **Table 11.1**, respectively.

11.6.42 At the coastal footpath, very low to low noise magnitude levels are predicted during the assessed scenarios (at a receptor of low sensitivity) and, therefore, the significance of the impact is assessed as **minor adverse**. As noted above, the assessed scenarios do not include construction of the temporary jetty. During jetty construction, it is predicted (see **Table 11.18**) that a medium-term impact of **moderate adverse** significance would result at the coastal footpath,

11.6.43 During the evening period (Mon-Sat), a medium noise magnitude is determined for 'Scenario D' at Benhole Lane (north), due to bulldozers operating in the area of the aggregates handling facility, and at Pixies Mound, due to the National Grid 400kV substation construction (cranes, compressors and electric bolters associated with mechanical and electrical (plant installation). The significance of these impacts is assessed as **minor adverse**.

11.6.44 Walkers using these amenity locations are likely to be transient and are unlikely to be subject to the same exposure duration as defined for fixed property receptor locations. Therefore, whilst the predicted noise levels might result in periodic disturbance, the impact on a person's enjoyment of the amenity is likely to be less significant than has been assessed.

11.6.45 The nature of construction work means that the worst-case situation with the plant working at closest approach may exist for only a matter of days or even hours and there would be regular periods, even during the course of a single day, when the assumed noise generating plant would not be in operation during breaks or changes of working routine.

11.6.46 Blasting of the bedrock (if required) during excavation works in unweathered rock at the two UK EPR reactor unit sites would be approximately 1km north of the nearest private residential property (Doggetts). Given the low magnitude blasts that would be created, and this separation distance, the short-term noise impacts of these events is unlikely to be significant in the context of the proposed noise emission limits in **Table 11.2**. It is also unlikely that impulsive noise from these events would be sufficient to cause a startle response from local residents.

ii. Construction – Noise from Occupation and Use of On-Site Campus Accommodation and Associated Leisure Facilities

11.6.47 This contractor's accommodation campus will be located north of the proposed earth bund which will provide acoustic screening, with the nearest residential accommodation blocks positioned approximately 100m north of Doggetts.

11.6.48 The closest campus amenities (such as shops and leisure facilities) will be approximately 180m north of Doggetts. Mechanical service units (including air-conditioning and refrigeration plant) associated with amenity buildings will therefore be located at a significant distance from existing residential dwellings. Furthermore, there is the opportunity for these items of plant to be located on the northern façades of the respective buildings, thereby providing significant acoustic screening. Similarly, building elements of the proposed amenity blocks will be designed to sufficiently reduce noise breakout.

11.6.49 Acoustic design and control measures will be incorporated to ensure that noise emissions from occupation and amenity use do not exceed 5dB above the $L_{A90,T}$ background level (or 30dB, whichever is greater) at the nearest existing residential properties. The overall noise impact upon existing residential dwellings is therefore assessed as **minor adverse**.

11.6.50 In addition to existing noise sensitive receptors, potential noise impacts to residents of the proposed on-site campus accommodation and associated leisure facilities may occur. Given that this facility will represent the closest residential receptor location to the proposed construction works, noise levels at the campus are likely to exceed those predicted above. However, as the campus forms part of the construction, it will be managed by the contractor's site management, who will be responsible for ensuring adequate living and amenity conditions. Design of the campus buildings, and in particular glazing and ventilation design, will ensure that internal noise levels (in sensitive rooms) are adequate for reasonable resting and sleeping conditions to prevail. This will take account of the need to provide suitable internal amenity during the daytime, when night-shift staff are resting or sleeping (should night-shift staff be accommodated at this campus).

iii. Construction – Noise from Off-Site Traffic

11.6.51 Noise from road traffic generated during the HPC construction phase will have the potential to impact upon occupants of residential dwellings and other sensitive receptors, such as schools and places of worship, on the highway network. The peak levels of construction related traffic are predicted to be 2013 (peak HGV movements) and 2016 (peak workforce numbers). The predicted distribution of the construction works traffic on the highway network in these years has been used to assess the potential noise impacts by comparison of the ‘Do-Nothing’ scenario with the respective ‘Do-Something’ scenarios, as described in Section 11.4.

Daily (18-Hour) Road Traffic Noise

11.6.52 The assessed daily (18-hour AAWT) traffic data in 2013 is based upon the **average day**, during the **peak quarter** of the **peak year** for HGV movements. Although the assessment specifically considers this peak period, i.e. a reasonable worst-case scenario, it should be recognised that, throughout the long-term HPC construction phase there would be a sustained level of generated road traffic (notably HGVs and buses).

11.6.53 **Table 11I.1** in **Appendix 11I** provides a list of assessed road sections. **Table 11I.2** of **Appendix 11I** presents the base and forecast traffic flows. **Table 11I.3** of **Appendix 11I** presents the calculated Basic Noise Level (BNL), including correction for percentage HGV content and average vehicle speed, for each assessed road section.

11.6.54 Comparison between the calculated daily BNL for the 2013 ‘Do-Nothing’ and ‘Do-Something’ scenarios indicates that the greatest change in daily road traffic noise is predicted on High Street in Cannington, where an increase of +7.0dB(A) is predicted. Using the criteria presented in **Table 11.5**, this represents a high magnitude of change for receptors of medium value and sensitivity. The significance of impact for this assessed road section is therefore predicted to be **major adverse**.

11.6.55 Again, in 2013, before the Cannington bypass is operational, a medium magnitude change in daily road traffic noise is predicted on the C182 (Rodway) within Cannington. This impact is therefore assessed as being of **moderate adverse** significance.

11.6.56 A daily road traffic noise impact of **moderate adverse** significance is also predicted on the A39 southern bypass of Cannington throughout the HPC construction period.

11.6.57 For all other assessed roads on the network, a potential increase in daily road traffic noise due to HPC construction traffic ranging from +0.1 to +2.7dB(A) is predicted in 2013. Using the criteria presented in **Table 11.5**, the magnitude of change is assessed as either low or very low on receptors of medium value and sensitivity. This represents a predicted impact of **minor adverse** significance.

11.6.58 A comparison has also been undertaken of the potential change in daily road traffic noise between the calculated BNL in the 2016 'Do-Nothing' and 'Do-Something' scenarios. During this period, the A39 southern Cannington bypass is predicted to experience the greatest change of +4.3dB(A), due to diversion of HPC and public traffic on to the western bypass. This represents a medium magnitude of change and therefore an impact of **moderate adverse** significance on receptors of medium value and sensitivity along this road. Along all other assessed links, the magnitude of change in daily road traffic noise is assessed as either low or very low on receptors of medium value and sensitivity in 2016. The significance of impact is therefore assessed as **minor adverse**.

11.6.59 Beneficial impacts are predicted in 2016 in Cannington with the bypass in place on the C182 (Rodway) south of the northern roundabout of the bypass and Main Road/Fore Street through Cannington. On these links a daily road traffic noise reduction of -2.6dB(A) and -2.1dB(A) respectively is predicted, due to diversion of HPC and public traffic on to the western bypass. This represents a medium and low magnitude change (on receptors of medium value and sensitivity) when compared with the criteria presented in **Table 11.5**. The noise impact is assessed as being of **moderate** and **minor beneficial** significance, respectively.

Hourly Road Traffic Noise

11.6.60 In addition to the above assessment of noise from 18-hour traffic flows over the highway network during HPC construction, it is necessary to undertake an assessment of potential impacts of vehicle movements, associated with changes of shift at the HPC development site during sensitive periods, as well as peak HGV movements during the day. **Tables 11I.4** to **11I.10** in **Appendix 11I** presents the forecast hourly traffic flows on all assessed road sections for the following periods:

- 05:00-07:00 – bus movements (start of shift 1) in the early morning development peak;
- 12:00-13:00 – peak HGV movements during the day; and
- 23:00-01:00 – bus movements (end of shift 2) in the late evening development peak.

11.6.61 The hourly road traffic noise assessments of these periods are therefore worst-case periods taking account of the greatest sensitivity (early morning and late evening), and peak total traffic flows (HGVs during the daytime). The movement of HGVs, from the HPC development site and the proposed freight logistic facilities would be prohibited between the hours of 22:00-07:00.

11.6.62 The assessment of hourly road traffic noise between the hours of 12:00-13:00 is an absolute worst-case, taking the forecast **peak day** in the assessed **peak year**. This was assessed in this way primarily so that the transport assessment ensured that junctions had sufficient capacity throughout the HPC construction phase.

11.6.63 The assessment of hourly road traffic noise in the assessed early morning and late evening periods is a worst-case, based on a regular bus timetable for transporting the workforce to and from the HPC development site.

11.6.64 **Tables 11I.19** and **11I.20** in **Appendix 11I** show the predicted change in the BNL for each assessed hour in 2013 and 2016, respectively. **Tables 11I.29** and **11I.30** in **Appendix 11I** show the noise change magnitude for each assessed hour in 2013 and 2016, respectively.

HPC Construction – 2013 Hourly Traffic Noise Impacts

11.6.65 In 2013, prior to the opening of the proposed Cannington bypass, the greatest changes in hourly BNL are predicted in Cannington. The C182 (Rodway) (AC) and High Street (U) are predicted to experience **major adverse** (on receptors of medium value and sensitivity) impacts during the assessed early morning and late evening hours. This impact would last approximately 18 months prior to the opening of the Cannington bypass.

11.6.66 The A39 eastwards, from the southern Cannington bypass (P) through Sandford Hill (R) and Wembdon Rise (S) are predicted to experience a **major adverse** impact during the assessed early morning and late evening hours.

11.6.67 In Bridgwater, along the A39 Broadway (K5), the significance of impact is assessed as **major adverse** (on receptors of medium value and sensitivity) between the hours of 05:00-06:00 and 23:00-00:00. A **moderate adverse** early morning and late evening road traffic noise impact is predicted on other sections of the A39 through Bridgwater (links K1-K4).

11.6.68 Early morning and late evening road traffic noise impacts of **moderate** to **major adverse** significance were determined on the Western Way Northern Distributor Route (NDR) between Wylds Road at the Quantock Roundabout (links AE, AA, AB and Y). Whilst, an impact of **moderate adverse** significance is predicted along Wylds Road (AD), which is an industrial zone and therefore the designated route for night-time bus movements.

11.6.69 A **moderate adverse** traffic noise impact is also predicted between the hours of 05:00-06:00 and 23:00-00:00 on the A38 Bristol Road (links D and G) between Bridgwater and the proposed J23 development.

11.6.70 A medium magnitude of change is predicted on the Stogursey link between the hours of 06:00-07:00, on receptors of medium value and sensitivity. The significance of impact is therefore assessed as **moderate adverse**. During other assessed night-time hours, the predicted $L_{Aeq\ 1hour}$ is below 55dB, and therefore the road traffic noise impact is assessed as being of **minor adverse** significance. It should be noted that this assessment assumes that all transport of HPC workforce to and from the Williton park and ride site would use this route. In reality, some of these services will route via the A39, through Cannington, with others (minibus only) travelling through Stringston and Stogursey to pick up construction staff that are resident there.

11.6.71 A medium magnitude of change is also predicted for some of the assessed late-evening hours on roads through Williton (Links 2, 3, 4, 6, and 10). This represents an impact of **moderate adverse** significance.

11.6.72 During the daytime, in the hour during which peak vehicles movements associated with the HPC development would occur, the C182 (Rodway) (AC) and High Street (U) are predicted to experience **moderate** and **major adverse** significance impacts, respectively (on receptors of medium value and sensitivity). These impacts would last approximately 18 months, until the western Cannington bypass is operational.

11.6.73 Daytime road traffic noise impacts of **moderate adverse** significance are also predicted on the A39, southern Cannington bypass (P) and Wembdon Rise (S).

11.6.74 On all other assessed roads, in 2013, the magnitude of daytime road traffic noise change is assessed as either low or very low on receptors of medium value and sensitivity. Therefore, the impact is assessed as being of **minor adverse** significance on these links.

HPC Construction – 2016 Hourly Traffic Noise Impacts

11.6.75 In 2016, following the opening of the proposed Cannington bypass, an impact of **major adverse** significance (on receptors of medium value and sensitivity) is predicted on the A39 southern Cannington bypass (P) eastwards towards Bridgwater to Wembdon Rise (links R and S) during the majority of assessed early morning/late evening hours. An impact of this significance is also predicted along the proposed bypass.

11.6.76 Within Cannington village, impacts of **minor** to **moderate beneficial** significance are predicted on the C182 (Rodway) (AC), High Street (U) and Main Road/Fore Street (ZD) on receptors of medium value and sensitivity (as a result of HPC traffic and other vehicles using the proposed Cannington bypass).

11.6.77 In Bridgwater, early morning/late-evening road traffic impacts of **moderate** to **major adverse** significance are predicted along both designated routes for HPC construction traffic. Namely along the A39 between Taunton Road and Wembdon Road (links K1-K5) and between the A38 Bristol Road and Wembdon Road (links AA, AB, AD, AE and Y).

11.6.78 A **moderate adverse** traffic noise impact is also predicted on the A38 Bristol Road between Bridgwater and the proposed J23 development. These impacts are predicted occur between the hours of 05:00-06:00 and 23:00-00:00 (link D), and 05:00-06:00 (link G).

11.6.79 The impact of hourly traffic movements in Williton during the assessed hours is **moderate adverse** on the routes (mainly the A39) through Williton (Links 2-4, 6 and 10) on receptors of medium value and sensitivity.

11.6.80 In addition, the impact along the route that minibuses from the proposed Williton park and ride site will take (through Stringston and Stogursey) is assessed as being of **moderate adverse** significance during all hours excluding 00:00-01:00. A medium magnitude of noise level change is also predicted on the Stogursey link between the hours of 05:00-06:00 and 23:00-00:00, on receptors of medium value and sensitivity. The significance of impact is therefore assessed as **moderate adverse**. Between the hours of 00:00-01:00, the predicted $L_{Aeq\ 1hour}$ is below 55dB, and therefore the road traffic noise impact is assessed as being of **minor adverse** significance. It should be noted that this assessment assumes that all transport of HPC workforce to and from the Williton park and ride site would use this route. In reality, some of these services will route via the A39, through Cannington, with others (minibus only) travelling through Stringston and Stogursey to pick up construction staff that are resident there.

11.6.81 On all other assessed roads, in 2016, the magnitude of road traffic noise change is assessed as either low or very low on receptors of medium value and sensitivity. Therefore, the impact is assessed as being of **minor adverse** significance on these links.

11.6.82 During the daytime, in the hour during which peak HGV movements associated with the HPC development would occur, the A39 southern Cannington bypass (P) predicted to experience an impact of **major adverse** significance (on receptors of medium value and sensitivity). This is due to the diversion of HPC and public traffic towards the western Cannington bypass.

11.6.83 Daytime road traffic noise impacts during the peak hour of HGV movements of **moderate adverse** significance are predicted on the Northern Distributor Route in Bridgwater (links AA, AB, AE, Y and ZE), as well as the A39 between Bridgwater and Cannington (links R and S).

11.6.84 The C182 (Rodway) (AC) is predicted to experience an impact of **moderate beneficial** significance, due to HPC construction and public traffic diverting away from the village centre and on to the western Cannington bypass.

11.6.85 On all other assessed roads, in 2016, the magnitude of daytime road traffic noise change is assessed as either low or very low on receptors of medium value and sensitivity. Therefore, the impact is assessed as being of **minor adverse** significance on these links.

Construction – Noise from Highway Improvements

11.6.86 As part of the proposed HPC development, eleven highway improvements schemes are proposed to existing public highways. The proposed works, are described in **Volume 1**, **Chapter 2**.

11.6.87 For the eleven schemes the only works considered to be of sufficient scale to cause significant adverse noise effects are associated with construction of new roundabouts; at the junction of the A39 and B3190 at Washford Cross, near the proposed Williton park and ride site, and at the junction of the A39 and B3339 at Sandford Corner, south of Cannington. All other proposed highways improvements would require small-scale works lasting for very short periods, and would be completed entirely within the existing highway boundaries.

11.6.88 Construction of the Washford Cross roundabout, which will replace the existing priority junction, is expected to last a maximum of 6 months. The closest noise sensitive receptor to this proposed work is Tropiquaria Zoo (25m to the north-west). The predicted noise level (see **Table 11D.10** of **Appendix 11D**) associated with road construction works at the closest outdoor area of Tropiquaria Zoo is 74dB $L_{Aeq,12h}$ which includes a typical ambient noise level of 63dB $L_{Aeq,day}$ (see **Table 11.2**).

11.6.89 This construction noise magnitude is therefore assessed as high (see **Table 11.7**) on receptors of low importance and sensitivity. The impact of these short-term activities is predicted to be of **moderate adverse** significance. However, human receptors at this location will be transient and are therefore very unlikely to be subject to the same exposure duration as defined for fixed residential receptor locations. Therefore, whilst the predicted noise levels might result in short-term disturbance, the impact on a person's enjoyment of the amenity is likely to be less significant than has been assessed.

11.6.90 The closest residential noise sensitive receptors to the proposed work are Shells Cottages (approximately 200m south-west). At these properties, the predicted road construction noise level (see **Table 11D.11** of **Appendix 11D**) is 54dB $L_{Aeq,12h}$ excluding ambient noise level. This construction noise magnitude is therefore likely to be assessed as low (see **Table 11.7**) on receptors of medium importance and sensitivity. The impact of these short-term activities is predicted to be of **minor adverse** significance.

11.6.91 Construction of the Sandford Corner roundabout, which will replace the existing priority junctions, is also expected to last a maximum of 6 months. The closest noise sensitive receptor to this proposed work is a single residential dwelling approximately 25m to the east and south-east. The predicted noise level (see **Table 11D.12** of **Appendix 11D**) associated with road construction works at this property is 73dB $L_{Aeq,12h}$ excluding ambient noise level. This construction noise magnitude is therefore likely to be assessed as medium (see **Table 11.7** on receptors of medium importance and sensitivity. The impact of these short-term activities is predicted to be of **moderate adverse** significance.

11.6.92 The nature of the construction works means that the conservative situation predicted may exist for only a matter of days, or even hours. There would be regular periods, even during the course of a single day, when the assumed plant would not be in operation, for example during breaks or changes of working routine.

iv. Construction – Vibration from On-Site Construction Activities (excluding blasting) and Highway Improvements Works

11.6.93 Surface plant such as cranes, compressors and generators are not recognised as sources of high levels of environmental vibration. Reference to Figure 1 of 'Control of Vibration and Noise during Piling' (British Steel, 1998 (Ref. 11.26) confirms that, even at a closest distance of 10m, peak particle velocities (PPV) significantly less than 5mm/s are generated by such plant. For example, a bulldozer may generate a PPV of approximately 0.6mm/s and a 'heavy lorry on poor road surface' a PPV of less than 0.1mm/s at 10m. These values are well below limits at which even cosmetic building damage becomes likely (15mm/s (BS 5228-2 (Ref. 11.17)).

11.6.94 Two methods of piling are presently proposed on the HPC development site. These are vibratory sheet piling and continuous flight augur (CFA) piling. Each of these generate relatively low levels of vibration compared with hammer driven piling techniques. Given the distance separations between the site of potential piling operations and the nearest residential dwellings (greater than 1km), vibration levels generated during normal construction activities on the SCPA are likely to be well below the perceptibility level. Notwithstanding this, vibration impacts will be minimised to ensure sensitive activities and machinery associated with nuclear power generation at the operational Hinkley Point B site (approximately 600m to the east) are not adversely affected by the works. Vibration impacts of typical construction activities on the development site are assessed as **minor adverse** at the nearest residential receptors and buildings at the Hinkley Point A and B stations.

v. Construction – Vibration from Blasting

11.6.95 During deep excavation, blasting of the bedrock will be required. This is likely to involve the drilling of a number of boreholes within a rock face, into which are placed the necessary explosive charges. Blast events will be localised and therefore a minimum explosive charge will used to achieve the required rock extraction rate.

11.6.96 Blasting events, however, can be a cause for concern for neighbouring residents due to firstly the sound, which will heighten senses, followed by the possibility of secondary vibrations at audible frequencies caused by air overpressure. This is only likely to occur following surface blasting, where topographical screening of the air overpressure is minimal. In respect of possible effects of this, BS 6472-2 (Ref. 11.21) states that there is *"…no known evidence of structural damage occurring in the United Kingdom as a result of air overpressure levels from blasting associated with mineral extraction"*. The subjective response of a receiver to this air overpressure is often unrelated to the magnitude of the associated ground-borne vibration, which in some cases is not actually perceptible. A well designed blast would, by its very nature minimise the generation of air overpressure, and at distances of greater than 500m, it would not be measureable, except in completely calm meteorological conditions.

11.6.97 Three trial blasts (B-BBH1, B-BBH2 and B-BBH3) were undertaken within the Built Development Area West in April 2010, to determine the reaction of the bedrock to blasting, and to assess the potential vibration impacts. During this time continuous monitoring of both noise and vibration was undertaken at two locations:

- West of the Hinkley Point A site boundary; and
- Bayleys Brook House (residential dwelling) in Shurton.

11.6.98 The monitoring results are presented in the Trial Blast Noise and Vibration Report (see **Appendix 11B**).

11.6.99 **Plate 11.1** to **Plate 11.4** present the noise and vibration levels measured during trial blasting tests within the HPC development site which were undertaken to determine the nature of the levels that could occur at potentially sensitive receptors. For the measurements which were undertaken at Bayleys Brook House and close to the boundary of Hinkley Point A the figures clearly indicate that vibration levels from blasting operations are unlikely to exceed the very low magnitude criterion (6mm/s) identified in **Table 11.9**. Only blast event B-BBH2 registered an observable increase in vibration above the background level at Bayleys Brook House. This maximum recorded PPV level (0.201mm/s) is below the 0.3mm/s level that BS 5228-2 (Ref. 11.21) suggests "…*might be just perceptible in residential environments*". It is however, above 0.14mm/s, the level at which BS 5228-2 states that "…*might be just perceptible in most sensitive situations for most vibration frequencies associated with construction."*

11.6.100 It should be noted that good practice for community relations and health and safety, i.e. notifying the community of planned blast events, and the pre-blast alarm, both serve to raise the sensitivity of local residents to both noise and vibration. Therefore, vibrations may have been perceived by alerted residents.

11.6.101 Peak vibration levels from the blast events are more clearly discernible in the measurement data obtained at the Hinkley Point A monitoring location, approximately half the separation distance than that to Bayleys Brook House (but in a different direction) from the blast site. However, the generated vibration levels at this location were again well below the very low magnitude criterion (6mm/s).

11.6.102 It is difficult to be certain of the exact cause of the measured L_{Amax} during a given one-minute measurement period. However, the maximum A-weighted instantaneous noise level at Bayleys Brook House did not exceed 65dB $L_{Amax,T}$ as a result of the trial blast.

11.6.103 Overall, it is concluded that the vibration magnitude events, although possibly perceptible to alerted residents, was determined to be 'Very Low' in relation to disturbance impacts. Cosmetic damage to buildings is highly unlikely as threshold values for buildings are much higher than those for perception, and disturbance is used in this assessment.

11.6.104 It is therefore predicted that the blasting noise and vibration would have a **minor adverse** impact on the nearest potentially affected receptors of low to medium importance and sensitivity.

Plate 11.1: Measured Noise and Vibration Levels at Bayleys Brook House during Blast Event B-BBH2

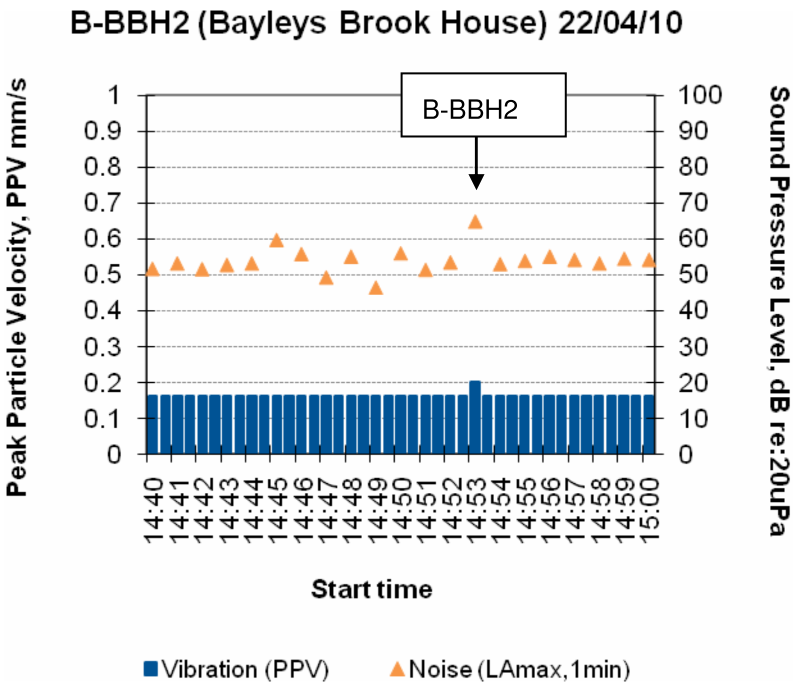


Plate 11.2: Measured Noise and Vibration Levels at Hinkley Point A during Blast Event B-BBH2

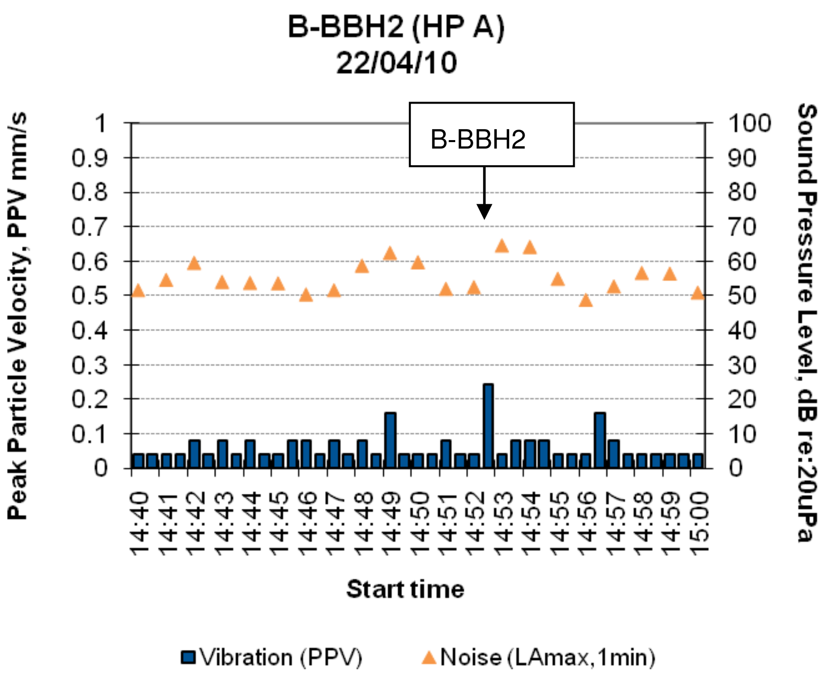


Plate 11.3: Measured Noise and Vibration Levels at Bayleys Brook House during Blast Event B-BBH3 and B-BBH1

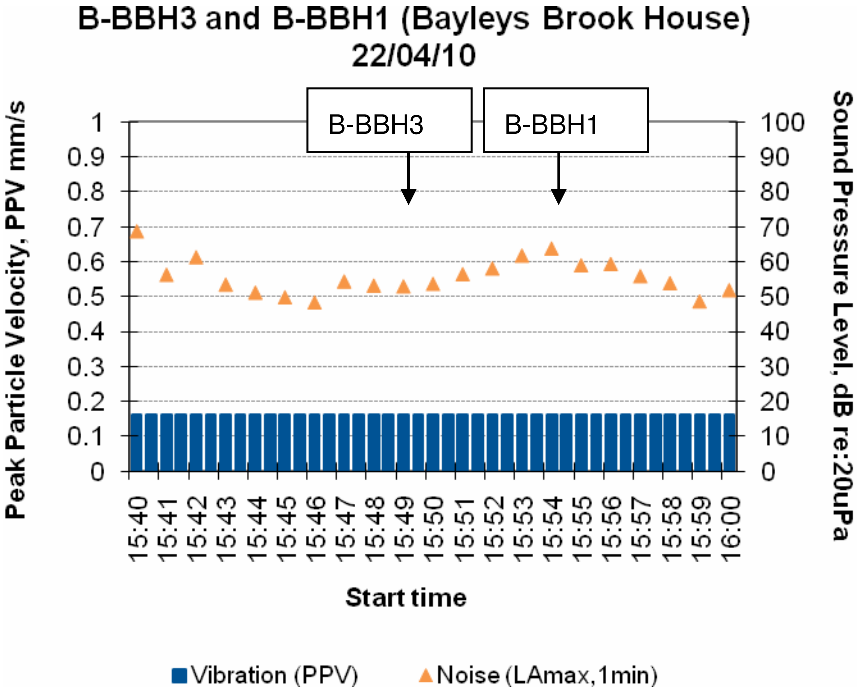
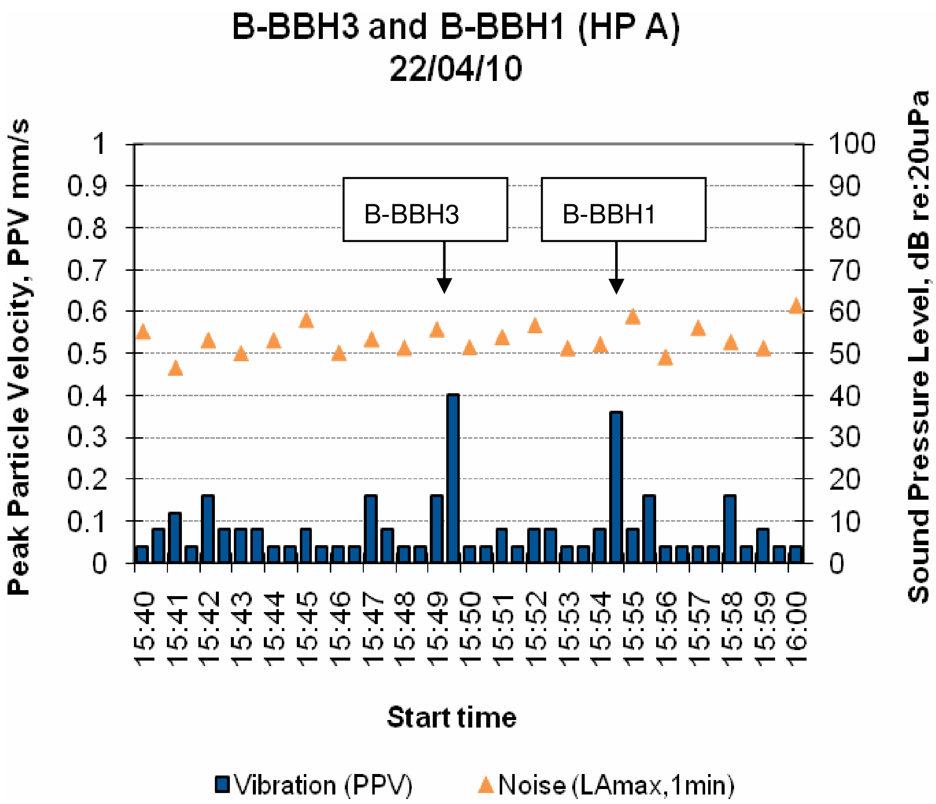


Plate 11.4: Measured Noise and Vibration Levels at Hinkley Point A during Blast Event B-BBH3 and B-BBH1



vi. Construction – Vibration from Off-Site Traffic

11.6.105 Along public highways, passing HGVs, including trucks and buses, may cause occasional building excitation through ground-borne vibration as the vehicle traverses discontinuities, such as rough surfaces or speed-humps. Ground-borne vibration levels generated by HGV traffic will vary depending upon a number of factors (e.g. loading, road surface abnormalities, distance to property, and ground conditions). It is therefore not feasible to quantify potential ground-borne vibration magnitude. However, it is highly unlikely that vibration levels would be sufficient to cause even cosmetic damage to buildings.

11.6.106 The overall impact of ground-borne vibration resulting from road traffic associated with the HPC construction is assessed as being of **minor adverse** significance, on receptors of medium value and sensitivity.

11.6.107 The assessment of 18-hour road traffic flow in 2013 has shown that an increase in traffic is predicted on the A39 southern bypass (P), the A39 between Quantock Roundabout and Sandford Corner (S) and on the route through Stringston and Stogursey. Using the guidance in DMRB (Ref. 11.12), and based on the predicted change in traffic noise, it was determined that the percentage of people *"bothered very much or quite a lot"* by airborne vibration within 40m of these routes will increase by a further 6-10%.

11.6.108 The assessment of 18-hour road traffic flow in 2016 has shown that an increase in traffic is predicted on the A39 southern bypass (P), the A39 between Quantock Roundabout and Sandford Corner (S) and on the route through Stringston and Stogursey. Using the guidance in DMRB (Ref. 11.12), and based on the predicted change in traffic noise, it was determined that the percentage of people *"bothered very much or quite a lot"* by airborne vibration within 40m of these routes will increase by a further 4-11%.

11.6.109 Overall, the impact of airborne vibration resulting from road traffic associated with the HPC construction is assessed as being of **minor adverse** significance, on receptors of medium value and sensitivity.

d) Cumulative Construction Impacts

11.6.110 Major construction activities have the potential to result in cumulative noise and vibration impacts at neighbouring sensitive receptors in terms of disturbance to amenity. The construction vibration assessment above determined that impacts, even during blasting events, at the nearest residential dwellings will be of no greater than minor adverse significance. Vibration may however be perceptible in residential properties, which can lead to feelings of anxiety and/or annoyance in sensitive individuals with strong feelings towards the proposed HPC Project. In this context, the combination of construction noise and vibration could potentially exacerbate an individual's aggravation, thereby heightening their senses to subsequent activities.

11.6.111 Overall, impacts resulting from construction noise will result in the most significant adverse effects to local residents throughout the construction phase, with vibration impacts being of negligible to minor significance. The cumulative impacts are therefore assessed as being no greater than has been assessed for the construction noise.

11.6.112 Noise and vibration from both construction machinery on-site and from construction vehicles on public highways has the potential to result in combined impacts at sensitive receptor locations. These combined effects are therefore not fully addressed in the detailed impact assessment sections above. However, of the neighbouring residential dwellings, only Doggetts would be potentially affected by such in-combination effects (noise only), due to the relative short separation distance from the C182 (Wick Moor Drove).

11.6.113 At a distance of approximately 170m west of the C182, the predicted daily road traffic noise level at Doggetts (Receptor 7 in **Figure 11.1**) would be 50dB $L_{Aeq,16hr}$ in the 2016 'Do-Something' scenario, calculated in accordance with CRTN (Ref. 11.14) and PPG 24 (Ref. 11.6) guidance. Based on the findings presented in **Table 11.7**, for the majority of the HPC construction phase, road traffic noise on the C182 will be the slightly dominant noise source at Doggetts. However, during construction of the accommodation campus, and during early and final landscaping, the noise generated by on-site machinery will be most significant.

11.6.114 Noise exposure from on-site construction machinery will vary significantly dependent upon activity intensity and location. For periods, noise levels generated by on-site construction and by off-site road traffic will be similar, the combined effect would therefore be a slightly more adverse effect. In accordance with the threshold criteria for construction (**Table 11.3**), the magnitude of noise from the combined sources during these periods would be no greater than has been assessed for the construction works alone.

11.6.115 Road traffic, even including HGVs, does not generate significant ground-borne vibration. At the nearest sensitive receptor (Doggetts), vibration from road traffic will not be perceptible. Therefore, overall the worst-case potential impact of combined vibration sources throughout the HPC construction phase is assessed as being of **minor adverse** significance.

e) Operational Impacts

i. Potential Noise-generating Activities during the Operational Phase

11.6.116 Once the construction phases are complete for each UK EPR reactor unit, they will undergo commissioning which will last approximately two years per unit. The commissioning phase will involve a number of activities that are likely to generate noise emissions with atypical characteristics; especially during the testing of essential standby plant such as the diesel generators and the overspeed tests of the steam turbines, which may emit high frequency sounds during high pressure leak tests of water circulation and nuclear steam supply systems.

11.6.117 The primary sources of noise during the operation of HPC relate to the operation of UK EPR reactor units, including the following:

- the discharge stack;
- air entry and exit openings;
- ventilation openings;
- pumping stations;
- steam pipes situated on the Reactor building; and
- equipment situated in the Turbine Hall (such as transformers and alternator).

11.6.118 In addition to site plant noise, there will also be operational traffic-related noise effects. The operation of HPC will require a workforce of approximately 900 staff in total, which will generate additional traffic on the highway network. Additional heavy vehicular traffic and workforce traffic will also be generated for materials delivery during maintenance and refuelling outages, where it is anticipated that a further 600-1,000 staff would be required.

ii. Operation – Commissioning Activities

11.6.119 During the commissioning tests, some activities are likely to generate noise emissions with atypical characteristics; such as high frequency sounds during high pressure leak tests of water circulation and nuclear steam supply systems. It is expected that on-site commissioning tests will require operation of the eight essential diesel generators (EDGs) and four Stand-by Black-out generators (SBOs) for 245-hours per generator.

11.6.120 Release of stored pressure following these tests may be audible at a number of the nearest receptor locations given the possible magnitude of sound pressure levels and the distinctive nature of the sound likely to be generated. However, events are likely to be very short-term (no more than a few minutes each) and can be managed to occur within daytime periods only. Other activities undertaken during the commissioning phase are unlikely to generate noise emissions in excess of those which would occur for the fully operational HPC. Given the short-term nature of these activities, the overall noise impact of commissioning testing is assessed as being of **minor adverse** significance.

11.6.121 Coincident with the commissioning phase, the jetty will be dismantled and removed from site. Dismantling of the jetty development would require similar activities to its construction (except blasting). The predicted noise levels presented in **Table 11.17** are therefore considered representative of a worst-case scenario for this phase of the jetty development. The potential noise impacts are therefore assessed as being of **minor adverse** significance.

11.6.122 Similarly, vibration generated during this phase would be no more significant than assessed for the jetty construction phase, which was also assessed as being of **minor adverse** significance.

iii. Operation – Noise from HPC Operation

11.6.123 The propagation of operational noise emissions from sources on the HPC site, including: machinery; building vents; and building façades, have been modelled using CadnaA computational predictive software. The model scenarios and assumptions of this modelling study are described in detail in **Appendix 11F**. **Table 11.20** below provides a summary of the predicted façade noise level at three neighbouring noise sensitive receptor locations. These locations correspond to background noise measurement locations detailed in the Factual Noise Report (see **Appendix 11A**) (note: background measurements were undertaken in free-field conditions).

Table 11.20: Predicted Operational Noise Level at Nearest Receptor Dwellings (façade) in Proximity to the development site based on Prediction Modelling

Ref.*	Receptor	Predicted Sound Pressure Level, dB (Façade)		
		L_{AT}(LT) (Average wind direction)	L_{AT}(DW) Downwind	L_{AT} Neutral (no wind)
ML2	Knighton Farm (R9)	33.7	36.6	35.2
ML3	Doggetts (R7)	29.6	32.3	30.9
ML4	Wick Farm (R6)	32.2	34.9	33.4

Note: * Refer to Factual Noise Report (**Appendix 11A**) for baseline monitoring location identifiers. Receptor (R) locations shown in **Figure 11.1**.

11.6.124 Calculations were undertaken using three meteorological scenarios:

- average wind direction based on hourly data (2004-2008);
- downwind conditions; and
- neutral (no wind).

11.6.125 BS 4142: 1997 (Ref. 11.23) does not specify how wind effects should be accounted for in propagation predictions, only that the calculation method should be reported and reasoned appropriately. Operational noise propagation has been determined based upon all three scenarios to provide an indication of the meteorological effects. Noise propagation calculations were undertaken in accordance with the International Standards Organisation guidance document ISO 9613: Part 2: 1996 'Attenuation of sound during propagation outdoors' (Ref. 11.22) and the results are presented as noise contours for the neutral and average wind scenarios in **Figure 11.8** and **11.9**.

11.6.126 As would normally be expected, the modelling predictions indicate that noise levels at each assessed receptor location due to operation of the Hinkley Point C site will be greatest under downwind conditions. However, based on meteorological data recorded between 2004 and 2008, wind blowing from the direction of the operational areas of the site to the three assessed receptor locations is infrequent. Knighton Farm was downwind (wind direction from 30°-60°) for just 6.7% of the time, equating to an equivalent of less than 25 days per year. At Doggetts, this was even less common, with downwind conditions occurring for just 3.4% of time (less than 13 days). With a prevailing wind (23.3%) from the west to north-west (270°-300°), there is a slightly greater occurrence of downwind conditions (300°-330°) at Wick Farm, however, this only amounts to 10.2% of the year (approximately 37 days).

11.6.127 Under neutral conditions (no wind), the noise levels are predicted to be 1.4-1.5dB lower. The annual average site noise levels are predicted to be even lower due to the prevailing winds which will inhibit noise propagation to the assessed receptor locations for the majority of the year. The acceptable operational noise criterion typically recommended by WSC is 5dB above background. However, this criterion is based upon the BS 4142: 1997 assessment methodology which states that it is not applicable *"when background and rating noise levels are both very low"* (below 30dB $L_{A90,T}$ and 35dB $L_{Ar,T}$). The baseline noise survey, detailed in the Factual Noise Report (**Appendix 11A**), subsequently determined that background noise levels do fall below the 30dB $L_{A90,T}$ criterion at night (refer to **Table 11.11**), as is typical of a rural location. **Table 11.21** shows the predicted impacts under neutral conditions which neither favour nor discriminate against propagation from source to receiver, in accordance with this methodology. The background noise levels used in this assessment are the lowest measured values to provide an absolute worst-case assessment.

Table 11.21: Assessment of Predicted Specific Noise Levels during Operation of two UK EPR Units at HPC against the Lowest Measured Background Noise Levels at the Nearest Receptor Locations

Ref.*	Receptor	Sound Pressure Level, dB (Free-field)			Difference, dB		Predicted noise less than 5dB above background
		Predicted specific noise level, $L_{Aeq,T}$ (neutral wind)	Lowest measured background level, $L_{A90,T}$ #				
			Day	Night	Day	Night	
ML2/R9	Knighton Farm	32.2	30	30	+2.2	+2.2	Yes
ML3/R7	Doggetts	27.9	32	30	-4.1	-2.1	Yes
ML4/R6	Wick Farm	30.4	37	36	-6.6	-5.6	Yes

Note: * Reference receptor (R) locations identified in **Figure 11.1**, and baseline monitoring locations (ML) referred to in the Factual Noise Report (**Appendix 11A**).
Minimum value of 30dB $L_{A90,T}$ due to limitations of BS4142 methodology.

11.6.128 The assessment indicates that, taking into account the limitations of BS4142, predicted noise levels under neutral wind conditions will be acceptable.

11.6.129 Adoption of the specific target criterion of 38dB $L_{Aeq,T}$ (façade) is proposed for the total noise emissions from all plant operating on the proposed HPC site, determined at the nearest residential properties. The predictions in **Table 11.20** indicate that in the worst-case the annual average noise level outside the assessed receptor dwellings during the night will be well below this criterion. Thus, in accordance with the World Health Organisation guidance document 'Night Noise Guidelines for Europe' (2009) (Ref. 11.2), no observable adverse effects on sleeping conditions are predicted to occur. Therefore, the overall noise impact of operation of the HPC power station will be of **minor adverse** significance.

11.6.130 The detailed noise propagation modelling exercise identified that the most significant noise sources include the two main stack exhaust points (one for each UK EPR reactor), roof-mounted refrigeration units, the main transformer buildings, and heat exchangers associated with the Interim Spent Fuel Store (ISFS) building. However, it should be noted that two of these identified sources will not operate continuously. Ventilation from the two main stacks will only occur as required to maintain appropriate and safe internal conditions. Similarly, it is assumed that eight of the 12 heat exchangers associated with the ISFS building are in operation. However, ventilation will only be required during periods of high ambient air temperature and/or on occasions of a large inventory being stored in the cooling ponds. It should be noted that operation of all 12 heat exchangers would only occur in the event of an emergency.

11.6.131 Furthermore, it was assumed that four of the eight essential diesel generators (EDGs) and two of four Station Black Out (SBO) generators are in operation. This is safety equipment, providing backup power supply in the unlikely event of loss of the main off-site power supply when house load operation fails, so that the UK EPR units can be secured and the reactor cooled. These backup generators routinely operate during periodic tests, which represent an estimated 60-hours per year for each of the EDG and SBO generators.

11.6.132 Mitigation measures will ensure that no noise emissions contain acoustic features which may accentuate the likelihood of disturbance, as defined in Section 8 of BS 4142: 1997. Possible acoustic features include:

- a distinguishable, discrete, continuous note (whine, hiss, screech and hum);
- distinct impulses (bangs, clicks, clatters, or thumps); or
- noise emissions which are irregular enough to attract attention.

11.6.133 Potential sound mitigation to minimise the possible long-term impacts of operational noise are discussed in Section 11.7 below.

iv. Operation – Vibration Noise from HPC Operation

11.6.134 Due to the separation distance (greater than 1.0km), the operation HPC will not result in significant adverse vibration impacts at the nearest residential dwellings in Shurton, Burton, Knighton and Wick. Operational safety requirements implemented at the detailed design stage will ensure that moving parts or machinery will be sufficiently isolated from the ground to ensure that ground-borne vibration is not detrimental to processes either on the operational HPC site or the operational Hinkley Point B site (approximately 0.6km to the west). Operational vibration impacts are therefore assessed as being of **minor adverse** significance.

v. Operation – Noise from Off-Site Traffic

11.6.135 Noise from road traffic generated during the early operation of HPC will have the potential to impact upon occupants of residential dwellings and other sensitive receptors, such as schools and places of worship, aligning the highway network. Whilst traffic generation will be significantly reduced, the assessed year (2021) does not represent only HPC operation, but also residual activities associated with its construction phase. This includes dismantling and restoration of the temporary associated development sites, as well as the construction of the ISFS which will continue to be constructed once the two UK EPR reactor units become operational.

11.6.136 **Table 11I.1** in **Appendix 11I** provides a list of assessed road sections. **Table 11I.2** of **Appendix 11I** presents the base and forecast traffic flows. **Table 11I.3** of **Appendix 11I** presents the calculated Basic Noise Level (BNL), including correction for percentage HGV content and average vehicle speed, for each assessed road section.

11.6.137 Comparison between the calculated daily BNL for the 2021 'Do-Nothing' and 'Do-Something' scenarios indicates that the greatest change in daily road traffic noise is predicted on the A39 southern Cannington bypass, where an increase of +3.0dB(A) is predicted. Using the criteria presented in **Table 11.5** this represents a medium magnitude of change for receptors of medium value and sensitivity. The significance of impact for this assessed road section is therefore predicted to be **moderate adverse**. The level of daily road traffic noise impact significance is predicted to be no worse than **minor adverse** for all other assessed road sections.

11.6.138 Beneficial impacts are predicted in 2021 in Cannington, due to legacy use of the proposed bypass, on roads through Cannington. On these links, a daily road traffic noise reduction of -0.7 to -3.6dB(A) is predicted. This represents a very low to medium magnitude change (on receptors of medium value and sensitivity) when compared with the criteria presented in **Table 11.5**. The noise impact is assessed as being of **minor** to **moderate** beneficial significance.

11.6.139 In addition to the above assessment of noise from 18-hour traffic flows over the highway network during early operation of HPC, it is necessary to undertake an assessment of potential impacts of vehicle movements, including a single construction shift (spent fuel building) and daytime deconstruction of associated development sites. **Tables 11I.4** to **11I.10** in **Appendix 11I** presents the forecast hourly traffic flows on all assessed road sections for the following periods:

- 05:00-07:00;
- 12:00-13:00; and
- 23:00-01:00.

11.6.140 **Table 11I.21** in **Appendix 11I** shows the predicted change in the BNL, whilst **Table 11I.31** shows the noise change magnitude for each assessed hour in 2021.

vi. HPC Early Operation – 2021 Hourly Traffic Noise Impacts

11.6.141 In 2021, when the HPC is fully operational, but construction of the ISFS building and deconstruction of the associated development sites is continuing, the night-time noise impacts from road traffic was determined to be of **minor adverse** significance on all but one route. This is because the remaining construction workforce would operate on a single-shift, therefore removing the requirement for late evening bus movements.

11.6.142 The exception is between the hours of 06:00-07:00 on the existing A39 south Cannington bypass, where a road traffic noise impact of **moderate adverse** significance is predicted.

11.6.143 During the daytime, a noise change of medium magnitude is also predicted on this route, on receptors of medium value and sensitivity, due mainly to HGV traffic associated with ISFS construction. The daytime road traffic noise impact on this section of road is therefore assessed as being of **moderate adverse** significance.

11.6.144 In 2021, the daytime road traffic noise impact was assessed as being no worse than **minor adverse** significance on all other roads, and indeed, with the western Cannington bypass remaining (after the main HPC construction works are complete and both units are operational), hourly road traffic noise impacts of **minor beneficial** significance were determined along many of the assessed routes. This is most notable during the assessed night-time periods, especially within Cannington Village.

vii.HPC Permanent Operation

11.6.145 Upon completion of construction of the ISFS building, and deconstruction of associated development sites, where applicable, the vehicular traffic generation by the HPC site will reduce further. Most significantly, the number of HGV movements between HPC and the M5 Motorway will reduce to negligible levels. Under normal operation, traffic generation will result from commuting site staff (peak operational workforce will be 900 during the dayshift 08:00-16:30), with a short-term increase (600 dayshift, and 400 night-shift for approximately 1-month) during planned outages, at approximately 18 month intervals.

11.6.146 As a result, remaining road traffic noise impacts would be significantly less adverse than was assessed in 2021.

viii. Operation – Vibration from Off-Site Traffic

11.6.147 Along public highways, passing HGVs, including trucks and buses, may cause occasional building excitation through ground-borne vibration as the vehicle traverses discontinuities, such as rough surfaces or speed-humps. Ground-borne vibration levels generated by HGV traffic will vary depending upon a number of factors (e.g. loading, road surface abnormalities, distance to property, and ground conditions). It is therefore not feasible to quantify potential ground-borne vibration magnitude. However, it is highly unlikely that vibration levels would be sufficient to cause even cosmetic damage to buildings.

11.6.148 The overall impact of ground-borne vibration resulting from road traffic associated with the early operation of HPC is assessed as being of **minor adverse** significance, on receptors of medium value and sensitivity.

11.6.149 The overall impact of airborne vibration resulting from road traffic associated with the early operation, and throughout HPC operation, is assessed as being of **minor adverse** significance, on receptors of medium value and sensitivity.

11.7 Mitigation of Impacts

a) Mitigation of Construction Impacts

11.7.1 British Standard BS 5228: Part 1: 2009 (Ref. 11.11) gives detailed advice on standard good construction practice for minimising effects of construction noise. This can take the form of reduction at source, control of noise spread, and in areas of very high noise levels, insulation at receptors. It is likely to be a requirement of any construction contract that the constructors comply with the recommendations in this standard, in order to achieve specific noise limit criteria for each site. The adoption of Best practice construction measures has been taken into account within the assessments set out above.

11.7.2 With regard to blasting operations, as with standard construction activities, blasting events (if required) will be designed to ensure Hinkley Point B operations are not adversely affected. This provision will also ensure that impacts at the nearest residential dwellings (a further 400m from events) are suitably minimised.

11.7.3 During the early stages of HPC construction, early landscaping will raise the elevation of land in the south of the SCPAto the south of the main construction fence line at 144750mN providing screening of all future works. These amended elevations were included within the later modelled scenarios (Scenarios C, D and E), described in Section 11.4.

- Additional, site-specific mitigation measures may be agreed with Officers of WSC and SDC through the use of their prior approval powers under Section 61 of the Control of Pollution Act 1974 (Ref. 11.5).

11.7.4 Measures to be incorporated will be included within the **Noise and Vibration Management Plan** (**NVMP**) for the HPC development site. This will include details of the requirements for ambient noise monitoring throughout the HPC construction programme. Long-term noise monitoring stations will be established at a number of locations within the villages of Shurton, Knighton and Wick. The **NVMP** will also describe the formal procedures for reporting measured ambient noise levels and responding to noise and/or vibration complaints.

11.7.5 In recognition of the overall scale of the proposed HPC construction, EDF Energy has already committed to a Neighbourhood Support Scheme which comprises a Property Price Support Scheme and a Noise Insulation Scheme. These voluntary schemes allow residential property owners in the villages of Shurton, Burton, Knighton, Wick and Stolford to apply for either secondary glazing or new double-glazing, with acoustic ventilation, to be fitted. These schemes are offered irrespective of the significance of the noise impacts as determined in the ES, but demonstrate a fair and responsible action as a commitment to being a good neighbour.

11.7.6 Construction works associated with highway improvements schemes will be restricted to standard daytime working hours only, between the hours of 07:00-19:00 Monday to Friday, and 07:00-13:00 on Saturdays. As such, no works will take place on Sundays or public holidays.

b) Mitigation of Off-Site Traffic Impacts

11.7.7 The associated development sites form part of a transport strategy proposed to alleviate construction traffic impacts associated with the development of the HPC Project. As well as limiting traffic congestion and other potential environmental impacts, such as impacts on local air quality, these mitigation measures are intended to help reduce noise and vibration impacts from road traffic during construction of the HPC Project. The traffic data used in the assessment has made a range of worst-case assumptions which make the assessment robust.

11.7.8 Once operational, the proposed Cannington bypass would reduce the predicted noise impacts from HPC construction traffic in Cannington village. As a result of the proposed bypass, beneficial impacts are predicted along the route through Cannington in the 2016 and 2021 assessment scenarios.

11.7.9 The assessment has assumed that the **Freight Management Strategy** (appended to the **Transport Assessment**) would be in place to minimise as far as is practicable the disturbance from HGVs accessing the HPC development site. There would be no HGVs travelling to the HPC development site during these sensitive periods (between the hours of 22:00 and 07:00).

11.7.10 The two designated routes from Junction 23 and 24 of the M5 through Bridgwater have been designed, where practicable, to use main roads and commercial/industrial routes avoiding more sensitive residential areas. During the night-time periods, buses travelling to and from the J23 development would be diverted from the designated route. Buses would use Wylds Road instead of A38 and The Drove onto Wylds Road. This diversion avoids sensitive residential areas along the A38 in preference for the industrial areas on Wylds Road which would not be occupied during these hours.

c) Mitigation of Operational Impacts

11.7.11 The assessment assumes that, where applicable and permissible in terms of operational and safety requirements, the detailed design of the HPC Project, including plant selection and location, would reduce noise emissions at source as far as reasonably practicable. The assessment set out above assumes that the operational noise emissions would not include tonal or distinct characteristics.

11.8 Residual Impacts

a) On-site Construction

11.8.1 During short-term activities associated with construction of the emergency access road, as well as early and final landscaping south of the 144750mN main construction fence line, the adverse noise impact is assessed as being of short-term **major adverse** significance. This assessment was based on worst-case assumptions with all machinery operating at the closest point to the assessed dwellings. During all other construction activities, including combined on-site works elements during construction of HPC, the residual noise impact is assessed as being of long-term **minor adverse** significance at all assessed residential dwellings and public outdoor amenity locations.

11.8.2 During the night-time, the reduced shift and restricted working will ensure that construction noise impacts are significantly less than during the daytime. Overall, it is assessed that the residual impact of night-time working north of Green Lane will be of long-term **minor adverse** significance to all residential receptor locations.

11.8.3 The residual noise impact to visitors to Pixies Mound during short-term road upgrading works nearby is assessed as being of short-term **moderate adverse** significance. However, this is based upon a one-hour exposure period. In reality, receptors (primarily walkers) are likely to be continually mobile, and are therefore unlikely to experience the predicted noise level for sufficient time for the proposed noise threshold for construction works to be exceeded.

11.8.4 The residual noise impact to the users of the public footpaths along the western boundary of the HPC development site and the coastal footpath to the north of the site is assessed as being of long-term **negligible** to **minor adverse** significance.

11.8.5 Control measures adopted to ensure no adverse construction vibration impacts to ongoing nuclear power generation at Hinkley Point B should provide sufficient protection to the nearest sensitive receptors. It is therefore assessed that the residual vibration impact during the construction phase will be of long-term **minor adverse** significance.

11.8.6 Occupation of the contractor's accommodation campus, including operation and use of the proposed amenities will result in a long-term **minor adverse** noise impact at the nearest noise-sensitive receptor.

b) Off-site Construction Traffic

11.8.7 In relation to noise from road traffic, the impact assessment during construction has been conducted for the years of 2013 and 2016. These are the years that have been assessed in the **Transport Assessment** and represent the peak periods of traffic generation during HPC construction. The 2013 assessment includes the peak period of HGV movements and the 2016 assessment includes the peak period in terms of workforce numbers.

11.8.8 It should be noted that there will be relatively high levels of sustained traffic generation for a period of approximately five to six years within the overall construction programme for HPC. While the 2013 and 2016 assessments represent the peaks in terms of anticipated traffic generation (and thus the worst-case in terms of associated noise impacts) some remaining but lower level of adverse impacts will persist through the main years of the construction programme.

11.8.9 The adverse impacts that have been identified essentially fall into two categories. The first of these is daytime noise impacts which arise principally from the HGV movements to and from the HPC development site. These movements will be limited to the two authorised HGV Routes, and HGV movements on these routes will be restricted to between the hours of 07:00-22:00. Worse-case assumptions have been made for HGV movements in the transport modelling which has been used for the noise impact assessment.

11.8.10 The second area of impacts is noise which arises early in the morning or late in the evening from bus movements required to transport HPC construction workforce to and from the HPC development site. These movements will not occur through the night but will align with the beginning of the first construction shift and the end of the second construction shift and will be limited to a window of approximately 1.5 to 2 hours. As with HGV movements, the modelling of bus movements has been made on robust assumptions which assume that very regular timetables operate on all direct, campus and park & ride bus routes associated with the beginning and end of each construction shift. These timetables are not fixed at this stage and will be finalised once a bus operator has been appointed to provide the bus services. In practice, bus provision and timetables will be regularly adjusted to match the changing patterns of demand and the actual number of buses on many routes is likely to be significantly less than has been modelled at many points in the construction programme. However, at this stage and for the purpose of providing a very robust assessment of transport and noise impacts, fixed timetables on all routes have been used in the modelling.

11.8.11 More generally it should also be noted that EDF Energy's transport strategy has been developed with a significant focus on reducing the traffic impacts during the construction phase of the development. A wide range of measures are being implemented to reduce the volume of traffic movements in relation to both freight and people. While not specifically discussed in this chapter, these measures substantially reduce the scale of traffic – and thus potential noise impacts – which would otherwise occur in their absence. Further information on the transport strategy and the robust nature of the HGV and bus movement assumptions is contained in **Chapter 10** of this volume and in the **Transport Assessment**.

11.8.12 With respect to the absolute noise levels which will arise from HPC related traffic, with the exception of four properties north of Cannington on the C182 (Rodway), these are not predicted, at any point in the construction programme, to breach any statutory limits in relation to road traffic noise or exceed levels at which there would be a statutory requirement to provide mitigation in the form of noise insulation.

11.8.13 A further consideration is that, due to the natural reduction in traffic noise with distance, the adverse impacts that have been assessed will only apply to residential properties and any other receptors which are located adjacent to the road on the affected road links. Any properties that are screened from the road by buildings or other features, or that are set back from the road, will experience substantially reduced impacts which are not likely to be more than long-term **minor adverse** in nature. It is also relevant in this context that on some of the links which are assessed as experiencing adverse impacts there are very few residential properties, or other receptors, which are close to the road – an example of this would be stretches of the A39 between Cannington and Bridgwater.

11.8.14 The two locations where significant numbers of residential properties are assessed as experiencing adverse road traffic noise impacts are Cannington and Bridgwater.

11.8.15 In Bridgwater the scale of noise impacts arising from HPC traffic is materially lower in absolute terms than for Cannington and background traffic flows – in particular during the day – are much higher. Noise impacts arising from daytime HGV movements along one of the designated routes in Bridgwater (the Northern Distributor Route) are assessed as being of **moderate adverse** significance in 2016. Before the opening of the freight management facilities in 2013, and on the other designated HGV route in 2013 and 2016, these daytime impacts are assessed as no more than **minor adverse**. Where other **moderate** or **major adverse** impacts have been assessed in Bridgwater, these relate to the shorter periods of time associated with early morning and late evening bus movements which have as noted above, been modelled on a worse-case basis. These impacts are also limited to existing A-roads which are recognised as the main corridors for traffic through Bridgwater.

11.8.16 The scale of adverse road traffic noise impacts is greatest in Cannington prior to the construction of the Cannington bypass. Properties adjacent to the road in Cannington, on the HGV route to the HPC development site, will experience both daytime noise impacts from HGV movements which are assessed as **major adverse** and early morning/late evening noise impacts from bus movements which are also assessed as **major adverse**. The absolute change in noise levels arising from HPC related traffic is also significantly higher in Cannington prior to the construction of the bypass, than would be the case in Bridgwater.

11.8.17 In recognition of the scale of adverse noise impacts which have been assessed, and taking account of the relatively rural/village character of Cannington, EDF Energy will be providing an offer of noise insulation support to those properties in Cannington which are most affected by transport related noise arising from the HPC Project construction phase. Detailed eligibility will be based on a careful analysis of the findings of the noise assessment work, and further details and communication to eligible residents will take place following submission of the DCO application. The noise insulation scheme will be similar to the support already being offered to properties closest to the HPC development site and will be offered by EDF Energy on a voluntary basis.

11.8.18 Road traffic noise impacts in Cannington will of course also be of a temporary nature as the Cannington bypass will provide traffic relief for the village for the majority of the construction programme. It can be noted that there are long-term and permanent **moderate** to **minor beneficial** noise impacts predicted in Cannington in 2016 and 2021, respectively, arising from the operation of the Cannington bypass and this will persist as a permanent legacy benefit of the HPC Project.

c) In-Combination of Construction

11.8.19 The in-combination noise and vibration effects of on-site machinery and off-site vehicle movements during the construction phase have been assessed to be no more significant than those determined by the detailed individual assessments.

d) Highway Improvements

11.8.20 The most significant proposed highway improvement works with potential to cause adverse noise impact are associated with the construction of roundabouts at Sandford Corner, Cannington and Washford Cross, Williton. It is assessed that construction of the Sandford Corner roundabout will result in a residual short-term noise impact of **moderate adverse** significance at the nearest residential dwelling. These temporary works would be undertaken during standard working day periods only.

11.8.21 Construction of the Washford Cross roundabout will result in a short-term residual noise impact of **minor adverse** significance at the nearest residential dwelling, but **moderate adverse** significance at an adjacent public amenity location. Again, these temporary works would be undertaken during standard working day periods only.

11.8.22 The residual vibration impacts resulting from short-term roundabout construction activities at each location are assessed as being of **minor adverse** significance.

e) On-site Operation

11.8.23 The noise prediction modelling exercise has indicated that worst case, the proposed target criterion of 38dB $L_{Aeq,T}$ is unlikely to be exceeded. Therefore, the overall long-term operational noise impact of the proposed nuclear power station is assessed as being of **minor adverse** significance.

11.8.24 Vibration attenuation measures adopted to ensure no adverse operational impacts to ongoing nuclear power generation at Hinkley Point B, as well as the proposed Hinkley Point C power station itself, should provide sufficient protection to the nearest sensitive receptors. It is therefore assessed that vibration impacts once fully operational will be of **minor adverse** significance.

f) Off-site Operation Traffic

11.8.25 The predicted change in 18-hour daytime road traffic noise during early operation, and subsequent long-term operation, of the proposed nuclear power station in 2021 is assessed as being of **minor adverse** to **moderate beneficial** significance on all existing highways.

11.8.26 The residual impact of road traffic noise during the early morning and late evening periods is of **minor adverse** significance on all but one road link during early operation of HPC. On the A39 southern Cannington bypass, between 06:00-07:00, the residual road traffic noise impact is assessed as being of **moderate adverse** significance. In the permanent operation scenario, however, this is expected to reduce to a **minor adverse** impact.

11.8.27 During the daytime, peak traffic early operational movements in 2021, including construction of the ISFS building and deconstruction of the associated development sites, are predicted to result in road traffic noise impacts of **moderate adverse** significance on the A39 southern bypass of Cannington. Again, these impacts are expected to reduce to **minor adverse** significance in the permanent operation scenario. The impact on all other links is assessed as being of **minor adverse** significance.

11.8.28 During the early operation phase in 2021, hourly road traffic noise impacts of **minor beneficial** significance are predicted on many routes, particularly at night and most notably within Cannington.

11.9 Summary of Impacts

11.9.1 **Table 11.22** presents a summary of the impacts predicted with respect to noise and vibration during the construction, operation and post-operational phase of the proposed development, setting out impacts prior to mitigation, the mitigation proposed and the subsequent residual impacts.

Table 11.22: Summary of Impacts

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
On-site Construction Phase							
Residential dwellings south of the development site	Daytime noise during: • Construction of the emergency access road; • Early landscaping; and • Final landscaping.	High	Localised Direct Adverse Temporary Short-term Reversible	Medium	Major	EDFE to offer a voluntary Main Site Neighbourhood Support Scheme to these properties	Major adverse
	Daytime noise during final landscaping	High	Localised Direct Adverse Temporary Medium-term Reversible	Medium	Major	EDFE to offer a voluntary Main Site Neighbourhood Support Scheme to these properties	Major adverse
	Noise during all other concurrent construction works	Low/very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse
	Night-time noise from Jetty construction	Low/very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse

NOT PROTECTIVELY MARKED

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
	Vibration	Low/very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse
	Noise from occupation of the accommodation campus	Low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse
Visitors to Pixies Mound	Noise during road upgrading works	High	Localised Direct Adverse Temporary Short-term Reversible	Low	Moderate	None proposed	Moderate adverse
	Noise during all other construction works	Medium to very low	Localised Direct Adverse Temporary Long-term Reversible	Low	Minor	n/a	Minor adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Users of the public footpath along the western site boundary	Noise during final landscaping close to the site boundary	High	Localised Direct Adverse Temporary Medium-term Reversible	Low	Moderate	None proposed	Moderate adverse
Users of the coastal footpath	Noise during: • jetty construction; and • final landscaping close to the site boundary.	High	Localised Direct Adverse Temporary Medium-term Reversible	Low	Moderate	None proposed	Moderate adverse
Users of the public footpath along the western site boundary and coastal footpath	Noise during all other concurrent construction works	Medium/very low	Localised Direct Adverse Temporary Long-term Reversible	Low	Minor to negligible	n/a	Minor to negligible adverse
Off-site Highways Improvement Works							
Tropiquaria Zoo, children's playground	Noise from Washford Cross roundabout construction	High	Localised Direct Adverse Temporary Short-term Reversible	Low	Moderate	None proposed	Moderate adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Nearest residential property to Washford Cross roundabout construction	Noise	Low	Localised Direct Adverse Temporary Short-term Reversible	Medium	Minor	n/a	Minor adverse
	Vibration	Low	Localised Direct Adverse Temporary Short-term Reversible	Medium	Minor	n/a	Minor adverse
Nearest residential property to Sandford Corner roundabout construction	Noise	Medium	Localised Direct Adverse Temporary Short-term Reversible	Medium	Moderate	None proposed	Moderate adverse
	Vibration	Low	Localised Direct Adverse Temporary Short-term Reversible	Medium	Minor	n/a	Minor adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Off-site Construction Phase Road Traffic							
Residential properties in proximity to the proposed western bypass of Cannington	2016 Daily road traffic noise	High	Localised Direct Adverse Temporary Long-term Reversible	Medium	Major	EDFE to offer a voluntary Transport Noise Insulation Scheme	Major adverse
	2016 Road traffic noise at night	High	Localised Direct Adverse Temporary Long-term Reversible	Medium	Major	EDFE to offer a voluntary Transport Noise Insulation Scheme	Major adverse
	2016 Daily road traffic vibration	Low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse
Residential properties on designated bus and HGV routes in Bridgwater (between the M5 and the Quantock	Daily road traffic noise	Low/very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Roundabout)	Road traffic noise at night	High/medium	Localised Direct Adverse Temporary Long-term Reversible	Medium	Major to moderate	None proposed	Major to moderate adverse
	2013 Peak daytime road traffic noise	Low/very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse
	2016 Peak daytime road traffic noise	Medium/Low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Moderate to minor	None proposed	Moderate to minor adverse
	Daily road traffic vibration	Low/very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Residential properties on High Street in Cannington	2013 Daily road traffic noise	High	Localised Direct Adverse Temporary Medium-term Reversible	Medium	Major	EDFE to offer a voluntary Transport Noise Insulation Scheme	Major adverse
	2016 Daily road traffic noise	Very low	Localised Direct Beneficial Temporary Long-term Reversible	Medium	Minor	n/a	Minor beneficial
	2013 Road traffic noise at night	Medium	Localised Direct Adverse Temporary Medium-term Reversible	Medium	Moderate	EDFE to offer a voluntary Transport Noise Insulation Scheme	Moderate adverse
	2016 Road traffic noise at night	Very low	Localised Direct Beneficial Temporary Long-term Reversible	Medium	Minor	n/a	Minor beneficial

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
	2013 Peak daytime road traffic noise	High	Localised Direct Adverse Temporary Medium-term Reversible	Medium	Major	EDFE to offer a voluntary Transport Noise Insulation Scheme	Major adverse
	2016 Peak daytime road traffic noise	Very low	Localised Direct Beneficial Temporary Long-term Reversible	Medium	Minor	n/a	Minor beneficial
	Daily road traffic vibration	Low/very low	Localised Direct Beneficial Temporary Long-term Reversible	Medium	Minor	n/a	Minor beneficial
Residential properties on the C182 (Rodway) in Cannington (between High Street and the proposed bypass roundabout)	2013 Daily road traffic noise	Medium	Localised Direct Adverse Temporary Medium-term Reversible	Medium	Moderate	n/a	Moderate adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
	2016 Daily road traffic noise	Low	Localised Direct Beneficial Temporary Long-term Reversible	Medium	Minor	n/a	Minor beneficial
	2013 Road traffic noise at night	High	Localised Direct Adverse Temporary Medium-term Reversible	Medium	Major	EDFE to offer a voluntary Transport Noise Insulation Scheme	Major adverse
	2016 Road traffic noise at night	Low	Localised Direct Beneficial Temporary Long-term Reversible	Medium	Minor	n/a	Minor beneficial
	2013 Peak daytime road traffic noise	Medium	Localised Direct Adverse Temporary Medium-term Reversible	Medium	Moderate	EDFE to offer a voluntary Transport Noise Insulation Scheme	Moderate adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
	2016 Peak daytime road traffic noise	Medium	Localised Direct Beneficial Temporary Long-term Reversible	Medium	Moderate	n/a	Moderate beneficial
	Daily road traffic vibration	Low/very low	Localised Direct Beneficial Temporary Long-term Reversible	Medium	Minor	n/a	Minor beneficial
Residential properties on the A39 between the Quantock Roundabout and the proposed bypass roundabout (southwest of Cannington)	2013 Daily road traffic noise	Medium/very low	Localised Direct Adverse Temporary Medium-term Reversible	Medium	Moderate to minor	None proposed	Moderate to minor adverse
	2016 Daily road traffic noise	Medium/very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Moderate to minor	None proposed	Moderate to minor adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
	Road traffic noise at night	High/medium	Localised Direct Adverse Temporary Long-term Reversible	Medium	Major to moderate	None proposed	Major to moderate adverse
	2013 Peak daytime road traffic noise	Medium/low	Localised Direct Adverse Temporary Medium-term Reversible	Medium	Moderate to minor	None proposed	Moderate to minor adverse
	2016 Peak daytime road traffic noise	High/medium	Localised Direct Adverse Temporary Long-term Reversible	Medium	Major to moderate	None proposed	Major to moderate adverse
	Daily road traffic vibration	Low/very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Residential properties on C182 (Rodway) between the proposed bypass roundabout and the HPC site	Daily road traffic noise	Low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse
	Road traffic noise at night	Low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse
	Peak daytime road traffic noise	Low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse
	Daily road traffic vibration	Low/very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Residential properties in Williton	Daily road traffic noise	Low/very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse
	Road traffic noise at night	Medium to very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Moderate to Minor	None proposed	Moderate to Minor adverse
	Peak daytime road traffic noise	Low/very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse
	Daily road traffic vibration	Low/very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Residential properties between Williton and the HPC site (West Quantoxhead, Kilve, Stringston and Stogursey)	Daily road traffic noise	Low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse
	Road traffic noise at night	Medium/low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Moderate to Minor	None proposed	Moderate to Minor adverse
	Peak daytime road traffic noise	Very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse
	Daily road traffic vibration	Very low	Localised Direct Adverse Temporary Long-term Reversible	Medium	Minor	n/a	Minor adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Operation Phase							
Residential dwellings south of the development site	Noise during commissioning activities	Low	Localised Direct Adverse Temporary Short-term Reversible	Medium	Minor	n/a	Minor adverse
	Noise during jetty dismantling	Low	Localised Direct Adverse Temporary Short-term Reversible	Medium	Minor	n/a	Minor adverse
	Vibration during jetty dismantling	Very low	Localised Direct Adverse Temporary Short-term Reversible	Medium	Minor	n/a	Minor adverse
	Noise during HPC operation	Low	Localised Direct Adverse Permanent Reversible	Medium	Minor	n/a	Minor adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
	Noise during HPC operation	Very low	Localised Direct Adverse Permanent Reversible	Medium	Minor	n/a	Minor adverse
Off-site Early Operation Phase Road Traffic 2021							
Residential properties in proximity to the proposed western bypass of Cannington	Daily road traffic noise	High/medium	Localised Direct Adverse Temporary Short-term Reversible	Medium	Major to moderate	EDFE to offer a voluntary Transport Noise Insulation Scheme during the HPC construction phase	Major to moderate adverse
	Road traffic noise at night	Low	Localised Direct Adverse Temporary Short-term Reversible	Medium	Minor	n/a	Minor adverse
	Daily road traffic vibration	Low	Localised Direct Adverse Temporary Short-term Reversible	Medium	Minor	n/a	Minor adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Brymore School	Daily road traffic noise	Low	Localised Direct Adverse Temporary Short-term Reversible	High	Minor	n/a	Minor adverse
Cannington Cemetery	Daily road traffic noise	Low	Localised Direct Adverse Temporary Short-term Reversible	Medium	Minor	None proposed	Minor adverse
Churches in Cannington	Daily road traffic noise	Low	Localised Direct Beneficial Temporary Short-term Reversible	Medium	Minor	n/a	Minor beneficial
Residential properties on High Street, Main Road, Fore Street and the C182 (Rodway) in Cannington	Daily road traffic noise	Medium to very low	Localised Direct Beneficial Temporary Short-term Reversible	Medium	Moderate to minor	n/a	Moderate to minor beneficial

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
	Road traffic noise at night	Low/very low	Localised Direct Beneficial Temporary Short-term Reversible	Medium	Minor	n/a	Minor beneficial
	Daily road traffic vibration	Very low	Localised Direct Beneficial Temporary Short-term Reversible	Medium	Minor	n/a	Minor beneficial
Residential properties in proximity to the A39 southern Cannington bypass	Daily road traffic noise	Medium	Localised Direct Adverse Temporary Short-term Reversible	Medium	Moderate	n/a	Moderate adverse
	Road traffic noise at night	Medium/low	Localised Direct Adverse Temporary Short-term Reversible	Medium	Moderate to minor	n/a	Moderate to minor adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
	Peak daytime road traffic noise	Medium	Localised Direct Adverse Temporary Short-term Reversible	Medium	Moderate	n/a	Moderate adverse
	Daily road traffic vibration	Low	Localised Direct Adverse Temporary Short-term Reversible	Medium	Minor	n/a	Minor adverse
Residential properties on all other assessed existing highways	Daily road traffic noise	Low/very low	Localised Direct Adverse/ beneficial Temporary Short-term Reversible	Medium	Minor	n/a	Minor adverse to minor beneficial
	Road traffic noise at night	Low/very low	Localised Direct Adverse/ beneficial Temporary Short-term Reversible	Medium	Minor	n/a	Minor adverse to minor beneficial

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
	Daytime traffic noise (hourly)	Low/very low	Localised Direct Adverse/beneficial Temporary Short-term Reversible	Medium	Minor	n/a	Minor adverse to minor beneficial
	Daily road traffic vibration	Low/very low	Localised Direct Adverse Temporary Short-term Reversible	Medium	Minor	n/a	Minor adverse
Off-site Permanent Operation Phase Road Traffic							
Residential properties in proximity to the proposed western bypass of Cannington	Daily road traffic noise	Medium	Localised Direct Adverse Permanent Reversible	Medium	Moderate	EDFE to offer a voluntary Transport Noise Insulation Scheme during the HPC construction phase	Moderate adverse
	Road traffic noise at night	Low	Localised Direct Adverse Permanent Reversible	Medium	Minor	n/a	Minor adverse
	Daily road traffic vibration	Low	Localised Direct Adverse Permanent Reversible	Medium	Minor	n/a	Minor adverse

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Brymore School	Daily road traffic noise	Low	Localised Direct Adverse Permanent Reversible	High	Minor	n/a	Minor adverse
Cannington Cemetery	Daily road traffic noise	Low	Localised Direct Adverse Permanent Reversible	Medium	Minor	n/a	Minor adverse
Churches in Cannington	Daily road traffic noise	Low	Localised Direct Beneficial Permanent Reversible	Medium	Minor	n/a	Minor beneficial
Residential properties on High Street, Main Road, Fore Street and the C182 (Rodway) in Cannington	Daily road traffic noise	Medium to very low	Localised Direct Beneficial Permanent Reversible	Medium	Moderate to minor	n/a	Moderate to minor beneficial
	Road traffic noise at night	Low/very low	Localised Direct Beneficial Permanent Reversible	Medium	Minor	n/a	Minor beneficial

Receptor	Potential Impact	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
	Daily road traffic vibration	Very low	Localised Direct Beneficial Permanent Reversible	Medium	Minor	n/a	Minor beneficial
Residential properties on all other assessed existing highways	Daily road traffic noise	Low/very low	Localised Direct Adverse/beneficial Permanent Reversible	Medium	Minor	n/a	Minor adverse to minor beneficial
	Road traffic noise at night	Low/very low	Localised Direct Adverse/beneficial Permanent Reversible	Medium	Minor	n/a	Minor adverse to minor beneficial
	Daily road traffic vibration	Very low	Localised Direct Adverse/beneficial Permanent Reversible	Medium	Minor	n/a	Minor adverse to minor beneficial

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Glossary

Term	Definition
dB	Sound levels from any source can be measured in frequency bands in order to provide detailed information about the spectral content of the noise i.e. whether is it high pitched, low pitched or with no distinct tonal character. These measurements are usually undertaken in octave or 1/3 octave frequency bands. If these values are logarithmically summed a single dB figure is obtained. This is usually not very helpful as it simply describes the total amount of acoustic energy measured and does not take any account of the ear's ability to hear certain frequencies more readily than others.
dB L_A	The dB L_A figure is used to relate better to the loudness of the sound heard. The dB L_A figure is obtained by subtracting an appropriate correction, which represents the variation in the ear's ability to hear different frequencies, from the individual octave or 1/3 octave band values, before logarithmically summing them. As a result, the single dB L_A value provides a good representation of how loud a sound is perceived.
L_{Aeq}	As almost all sounds vary or fluctuate with time it is helpful, instead of having an instantaneous value to describe the noise event, to have an average of the total acoustic energy experienced over its duration. The L_{Aeq}, 07:00-19:00 for example, describes the equivalent continuous noise level over the 12 hour period between 07:00 and 19:00. In the assessment of proposed industrial equipment or machinery noise, this is referred to as 'specific noise level'.
L_{Amax}	The L_{Amax} is the loudest instantaneous noise level. This is usually the loudest 125 milliseconds measured during any given period of time.
L_{An}	Method of describing with a single value a noise level which varies over a given time period, is to consider the average amount of acoustic energy and the length of time for which a particular noise level is exceeded. If a level of *x* dB L_A is exceed for 6 minutes within one hour, that level can be described as being exceeded for 10% of the measurement period. This is denoted as the $L_{A10\,(1\text{-hour})}$ = x dB. The L_{A10} index is often used to describe road traffic noise whilst the L_{A90}, the noise level exceeded for 90% of the time, is the usual descriptor of the underlying background noise. L_{A1} in addition to L_{Amax} are common descriptors of construction noise.
$L_{Ar,T}$	The rating level, $L_{Ar,T}$, is the specific noise level from proposed industrial plant or machinery plus any adjustment for the characteristic features of the noise.
Pascal (Pa)	Unit of pressure equal to 1 N/m2.
PPV	The Peak Particle Velocity (PPV) is the maximum velocity which is recorded during a particular event and can refer to a particular orientation (vertical or horizontal) or to the maximum (units: mm/s).
SWL or L_w	Sound Power Level (L_w) is the sound power measured on a decibel scale: Lp = 10 Log (*W/W0*), where W0 is the reference value of sound power, 10-12 Watts.
BNL	The basic noise level (BNL) is a parameter used in Guidance document 'Calculation of Road Traffic Noise'. It is the $L_{A10\,(18\text{-hour})}$ or $L_{A10\,(1\text{-hour})}$ at a reference distance of 10m away from the nearside carriageway edge. It is determined based upon the traffic flow, the speed of the traffic, the composition of the traffic, the gradient of the road and the road surface. On any given road the traffic flow, mean speed and composition are interdependent; for example, increasing the traffic flow may cause a reduction in the mean speed so that the net increase in noise level may be comparatively small. Similar effects are observed with changes in composition.
L_{AE} SEL	Sound Exposure Level. A parameter closely related to L_{Aeq} for assessment of events that have similar characteristics but are of different duration. The L_{AE} value contains the same amount of acoustic energy over a 'normalised' one second period as the actual noise event under consideration.

CHAPTER 12: AIR QUALITY

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12. AIR QUALITY

12.1 Introduction

12.1.1 This chapter of the Environmental Statement (ES) provides an assessment of the potential non-radiological air quality impacts associated with the construction and operation of the Hinkley Point C (HPC) development site (see **Volume 2**, **Chapters 2-4** for details). Radiological aspects are covered in **Volume 2**, **Chapter 21**.

12.1.2 Air quality effects arising from the construction and operation (including commissioning) of HPC relate to:

- Site preparation and ground terracing activities.
- Construction operations including the movement and operation of a wide range of construction plant and machinery.
- Off-site construction transport-related movements.
- HPC commissioning and operational processes.
- Off-site operational transport-related movements.

12.1.3 An introduction to air quality and the associated terminology used in this chapter is provided in **Appendix 12A.**

12.2 Scope and Objectives of Assessment

12.2.1 The scope of this assessment has been determined through a formal Environmental Impact Assessment (EIA) scoping process undertaken with the Infrastructure Planning Commission (IPC). It has also been informed by consultation with statutory consultees including West Somerset Council (WSC) and Sedgemoor District Council (SDC), as the relevant local authorities, and also by comments received from non-statutory consultees, including local residents and members of the general public, in response to the Stage 1, Stage 2, and Stage 2 Update consultations.

12.2.2 This chapter is complemented by an air quality monitoring report (Ref. 12.1), henceforth referred to as the "Air Quality Monitoring Report", and an air quality modelling report (Ref. 12.2), henceforth referred to as the "Air Quality Modelling Report". The Air Quality Monitoring Report includes details of the baseline air quality monitoring completed at locations in the vicinity of the HPC development site, whilst the Air Quality Modelling Report contains technical details of all the dispersion modelling studies undertaken to assist with the prediction of the potential air quality impacts as a result of the HPC development.

12.2.3 The assessment of air quality impacts has been undertaken adopting the methodologies described in **Volume 1**, **Chapter 7** and in section 12.4. The existing baseline conditions, against which the likely environmental impacts of the proposed development are assessed, have been determined through baseline air quality monitoring and modelling, and are described in sections 12.5 and 12.6.

12.2.4 Air quality impacts are presented in section 12.6, and appropriate mitigation measures aimed at preventing, reducing or off-setting any potential adverse impacts that are identified to be potentially significant are identified in section 12.7. An assessment of residual impacts following implementation of these mitigation measures is presented in section 12.8.

12.2.5 The potential site-specific cumulative air quality impacts from different aspects of the proposed HPC development during the construction and operational phases are assessed in this chapter. Cumulative air quality impacts arising from the proposed development in combination with other elements of the HPC Project and other relevant planned or reasonably foreseeable projects are identified and assessed in **Volume 11** of this ES.

12.2.6 The objectives underlying the air quality assessment are to:

- Identify potentially sensitive receptor locations that may be affected by the construction or operational phases of the proposed development.
- Characterise baseline air quality within the study area.
- Assess air quality impacts of the proposed development on sensitive receptors within the study area;
  - predict the potential air quality impacts during the site preparation works, construction of a temporary jetty, and construction of the two UK EPR Units (referred to herein as Units C1 and C2) and ancillary buildings;
  - predict the potential air quality impacts associated with road traffic at key stages of the construction phase and also during operation; and
  - predict the potential air quality impacts from the relevant components of the operational HPC power station.
- Recommend mitigation measures, if considered necessary, to prevent, reduce or off-set the air quality impacts on sensitive receptors.
- Assess the residual air quality impacts on sensitive receptors.

12.2.7 Air quality impacts resulting during decommissioning of the proposed HPC power station are not considered in this assessment. Decommissioning is outlined in **Volume 2**, **Chapter 5** of the ES, and prior to undertaking this phase, a full EIA will be submitted for approval to the relevant organisation(s) at the appropriate time.

12.3 Legislation, Policy and Guidance

12.3.1 This section identifies and describes legislation, policy and guidance of relevance to the assessment of potential air quality impacts associated with the construction and operation of the proposed development.

12.3.1 As stated in **Volume 1**, **Chapter 4**, the Overarching National Policy Statement (NPS) for Energy (EN-1) when combined with the NPS for Nuclear Power Generation (EN-6) provides the primary basis for decisions by the IPC on applications for nuclear power generation developments that fall within the scope of the NPSs.

12.3.2 Notwithstanding this, the IPC may consider other matters that are both important and relevant to its decision-making. This could include Planning Policy Statements (PPSs), Planning Policy Guidance Notes (PPGs), regional and local policy documents, although, if there is a conflict between these and the NPS, the NPS prevails for the purposes of IPC decision making.

12.3.1 Further, the Planning Act 2008 provides that the IPC must, in making its decision on an application, have regard to any Local Impact Report (LIR) prepared by relevant local authorities. It is anticipated that the LIRs will rely in part on PPSs, PPGs, regional and local policy to provide a context for their assessment. On this basis, regard has been given to these documents (where relevant to the technical assessment) since they are likely to inform the LIRs prepared by the relevant local authorities.

a) International Legislation

i. The World Health Organisation (WHO) Air Quality Guidelines (AQGs) (Ref. 12.3 and Ref. 12.4)

12.3.2 WHO AQGs (Ref. 12.3 and Ref. 12.4) offer global guidance to policy-makers on reducing the health impacts of air pollution. The guidelines, first produced in 1987 and updated in 1997, previously adopted a European scope, whilst the current 2005 guidelines are applied globally. They recommend revised limits for the concentration of selected air pollutants including particulate matter (PM), ozone (O_3), nitrogen dioxide (NO_2) and sulphur dioxide (SO_2) applicable across all WHO regions.

12.3.3 In addition to the guideline values, the AQGs give interim targets (ITs) related to outdoor air pollution, for each air pollutant, aimed at promoting a gradual shift to lower concentrations. If these ITs are achieved, reductions in risks for acute and chronic health impacts from air pollution would be expected, but the ultimate objective should be progress towards the guideline values.

12.3.4 Although these guidelines are neither standards nor legally binding criteria, they are designed to offer guidance in reducing the health impacts of air pollution based on expert evaluation of current scientific evidence. The WHO AQGs and ITs are summarised in **Appendix 12B**, **Table 1**.

b) European Legislation

i. Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on Ambient Air Quality and Cleaner Air for Europe (EU Directive 2008/50/EC) (Ref. 12.5)

12.3.5 European Union (EU) policy on air quality aims to develop and implement appropriate instruments to improve air quality within the EU member states. EU Directive 2008/50/EC (Ref. 12.5), which came into force in June 2008, merges most of the existing air quality legislation into a single directive (the exception is the fourth "Daughter Directive" under the 1996 Framework Directive (96/62/EC)) (Ref. 12.6). This reorganisation of the legislation did not include a change to the existing air quality Limit Values. It introduces a new framework for $PM_{2.5}$ (fine particles), including the limit value and exposure related targets with a period of two years provided to all EU Member States to transpose the new Directive. The introduction of this framework was based on increasing evidence that this size of particle can be more closely associated with observed adverse health impacts than PM_{10}. The EU air quality Limit Values are summarised in **Appendix 12B, Table 2**.

12.3.6 The air quality Limit Values relate to ambient pollutant concentrations in the air and the limits are set on the basis of medical and scientific evidence reviewed by the Expert Panel on Air Quality Standards (EPAQS) and the WHO as to how each pollutant affects human health. Above these limits, sensitive members of the public (e.g. children, the elderly and the infirm) may experience adverse health impacts.

12.3.7 Other European Directives relate to equipment standards such as the control of emissions of gaseous and particulate pollutants from internal combustion engines and on the quality of petrol and diesel fuels. These are discussed in greater detail in section 12.6.

c) UK Legislation and Guidance

i. The Environment Act 1995 (Ref. 12.7)

12.3.8 The Environment Act 1995 (Ref. 12.7) required the preparation of a national Air Quality Strategy to set air quality standards and objectives for specified pollutants. The Act also outlined measures to be taken by local authorities (LAs) in relation to meeting those standards and objectives (the Local Air Quality Management (LAQM) framework).

ii. The Air Quality Standards Regulations (Ref. 12.8)

12.3.9 The Air Quality Standards Regulations 2010 (Ref. 12.8) transpose into UK legislation the European Directives (Ref. 12.4), the Council's decision on exchange of information (Ref. 12.9), as well as replacing the Air Quality Standards Regulations 2007 (Ref. 12.10). The Air Quality Standards Regulations 2010 came into force in the UK on 11 June 2010. The Air Quality Limit Values are transposed into the updated Regulations as Air Quality Standards (AQS) with attainment dates in line with the European Directives.

iii. The Air Quality Regulations 2000 (Ref. 12.11), the Air Quality Regulations 2002 (Ref. 12.12) and the Air Quality Strategy for England, Scotland, Wales and Northern Ireland (Ref. 12.13)

12.3.10 In the UK, action on air quality is driven by the health-based objectives for key air pollutants, which have been made statutory through the Air Quality Regulations 2000 (Ref. 12.11), as amended in 2002 (Ref. 12.12), and set out in the 2007 Air Quality Strategy for England, Scotland, Wales and Northern Ireland (The Air Quality Strategy) (Ref. 12.13). The Air Quality Objectives (AQOs) are based on the Air Quality Standards/Air Quality Limit Values, with interim target dates to help the UK move toward the achievement of the EU Air Quality Limit Values. The AQOs in The Air Quality Strategy are a statement of policy intentions or policy targets and as such, there is no legal requirement to meet these objectives, except in so far as they mirror any equivalent legally binding Limit Values in EU legislation.

12.3.11 The AQOs incorporate dates by which each standard is to be achieved. These are policy based targets set by the Government which take into account economic efficiency, practicability and technical feasibility. Some objectives are equal to the EPAQS recommended standards or WHO guideline limits, whereas others involve a margin of tolerance (i.e. a limited number of permitted exceedences of the standard over a given period).

12.3.12 The AQOs for each pollutant in The Air Quality Strategy and the Air Quality Regulations set out above are summarised in **Appendix 12B, Table 3**. For some pollutants (e.g. NO_2), there is both a long-term (annual mean) and a short-term standard. In the case of NO_2, the short-term objective is for a 1-hour averaging period, whereas for fine particles (PM_{10}) it is for a 24-hour averaging period. These periods reflect the varying impacts on health of differing exposures to pollutants, for example temporary exposure of persons on the pavement adjacent to a busy road, compared with the exposure of occupiers of residential properties adjacent to a road.

12.3.13 The 2007 Air Quality Strategy replaced the previous Air Quality Strategy for England, Scotland, Wales and Northern Ireland (January 2000) and Addendum (February 2003). The majority of the AQOs set out in this previous version of The Air Quality Strategy were retained; however, the provisional objectives previously proposed for PM_{10} were replaced in England, Wales and Northern Ireland with a new framework for considering the impacts of $PM_{2.5}$. The Air Quality Standards Regulations 2010 (Ref. 12.8) incorporated into statute the annual mean $PM_{2.5}$ AQO limit value of 25µg/m^3 as previously set out in The Air Quality Strategy (to be achieved by 2015), and also defined exposure reduction targets for $PM_{2.5}$. However, these $PM_{2.5}$ objectives/reduction targets have not been incorporated into LAQM Regulations and local authorities have no statutory obligation to review and assess air quality against them.

12.3.14 Of the pollutants included in the Air Quality Strategy, NO_x/NO_2, PM_{10} and $PM_{2.5}$ are particularly relevant to this assessment, as road traffic is a major source of these pollutants. Where road traffic is the dominant source of air pollution, the objectives for these pollutants tend to be the most difficult to achieve according to the experience of local authorities undertaking review and assessments of air quality. Further, it is generally considered that where the AQOs for the concentrations of NO_2 and PM_{10} are achieved, and where there are no other significant local sources of air pollution, such as from industrial processes, the AQOs for the other pollutants included within the Air Quality Standards Regulations 2010 (Ref. 12.8) should also be achieved.

iv. Local Air Quality Management Technical Guidance LAQM.TG(09) (Ref. 12.14)

12.3.15 The Department for Environment, Food and Rural Affairs (Defra) has published technical guidance for use by local authorities in their review and assessment work. Local Air Quality Management Technical Guidance LAQM.TG(09) (Ref. 12.14) is designed to support local authorities in carrying out their duties under the Environment Act 1995 (Ref. 12.7) and subsequent Air Quality Regulations (Ref. 12.11 and Ref. 12.12).

12.3.16 LAQM.TG(09) provides guidance to local authorities on when to declare an Air Quality Management Area (AQMA) should exceedences of AQOs occur. In setting an AQMA, a local authority must then formulate an Air Quality Action Plan (AQAP) to seek to reduce pollutant concentrations to values below AQO levels. Progression towards this goal is managed through the on-going LAQM review and assessment process.

12.3.17 The guidance, referred to in this chapter as LAQM.TG(09), has been used where appropriate to inform the assessment presented herein.

v. The Environmental Protection Act 1990 (EPA) (Ref. 12.15)

12.3.18 The EPA 1990 (Ref. 12.15) makes provision within England, Wales and Scotland for the improved control of pollution arising from certain industrial and other processes. Part of the EPA applies to the control of dust and particulates associated with construction.

12.3.19 The EPA (Ref. 12.15) defines statutory nuisances. Definitions of statutory nuisance relevant to dust and particles are:

- *“Any dust, steam, smell or other effluvia arising from industrial, trade or business premises or smoke, fumes or gases emitted from premises so as to be prejudicial to health or a nuisance”; and*
- *“Any accumulation or deposit which is prejudicial to health or a nuisance”.*

12.3.20 Section 79 of the EPA states that where a statutory nuisance is shown to exist, the local authority must serve an abatement notice. Failure to comply with an abatement notice is an offence and, if necessary, the local authority may abate the nuisance and recover expenses.

12.3.21 There are no statutory limit values for dust deposition above which ‘nuisance’ or ‘annoyance’ is deemed to exist. Nuisance/annoyance is a subjective concept and its perception is highly dependent upon the existing conditions and the change to air quality conditions which has occurred (i.e. increases in pollutant concentrations or dust deposition rates relative to background levels).

12.3.22 However, research carried out on behalf of the former Department of the Environment (DoE) (Ref. 12.16) provides some guidance as to the determination of annoyance from dust and suggests that complaints are likely when the rate of dust deposition is 2 to 3 times the normal background level of dust deposition in the area. The report suggests that it is preferable that continuous sources with a high or medium dust emission potential are separated by a stand-off distance from sensitive uses, and goes on to recommend a distance of between 100-200m separation from a significant dust emitting source (with the qualification that these distances can be reduced if appropriate, and if effective mitigation measures are identified and implemented).

d) National Planning Policy

i. Planning Policy Statement 23: Planning and Pollution Control (PPS23) (2004) (Ref. 12.17)

12.3.23 National policy for local planning authorities in England regarding local air quality and new development is provided in PPS23 (Ref. 12.17). This statement provides advice on the policies and practices that should be taken into account by those involved in the planning of any development that has the potential to cause pollution.

12.3.24 With regard to emissions to air, and specifically LAQM, PPS23 states, in Paragraph 8, that:

- *"any consideration of the quality of air and potential impacts arising from development, possibly leading to an impact on health, is capable of being a material planning consideration, in so far as it arises or may arise from any land use."*

12.3.25 This is most likely to be the case in situations where the proposed development could produce an exceedence of the AQOs and result in an AQMA designation, where development is proposed in an AQMA, or where a proposed development renders a local authority's AQAP unworkable.

12.3.26 PPS23 also states that the presence of an AQMA should not result in the sterilisation of a site from development.

e) Regional Planning Policy

12.3.27 The Government's revocation of regional strategies was quashed in the High Court on 10 November 2010. However, on that same date the Government reiterated in a letter to Chief Planners its intention to revoke regional strategies through the Localism Bill. This letter was also challenged but, on 7 February 2011, the High Court held that the Government's advice to local authorities that the proposed revocation of regional strategies was to be regarded as a material consideration in their planning development control decisions should stand. The decision of the High Court was upheld by the Court of Appeal on 27 May 2011. Therefore, the regional strategies remain in place but in the case of development control decisions it is for planning decision makers to decide on the weight to be attached to the strategies (see **Volume 1**, **Chapter 4** for a full summary of the position regarding the status of regional planning policy).

i. Regional Planning Guidance 10 for the South West 2001-2016 (RPG10) (2001) (Ref. 12.18)

12.3.28 RPG 10 (Ref. 12.18) sets out the broad development strategy for the South West for the period to 2016 and beyond. Paragraph 4.9 explains that reducing the need to travel by concentrating development in and around urban areas and placing a greater emphasis on movement by foot, cycle and public transport will be important in helping to reduce air pollution overall. Policy EN2: Air Quality states:

"Local authorities should:

- *include in their development plans and proposals policies on the location of potentially polluting developments and of sensitive developments in the vicinity of existing polluting developments, in line with guidance in PPS23 (as and when it is updated) and in Air Quality and Land Use Planning LAGM.G3(00);*
- *designate air quality management areas where required as part of the local air quality management process; and*
- *ensure that air quality considerations are properly considered along with other material considerations in the planning process, particularly where any air quality management areas have been designated."*

ii. Draft Revised Regional Spatial Strategy (RSS) for the South West Incorporating the Secretary of State's Proposed Changes for Public Consultation (July 2008) (Ref. 12.19)

12.3.29 **Chapter 7** sets out the strategy's approach to environmental quality. Within this chapter, Policy RE9: Air Quality states:

- *"The impacts of development proposals on air quality must be taken into account and Local Authorities should ensure, through LDD's that new development will not exacerbate air quality problems in existing and potential AQMA's.*
- *This should include considerations of the potential impacts of new developments and increased traffic levels on internationally designated nature conservation sites, and adopt mitigation measures to address these impacts."*

iii. Somerset & Exmoor National Park Joint Structure Plan Review 1991-2001 (2000) (Policies 'saved' from 27 September 2007) (Ref. 12.20)

12.3.30 **Chapter 4** provides a framework for protection, conservation and management for the natural and built environment. There are no specific policies relating to air quality within the Structure Plan.

f) Local Planning Policy

i. West Somerset District Council. The West Somerset District Local Plan (2006) (Ref. 12.21)

12.3.31 The West Somerset District Local Plan forms part of the development plan for the site. The Local Plan was adopted in 2006 with relevant policies saved from April 2009.

12.3.32 There are no specific policies relating to air quality within the Local Plan and the HPC development site is not affected by any specific air quality designations.

ii. Sedgemoor District Local Plan 1991-2011 (Policies 'saved' from 27 September 2007) (Ref. 12.22)

12.3.33 The Sedgemoor District Local Plan (Ref. 12.22) forms part of the Development Plan for Sedgemoor. The Local Plan was adopted in September 2004 (with relevant policies 'saved' from 27 September 2007). The Proposals Map (Southern Sheet and Inset Map No. 20) indicates that the wider HPC Project area is not subject to any specific air quality designations. The site lies outside of the defined Development Boundary.

12.3.34 There are no specific policies relating to air quality within the Local Plan.

iii. Sedgemoor District Council Local Development Framework (LDF) Core Strategy (Proposed Submission) (September 2010) (Ref. 12.23)

12.3.35 The Sedgemoor LDF Core Strategy (Proposed Submission) was consulted on from September to November 2010. Changes prior to submission proposed as a result of the consultation process were reported and endorsed by the Council's Executive Committee on 9 February 2011. The Core Strategy (Proposed Submission) was submitted to the Secretary of State on 3 March 2011 and an Examination in Public (EiP) was held in May 2011. Once adopted, the Core Strategy will form part of the Development Plan for Sedgemoor.

12.3.36 EDF Energy submitted representations objecting to the Core Strategy (Proposed Submission), relating to chapter 4 ‘Major Infrastructure Projects’ (and policies MIP1, MIP2 and MIP3 contained in that chapter) and those sections relating to housing and Hinkley Point. EDF Energy also participated at the relevant EiP hearings. See **Volume 1**, **Chapter 4** for a full summary of the position regarding the status of the Core Strategy.

12.3.37 The following Core Strategy (Proposed Submission) policies are of potential relevance:

12.3.38 Policy S3 (Sustainable Development Principles) states that development proposals will be expected to, amongst other things, protect and enhance the quality of the natural, built and historic environment.

12.3.39 Policy D4 (Renewable and Low Carbon Energy Generation) states that the Council will support such proposals provided that such installations would not have significant adverse impact taking into account, amongst other things, any unreasonable adverse impact on users and residents of the local area including the generation of emissions.

12.3.40 Policy D9 (Sustainable Transport and Movement) states that proposals should contribute to the reduction of adverse environmental issues, including air pollution, through appropriate mitigation measures.

12.3.41 Policy D10 (Managing the Transport Impacts of Development) states that development proposals that will have a significant transport impact should be supported by an appropriate Air Quality Assessment.

12.3.42 Policy D16 (Pollution Impacts of Development and Protecting Residential Amenity) states:

> *“Development proposals that are likely to result in levels of air, noise, light or water pollution (including groundwater) vibration or soil contamination that would be harmful to other land uses, human health, tranquillity or the built and natural environment will not be supported.*
>
> *Where there are reasonable grounds to suggest that a development proposal may result in a significant adverse environmental impact, the Council will require planning applications to be supported by assessments relating to [amongst other things]:*
>
> - *air pollution; and*
> - *carbon emissions.*
>
> *Where it is demonstrated that it is possible to manage the potential adverse impacts of the development proposals through its design or mitigation measures, the Council will, by means of condition or legal agreement, seek to ensure such measures are effective, for example improving limitations on matters including hours of operation, emissions of fumes, noise and light, parking and servicing for both construction and operational stages.”*

g) Supplementary Planning Guidance

12.3.43 Sedgemoor District Council and West Somerset Council have jointly prepared draft supplementary planning guidance in relation to the HPC Project. Public consultation on the Consultation Draft version of the Hinkley Point C Project Supplementary Planning Document (the draft HPC SPD) commenced on 1 March 2011 and concluded on 12 April 2011. EDF Energy has submitted representations which object to the draft HPC SPD. See **Volume 1**, **Chapter 4** for a full summary of the position regarding the status of the draft HPC SPD.

12.3.44 The draft HPC SPD does not set out any specific guidance in relation to air quality impacts at the site. In relation to transport generally, Box 8 of the draft HPC SPD states that the County Council and District Councils will expect the HPC Project promoter to, amongst other things, provide necessary improvements to the transport network to mitigate against any adverse impacts on the community; including but not limited to congestion and air quality (page 19).

12.3.45 Further planning policy context is provided in the Legislative Planning Policy Context chapter (**Volume 1**, **Chapter 4**) and the Introduction chapter (**Volume 2**, **Chapter 1**).

i. Bridgwater Vision (Ref. 12.24)

12.3.46 Whilst not forming part of the statutory Development Plan for Sedgemoor, the Bridgwater Vision (Ref 12.24) sets out a regeneration framework for Bridgwater, comprising a 50 year vision and seven transformational themes for the town.

12.3.47 The document makes specific reference to Hinkley Point as a strategic project and acknowledges the opportunities and challenges such development will have on the area. It goes on to state that it will be essential to evaluate the environmental impact of the Hinkley Point proposals both pre and post construction but makes no specific reference to air quality issues.

ii. Air Quality Strategy for Somerset 2008 (Ref. 12.25)

12.3.48 The Air Quality Strategy for Somerset 2008 (Ref. 12.25) sets out strategic recommendations for working towards improved air quality and protecting existing air quality across Somerset. The Strategy represents the culmination of air quality management work over recent years, incorporating input from all six Councils that form the administrative region of Somerset (i.e. Somerset County Council (SCC) and the five local authorities of Mendip District Council, South Somerset District Council, Taunton Deane Borough Council, SDC and WSC).

12.3.49 The Strategy recognises the need to provide an integrated response to air quality management, and sets out a view to facilitating future improvements. The Strategy aims to complement the LAQM process, and the actions within the document provide a framework for how these improvements can be facilitated within Somerset.

iii. West Somerset Council Air Quality Progress Report 2011 (Ref. 12.26)

12.3.50 The 2011 Air Quality Progress Report (Ref. 12.26), prepared by WSC, forms part of the LAQM system introduced by the Environment Act 1995 (Ref. 12.7) and subsequent Air Quality Regulations (Ref. 12.11 and Ref. 12.12). This report follows on from the Council's Progress Report in 2010 (Ref. 12.27), which concluded that a

Detailed Assessment would not be required for any pollutant. There are currently no AQMAs declared within the authority area.

12.3.51 The report identifies that ambient NO_2 pollutant concentrations (the only pollutant monitored by the Council) at properties close to the main highway were found to be highest in Williton owing to relatively high traffic flows, reduced speed (congestion) and narrowing of the A39.

12.3.52 Recent monitoring data results suggest that annual mean NO_2 concentrations in Williton have increased in 2010 compared to the previous year (the observed temporal trend between 2007 and 2009 was for a general reduction in NO_2 concentrations in Williton), most notably at 'Williton County Stores' where an annual concentration increase of 4.3µg/m^3 was observed.

12.3.53 However, at the 'Williton County Stores' monitoring site, due to missing diffusion tubes during the monitoring period, data capture over 2010 was only 83%. This is below the 90% threshold that Defra suggest is preferred, as specified in LAQM.TG(09) (Ref. 12.14). Also, the two periods with missing diffusion tubes occur at times in the year (July 2010 onwards) when NO_2 concentrations at this location generally appear to be lower (Ref. 12.26). Furthermore, preliminary analysis of temporal trends from other national monitoring locations suggest that 2010 NO_2 annual mean concentrations at these locations were also higher than for previous years, indicating that these increases and the observed NO_2 concentration increases in Williton during 2010 are more likely to be due to regional or national factors, e.g. meteorological conditions resulting in poor dispersion, as opposed to factors local to Williton. The increased 2010 NO_2 annual mean concentrations in Williton, particularly at the 'Williton County Stores' monitoring location, should therefore be treated with caution, as opposed to a definitive indication that the trend of a general reduction in annual mean NO_2 concentrations in Williton (as observed between 2007 and 2009) has been reversed. Further local authority NO_2 monitoring results obtained at these locations for 2011 will help determine any definitive trends.

12.3.54 The 2011 Air Quality Progress Report concluded that no exceedences of either the annual mean or 1-hour mean NO_2 AQOs were identified within the authority area.

iv. Sedgemoor Air Quality Progress Report 2010 (Ref. 12.28)

12.3.55 The 2010 Air Quality Progress Report (Ref. 12.28), prepared by SDC, forms part of the LAQM system introduced by the Environment Act 1995 (Ref. 12.7) and subsequent Air Quality Regulations (Ref. 12.11 and Ref. 12.12). This report follows on from the Council's Updating and Screening Assessment Report in 2009 (Ref. 12.29), which concluded that a Detailed Assessment would not be required for any pollutant. There are currently no AQMAs declared within the authority area.

12.3.56 The report identifies that ambient NO_2 pollutant concentrations were highest in Bridgwater owing to high traffic flows, reduced speed (congestion) and narrowing of the A38, with properties close to the main highway.

12.3.57 The 2010 Air Quality Progress Report concluded that no exceedences of either the annual mean or 1-hour mean NO_2 objectives were identified within the authority area. Forward projection of the NO_2 monitoring results (the only pollutant monitored by the Council) to 2010 suggested that the NO_2 annual mean AQO would likely be met.

12.3.58 SDC plans to continue with existing NO_2 monitoring and to provide an Air Quality Progress Report in 2011.

12.4 Methodology

12.4.1 The assessment and all supporting surveys have been conducted in accordance with relevant best practice guidance and standard methodologies.

a) Study Area

12.4.2 The study area with respect to potential dust and particulate impacts and on-site construction plant and machinery exhaust emissions impacts is shown on **Figure 12.1** and **Figure 12.2**. **Figures 12.3, 12.4** and **12.5** show the study areas and road sources considered in the vehicle exhaust emissions impact assessment related to construction and early operational phase traffic. **Figures 12.6** and **12.7** show the study areas and sources considered in the assessment of marine vessel exhaust emissions, and the HPC commissioning and routine test impact assessment. The locations of the assessed sensitive receptors are also presented on each figure.

12.4.3 The geographical extent of the study area for this assessment includes:

- Human receptors located in proximity to the HPC development site boundary at residential dwellings in the villages of Burton and Shurton to the south, Wick to the south-east, and Stolford to the east of the site.
- Human receptors located adjacent to the highways potentially affected by the proposed development, in the villages of Williton and Cannington, and the town of Bridgwater.
- Ecological receptors located adjacent to either the HPC development site boundary or parts of the highway network where traffic flows may be affected by the proposed development.

12.4.4 The purpose of the assessment is to determine the potential worst-case impacts associated with the proposed development. Therefore, it is considered reasonable to assume that the nearest (unscreened, i.e. with no current barriers between the source and receptor which would reduce air quality impacts, e.g. dense woodland) receptor locations to the proposed HPC development site and road network are those likely to experience the greatest air quality impacts.

12.4.5 With regards to the inclusion of ecological receptors within the assessment of operational (non-vehicular) emissions from HPC, the screening criteria as defined in Environment Agency Horizontal Guidance Note H1 (Ref. 12.30) has been followed:

- Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or Ramsar sites within 15km of the site.
- Sites of Special Scientific Interest (SSSIs) within 2km of the site.
- National Nature Reserves (NNRs), Local Nature Reserves (LNRs), local wildlife sites and ancient woodland within 2km of the site.

12.4.6 In the absence of specific guidance for the scoping of ecological receptors within air quality assessments of marine vessel emissions, a 200m distance from the emission source has been applied. This is consistent with Highways Agency guidance published in the Design Manual for Roads and Bridges (DMRB) (Ref. 12.31) for the scoping of ecological receptors for inclusion within air quality assessments of vehicular emissions. Designated ecological sites (SACs, SPAs, SSSIs or Ramsar sites) within 200m of the source location (temporary jetty head) were therefore included within the assessment of marine vessel emissions.

12.4.7 With regards to the air quality assessment of vehicular emissions, with the exception of the C182 and the private access road leading from the C182 to the Combwich site, there are no affected roads within 200m of the above designated ecological sites (SACs, SPAs, SSSIs or Ramsar sites). Therefore, designated ecological sites located within 200m of the C182 and the private access road were considered in the off-site vehicular emissions assessment (consistent with Highways Agency DMRB guidance (Ref. 12.31).

12.4.8 The ecological receptors (statutory and non-statutory designated ecological sites) within the study area are identified and considered within **Volume 2, Chapter 20** but are also discussed herein, and in the context of the air quality assessment study area are illustrated in **Figure 12.1**.

12.4.9 For assessed off-site highway improvements, the working areas together with an area of 200m around them were considered. As above, the purpose of the assessment was to determine the potential worst-case impacts associated with the proposed development. In general this was represented by assessments of potential air quality impacts at the nearest residential dwelling or other identified sensitive receptor.

12.4.10 Only the human receptors and ecological sites that are located within the study area (as defined in **Figures 12.1, 12.2, 12.3, 12.4, 12.5** and **12.6**) are included in the assessment.

b) Baseline Assessment

12.4.11 Baseline environmental characteristics for the HPC development site and surrounding areas with specific reference to air quality were identified through:

- a baseline air quality monitoring campaign;
- review of desk based information; and
- consultation with officers of WSC and SDC.

12.4.12 With respect to air quality, the nearest human receptor locations to the HPC development site comprise residential dwellings in the villages of Burton, Shurton to the south and Wick to the south-east, and Stolford to the east. Therefore, in order to determine the existing background air quality at Hinkley Point, a baseline air quality monitoring programme was undertaken at sites that are representative of these receptor locations, as well as a continuous background monitoring site located adjacent to the existing Hinkley Point B power station.

12.4.13 The monitoring programme was undertaken for the pollutants of primary concern (NO_x, NO_2, PM_{10} and SO_2), for a period of over six months, commencing on 25 February 2009 and finishing on 15 September 2009 (Ref. 12.32). Full details of the monitoring results are provided in the Air Quality Monitoring Report (Ref. 12.1).

12.4.14 Desk based studies carried out for the assessment included the identification and evaluation of:

- local industrial pollution emission sources within the districts of West Somerset and Sedgemoor; and
- existing air quality - an evaluation of estimated ambient background pollutant concentrations provided in Defra's UK Air Quality Information Resource (UK-AIR) (Ref. 12.33).

12.4.15 The annual mean pollutant concentrations obtained during the monitoring programme were compared with the pollutant background concentrations available in the desk based assessment literature. From this comparison, with the exception of the assessment of vehicular exhaust emissions within the Bridgwater ADMS Roads model, the decision was taken to use the background concentrations as determined from the baseline monitoring programme for assessment purposes (see section 12.6 and the Air Quality Modelling Report, Ref. 12.2), as this would provide a worst-case approach in terms of evaluation of total concentrations (i.e. background plus development related emissions contributions) against the AQOs. With regards to the assessment of vehicular emissions at receptors within the Bridgwater ADMS Roads model area, the decision was taken to use the highest UK-AIR background pollutant concentrations for those grid squares located within the entire ADMS-Roads 'Bridgwater model' area, as this would provide a worst-case approach in terms of evaluation of total concentrations against the AQOs (see the Air Quality Modelling Report, Ref. 12.2).

c) Consultation

12.4.16 In undertaking this assessment, consultations have been held with WSC and SDC.

12.4.17 At a scoping consultation meeting held with both parties on 9 December 2008, the specific requirements for the air quality assessment were discussed and agreements reached regarding the methodologies to be adopted.

12.4.18 The following advice and direction was provided by WSC and SDC and has been taken into account within this assessment:

- baseline monitoring of NO_2 along potential vehicular routes to/from HPC was not required;
- use of UK-AIR background pollutant concentrations (Ref. 12.31) would be acceptable; and
- use of Environmental Protection UK (EPUK) significance criteria (Ref. 12.34) would provide a robust assessment of potential air quality impacts.

12.4.19 A second consultation meeting was held with the above parties on 1 October 2009, where the main findings of the assessment work undertaken to date were presented. No significant deviations to the planned scope or assessment methodology were requested.

12.4.20 A third consultation meeting was held with on 22 February 2011. The purpose of this meeting was to present additional work undertaken since Stage 2 consultation, and to review consultation comments received at Stage 2 and how these were to be addressed. The following key points were agreed during the meeting:

- With regards to the vehicular emissions dispersion modelling studies, there was no need to consider varying queue lengths at junctions for each scenario modelled, but there was, however, a need to consider a varying vehicle average speed for junctions within each scenario modelled.
- Exclusion of car park area sources within the vehicular dispersion modelling study would probably be acceptable, depending upon the size and intended usage of the car parks (see section 10.4 d)vi).

12.4.21 Responses were also received from the following consultees during the formal consultation process:

- WSC and SDC.
- Somerset County Council (SCC).
- Environment Agency (EA).
- Highways Agency (HA).
- Natural England (NE).
- Countryside Council for Wales (CCW).
- Health Protection Agency (HPA).
- Stogursey Parish Council (SPC).
- Cannington Parish Council (CPC).
- Fairfield Estate.
- Vale of Glamorgan Council.
- Homes & Communities Agency.
- Cannington Women's Institute.
- NHS Somerset Primary Care Trust.

12.4.22 Comments received have been reviewed and, where appropriate, addressed or additional clarification has been provided within this chapter. Detailed responses to all comments are provided in the **Consultation Report**.

d) Assessment Methodology

i. Introduction

12.4.23 For this chapter of the ES, the generic descriptions used to define the impact and its likelihood of occurrence (probability) are those given in **Volume 1**, **Chapter 7**. However, specific assessment criteria that define the magnitude and significance of air quality impacts have been developed and are presented below.

12.4.24 Beneficial impacts are identified, but not quantitatively assessed.

12.4.25 It is only necessary to describe mitigation measures for significant adverse impacts with respect to air quality. Major and moderate impacts are assessed as being potentially significant and are deemed to require specific mitigation.

12.4.26 Given the difference in the potential air quality impacts and assessment methodologies applied to fugitive dust and particulates, and other pollutant emissions to air (off-site vehicular emissions, on-site plant and machinery exhaust emissions, marine vessel emissions associated with operation of the temporary jetty, and HPC commissioning/operational emissions), two separate assessment criteria have been developed and applied, based upon current published best practice guidance:

- *Fugitive dust and particulates* – best practice guidance issued by the Greater London Authority (GLA) and London Councils (Ref. 12.35), Building Research Establishment (BRE) (Ref. 12.36) and Quality of Urban Air Review Group (QUARG) (Ref. 12.37) provide guidelines that allow the evaluation of the risk of air quality impacts occurring during demolition and/or construction activities, and these have been adapted for consideration of fugitive dust and particulates.
- *Other pollutant emissions to air* – assessment criteria applied to off-site vehicular emissions, on-site plant and machinery exhaust emissions, marine vessel emissions associated with operation of the temporary jetty, and HPC commissioning/operational emissions, have been developed from guidance published in the EPUK document entitled 'Development Control: Planning for Air Quality (2010 Update)' (Ref. 12.34).

ii. Assessment Criteria Applied to Off-site Vehicular Emissions, On-site Construction Plant and Machinery Exhaust Emissions, Marine Vessel Emissions and HPC Commissioning/Operational Emissions to Air

12.4.27 Air quality impacts associated with development related off-site vehicular emissions, on-site plant and machinery exhaust emissions, marine vessel emissions associated with operation of the temporary jetty, and HPC commissioning/operational emissions, have been determined by comparing the magnitude of change between the air quality predicted for the future assessment year with the proposed HPC development (the 'with development' scenario) against the air quality predicted for the future assessment year in the absence of the proposed development (the 'without development' scenario). This information has been used in combination with an evaluation of the air quality predicted for the 'with development' scenario against the relevant UK AQOs in order to determine the significance of the potential air quality impacts.

12.4.28 The descriptors presented in **Table 12.1** for the magnitude of change in pollutant concentrations due to off-site vehicular emissions, on-site plant and machinery exhaust emissions, marine vessel emissions associated with operation of the temporary jetty, and HPC commissioning/operational emissions, have been either taken directly or developed from guidance published by EPUK (Ref. 12.34). For long-term pollutant emissions, the magnitude of change is determined based upon the magnitude of increase of the annual mean pollutant concentration relative to the AQO limit value. For short-term pollutant emissions from road traffic and on-site exhaust emissions to air from construction plant and machinery, the magnitude of change is determined based upon the number of predicted exceedences of the short-term AQO limit, derived from empirical relationships between the annual mean concentrations and the number of exceedences of the short-term mean AQOs provided within LAQM.TG(09) (Ref. 12.14) (see section 12.4d) for more information).

12.4.29 In the absence of equivalent empirical relationships between the annual mean concentrations and the number of exceedences of the short-term mean AQOs for pollutants from non-road traffic sources, the magnitude of change of short-term pollutant emissions from marine vessels and HPC commissioning/operational sources has not been determined as above, as to do so would require a full calendar year of background monitoring data (in order to identify the existing number of exceedences within this period). Consequently, the magnitude of change of short-term emissions from marine vessels and HPC commissioning/operational sources has been determined based upon the magnitude of increase of the model-predicted short-term pollutant percentile concentration relative to the short-term AQO limit value (e.g. for 1-hour mean SO_2, the magnitude of increase in the 99.73 percentile relative to the 1-hour SO_2 AQO limit value of 350µg/m^3). With regards to pollutant emissions from marine vessels and HPC commissioning/operational sources, the same percentage criteria as defined in **Table 12.1** for 'other pollutants' has been applied to the predicted pollutant annual mean and percentile concentration increases.

12.4.30 The specific magnitude criteria for the 'other pollutants' which are relevant to this assessment (including those applied to marine vessel and HPC commissioning/ operational pollutant emissions), in relation to their defined objective and limit value, are presented in **Appendix 12C**.

Table 12.1: Definition of Impact Magnitude Developed for Off-site Vehicular Emissions and On-Site Exhaust Emissions to Air from Construction Plant and Machinery

Magnitude of change [a]	Annual mean NO_2/PM_{10} [b]	Number of days with PM_{10} > 50µg/m^3 [b]	Other Pollutants [b]
Large	Increase >4µg/m^3	Increase >4 days	Increase >10%
Medium	Increase 2 to 4µg/m^3	Increase 2 to 4 days	Increase 5-10%
Small	Increase 0.4 to 2µg/m^3	Increase 1 to 2 days	Increase 1-5%
Imperceptible	Increase <0.4µg/m^3	Increase <1 day	Increase <1%

[a] *The magnitude of change descriptors as provided in the EPUK guidance have been retained for the Air Quality Impact Assessment. Comparing these descriptors to those presented in* ***Volume 1, Chapter 7****, 'imperceptible' equates to 'very low', 'small' equates to 'low', 'medium' equates to 'medium', and 'large' equates to 'high'.*

[b] *Taken from EPUK guidance.*

12.4.31 Once the magnitude of the potential impact is established, the actual pollutant concentration at the receptor is taken into account, in combination with the magnitude of change, using the approach set out below in **Table 12.2**.

Table 12.2: Air Quality Impact Descriptors for Off-site Vehicular Emissions and On-Site Exhaust Emissions to Air from Construction Plant and Machinery

Absolute Concentration in Relation to relevant Objective/Limit Value	Change in Concentration or Number of Exceedences [a, b, c]		
	Small	Medium	Large
Above Objective/Limit Value with Scheme			
Annual mean PM_{10}/NO_2 concentration >40µg/m^3	Slight Adverse	Moderate adverse	Substantial Adverse
24-hour PM_{10} objective >35 exceedences			
Other pollutants >100% objective/limit value			
Just Below Objective/Limit Value with Scheme			
Annual mean PM_{10}/NO_2 concentration 36 to 40µg/m^3	Slight Adverse	Moderate adverse	Moderate Adverse
24-hour PM_{10} objective 32 to 35 exceedences			
Other pollutants 90-100% objective/limit value			
Below Objective/Limit Value with Scheme			
Annual mean PM_{10}/NO_2 concentration 30 to 36µg/m^3	Negligible	Slight adverse	Slight Adverse
24-hour PM_{10} objective 26 to 32 exceedences			
Other pollutants 75-90% objective/limit value			
Well Below Objective/Limit Value with Scheme			
Annual mean PM_{10}/NO_2 concentration <30µg/m^3	Negligible	Negligible	Slight Adverse
24-hour PM_{10} objective <26 exceedences			
Other pollutants <75% objective/limit value			

[a] *The impact descriptors as provided in the EPUK guidance have been retained for the Air Quality Impact Assessment. Comparing these descriptors to those presented in* ***Volume 1, Chapter 7,*** *'negligible' equates to 'negligible', 'slight adverse' equates to 'minor', 'moderate adverse' equates to 'moderate', and 'substantial adverse' equates to 'major'. However, the above air quality impact descriptors are only used as a tool to describe predicted impacts; whether air quality impacts are rated as significant or not significant is based upon the professional judgement of the air quality expert performing the assessment (as is recommended in the EPUK guidance).*

[b] *See* ***Table 12.1****.*

[c] *An imperceptible change (see* ***Table 12.1****) would be described as '****negligible****'.*

12.4.32 With regards to pollutant emissions from marine vessels and HPC commissioning/operational sources, the same percentage criteria as defined in **Table 12.2** for 'other pollutants' has been applied to the predicted pollutant annual mean and short-term percentile concentrations.

12.4.33 The specific impact descriptor criteria for the 'other pollutants' which are relevant to this assessment (including those applied to marine vessel and HPC commissioning/operational pollutant emissions), in relation to their defined objective and limit values, are presented in **Appendix 12C**.

12.4.34 The criteria presented in **Table 12.1** and **Table 12.2** have been used for describing the impact at each specific receptor. This has then been used to inform the evaluation of the overall significance of impacts. The latest EPUK guidance (Ref. 12.34) allows for the greater application of professional judgement when assessing impact significance than was prescribed in earlier versions. Impacts are therefore rated in the current assessment as significant or not significant using the professional judgement of the air quality assessor. The EPUK guidance (Ref. 12.34) states that considerations in making these decisions should include:

- number of properties affected by slight, moderate or substantial air quality impacts;
- number of people exposed to poor air quality when a development introduces new exposure into an existing area of poor air quality;
- magnitude of the changes and descriptions of the impacts at receptors;
- exceedence of an objective or limit value predicted to arise where none existed before or size of an exceedence area is substantially increased as a result of the development;
- existing air quality in the study area exceeds an objective or limit value and this exceedence is removed or the exceedence area is reduced as a result of the development;
- development interferes significantly with or prevents the implementation of actions within an AQAP;
- development interferes significantly with the implementation of a local air quality strategy;
- uncertainty of the results; and
- extent to which an objective or limit value is exceeded.

iii. Assessment Criteria Applied to Fugitive Dust and Particulates

12.4.35 As previously noted, best practice guidance (Ref. 12.35, 12.36, 12.37) has been adapted for consideration of fugitive dust and particulates generated by construction works associated with the proposed development. The guidance consolidates existing best practice used in London, the UK and other countries in order to provide a consistent approach in reducing emissions from these activities. The evaluation criteria used to define risk are presented in **Table 12.3**.

Table 12.3: Best Practice Guidance on Fugitive Dust and Particulates Risk Classification

Risk Categories	Criteria
Low Risk Site	• development of up to 1,000m^2 of land; and • potential for emissions and dust to have an infrequent impact on sensitive receptors.
Medium Risk Site	• development between 1,000 and 15,000m^2 of land; and • potential for emissions and dust to have an intermittent or likely impact on sensitive receptors.
High Risk Site	• development of greater than 15,000m^2 of land; • major development as defined by the Local Planning Authority (LPA); and • potential for emissions and dust to have a significant or likely impact on sensitive receptors.

12.4.36 The above classifications are proposed in the absence of specific fugitive dust and particulates mitigation measures. They are used in combination with site specific conditions to inform the assessment of the significance of the potential impact of fugitive dust and particulates from the proposed development.

12.4.37 Once the risk category was established by following the above methodology, the degree of significance of an adverse impact was determined for each potential impact from the Impact Assessment Matrix (IAM) shown below in **Table 12.4**. The impact criteria in **Table 12.4** have been developed specifically for assessment of the construction impacts of fugitive dust and particulates based on best practice guidance issued by the GLA and London Councils (Ref. 12.35).

Table 12.4: Impact Significance Assessment Matrix for Fugitive Dust and Particulates

Distance to Human Receptors (m)	Distance to Ecological Receptors (m)	Risk from Development		
		Low	Medium	High
100-200	50-100	Negligible	Negligible	Minor
50-100	25-50	Minor	Moderate	Moderate
0-50	0-25	Minor	Moderate	Major

12.4.38 The 200m distance to receptor criterion is based on the distance beyond which no significant impacts are expected for road traffic emissions (Ref. 12.38). The 100m distance to receptor criterion is based on guidance which assumes that the majority of dust is deposited within 100m of the emissions sources (Ref. 12.39). The 50m criterion allows the identification of properties which are close to the source and therefore likely to experience a greater magnitude of impact during construction activities.

12.4.39 Given that vegetation is less sensitive to dust deposition than humans (Ref. 12.40), the distance to receptor criteria for ecological receptors has been considered to be half that applied to human receptors. These criteria are based upon professional judgement and discussions with practitioners in the field, together with consideration of published reports.

iv. Assessment of Impacts from Operational (Non-Vehicular) Emissions

12.4.40 The potential air quality impacts of operational (including commissioning) emissions to air (non-vehicular) were assessed following a two staged approach:

- Stage 1 - use of a screening tool to identify emissions which require more detailed assessment, and allow screening out of insignificant emissions.
- Stage 2 - for emissions identified by the screening tool as being potentially significant, further detailed dispersion modelling was undertaken.

12.4.41 The initial screening assessment was undertaken following the methodology provided in the Environment Agency's H1 Environmental Risk Assessment guidance (Ref. 12.30). Where the results of the H1 assessment suggested the need for detailed assessment of any of the emissions not screened out in the initial screening stage, ADMS 4.2 dispersion modelling software was used to assess the potential impact of these planned operational discharges to air.

12.4.42 The potential operational emissions to air (non-vehicular) arising from a single UK EPR unit and its associated infrastructure will primarily be from the following sources:

- SO_2, NO_x, CO and PM_{10} and $PM_{2.5}$ in the exhaust gases from engines of backup diesel generators during periodic testing:
  - For each UK EPR Unit there are four main backup electricity generators (Essential Diesel Generators or EDGs) each rated at around 7.5MWe, and two final emergency backup generator sets (Station Black Outs or SBOs) each rated at around 2.5MWe. This is safety equipment, providing backup power supply in the unlikely case of loss of the main off-site power supply when house load operation fails, so that the UK EPR Unit can be secured and the reactor cooled. These backup generators routinely operate during periodic tests, which represent an estimated 60 hours per year for each of the EDGs and SBO generators. Each EDG and SBO will also be operational for 245 hours per year during the initial commissioning of the plant. These emissions will be discharged via exhaust stacks (one per generator), approximately 30 metres in height, located on the roof of the diesel generator buildings. Each diesel generator building will house two EDGs and one SBO; thus there will be two diesel generator buildings per UK EPR Unit.

- Formaldehyde (H_2CO), that may in turn produce CO, emitted by the thermal decomposition of insulation material during reactor plant start-up at first-use (commissioning) or return to operation following maintenance (approximately every 18 months):
  - Part of the plant piping in the reactor building is insulated using material, which when first heated, during the first unit start-up (commissioning) or following renewal after maintenance, undergoes some thermal decomposition and releases steam containing H_2CO, which in turn may produce CO. It is estimated that for start-up at first-use (commissioning) it will take 10 hours to evacuate these gases at normal flow rates, and 52 hours at low flow rates. During return to operation following maintenance, the operating time required to evacuate these emissions is estimated at 8 hours at normal flow and 42 hours at low flow. These gases will be captured by the ventilation extraction system and discharged to atmosphere via the main stack, which would be in the order of 70 metres in height. Two installation restarts are assumed per year during routine operation.

- Ammonia (NH_3) discharged as the temperature rises in the steam generators during start-up:
  - Depending on the type of maintenance planned during shutdown, laying up the steam generators wet will prevent their fabric corroding and provides a biological barrier (a water shield) while carrying out work in the vicinity. In this case, the steam generators are filled with demineralised water, laid-up with hydrazine with added morpholine, ethanolamine or ammonia in the proportions defined in the chemical specifications for lay-up on shutdown. Once the outage is over, the rise in temperature in the steam generators generates gaseous ammonia partly from this wet lay-up solution, and partly from the steam generators emergency feedwater system. These emissions will be discharged via four exhaust stacks per UK EPR Unit, approximately 38 metres in height, located on the roofs of the safeguard electricity buildings. It has

been estimated that the NH_3 emissions (worst-case, assuming that all the hydrazine is broken down into NH_3 by heating) from an entire steam generator (there are four steam generators per UK EPR Unit) will be released during a period of 83 hours per restart. Two installation restarts are assumed per year.

- Auxiliary boilers, fire fighting and hydrant diesel pumps, domestic heating boilers, and small diesel engines associated with the Interim Storage Facility For Spent Fuel (SO_2, NO_x, CO, PM_{10} and $PM_{2.5}$):
  - Domestic heating and auxiliary boilers will be routinely used around the site (particularly during periods of cold weather). Fire fighting diesel pumps located around the site will only be used for short periods in the event of an emergency or during periodic tests. Small diesel engines will also be used to provide backup power supply to the Interim Spent Fuel Storage Facility (ISFS) building. Emissions from these sources will be discharged to air via their own flue gas vents.

12.4.43 The operational assessment considers emissions to air during two potential emission scenarios:

- Commissioning scenario:
  - This scenario assesses all potential releases to air from the EDGs and SBOs, and all non-diesel generator emissions during the commissioning of the plant.
  - It is not anticipated that more than one EDG or SBO will be in operation at any one time during plant commissioning. As such, maximum short-term concentrations have been determined assuming that one EDG is operational continuously throughout the year; this approach enables the particular meteorological conditions conducive to producing transient peaks in ground level concentrations to be appropriately considered. Emission rates from the EDGs are greater than those occurring from the SBOs, hence the decision to only consider EDG emissions for the short-term assessment. The maximum predicted concentration from any particular EDG is reported in the impact assessment section.
  - With respect to longer-term pollutant concentrations, the maximum modelled annual mean concentrations, assuming continuous operation of any particular generator, have been factored by taking into account the combined annual operational hours of all EDGs and SBOs, i.e. 2,940 combined hours per year.
  - Similar approaches are adopted with regards to emissions from the non-diesel generator sources.
- Routine test scenario:
  - The routine test scenario presents the likely potential impacts to be expected as a result of the standard EDG/SBO testing, which will be scheduled throughout the lifetime of the power station. It is understood that testing of the backup diesel generators will take place individually, with only a single generator running at any one time. Consequently, the approach with regards to predicting short-term and long-term concentrations during this scenario is consistent with that used for the commissioning scenario but with combined annual operational hours factored accordingly.

H1 Screening Assessment

12.4.44 The Environment Agency's H1 Environmental Risk Assessment guidance (Ref. 12.30) provides a methodology to assess the risks to the environment and human health from facilities that produce discharges to the environment. The point source emissions to air released from the proposed UK EPR Units during the operational phase (as outlined above) were initially screened following the H1 methodology.

12.4.45 H1 Annex F contains long and short-term Environmental Assessment Levels (EALs) for releases to air derived from a number of published UK and international sources. For most of the pollutants considered in this study, these EALs are equivalent to the AQS and AQOs described in section 12.3. **Appendix 12B, Table 4** provides EALs for those pollutants and averaging periods for which an equivalent AQS or AQO is not prescribed.

12.4.46 The following steps of the H1 methodology have been followed for screening the non-vehicular operational point source emissions to air from HPC:

- calculate the process contribution to air (PC_{air});
- screen out insignificant emissions; and
- identify the need for detailed modelling.

12.4.47 The methodology used to calculate the process contribution and screen out insignificant emissions is provided in detail in the Air Quality Modelling Report (Ref. 12.2).

Detailed Dispersion Modelling

12.4.48 Detailed dispersion modelling was undertaken for those operational (non-vehicular) emissions to air that were identified by the H1 screening methodology as requiring further detailed assessment. ADMS 4 Version 4.2 modelling software with Surfer Version 9 was used for this study.

12.4.49 The results of the initial H1 screening assessment undertaken (**Appendix 12D**) showed that detailed dispersion modelling was required for the majority of pollutant emissions discharged from all release points. Consequently, with the exception of those sources that, due to their size (e.g. auxiliary boilers and engines from the ISFS), are unlikely to contribute significantly to ground level concentrations outside the HPC development site boundary, a detailed assessment of all potential emissions to air from the plant are considered within the operational emissions (non-vehicular) detailed dispersion modelling sections.

12.4.50 The emission parameters used in this study are presented in the Air Quality Modelling Report (Ref. 12.2) for the commissioning and routine test scenarios, respectively. All release rates were either obtained from information made available from EDF or the equipment manufacturer, with the exception of release rates for PM_{10} and CO discharged from the backup diesel generators. These release rates were calculated from Environmental Benchmark values for emissions to air for a compression ignition engine running off liquid fuel, published in Annex 1 of the Environment Agency's Environmental Permitting Regulations sector guidance for Combustion Activities (Ref. 12.41).

12.4.51 Information on additional model treatments, including those relating to the treatment of buildings, terrain, surface roughness, formulation of the receptor grid and exposure groups can be found in the Air Quality Modelling Report (Ref. 12.2). **Figure 12.7** illustrates the buildings and emission sources within the ADMS model setup.

12.4.52 Prior to compiling the dispersion model, minor variations to some of the building dimensions were made; in most, cases these changes to the building length and/or width by a few metres. These changes are not sufficient to alter the dimensions of the single, effective building which ADMS generates from the constituent buildings included in the model. Furthermore, the height of the 'main' building specified in the model did not change. Consequently, these minor variations will not affect the model predictions.

12.4.53 Annual hourly sequential meteorological data used in the model was obtained for the Hinkley Point site from the United Kingdom Meteorological Office (UKMO) Numerical Weather Prediction Model. The meteorological data used for this assessment covers the period 1 January 2005 to 31 December 2009, and includes hourly values for wind speed (m/s), wind direction (°), cloud amount (oktas), temperature (°C), sensible heat flux ($J/s/m^2$), boundary layer depth (m), precipitation rate (mm/hour) and relative humidity (%). A wind-rose for 2005 to 2009 is shown in **Figure 12.8**.

12.4.54 The ADMS model was run independently for each year of meteorological data in order to identify the year which produced the highest predicted concentrations, i.e. the worst-case scenario. The meteorological data for this year, if considered to be representative of the typical meteorological conditions at the HPC development site, was then used for the study.

12.4.55 Long-term (annual mean) and short-term concentrations were predicted at local human and ecological receptors in order to assess compliance with the statutory air quality standards and non-statutory guideline environmental assessment levels. This has been achieved using the "long term" mode of ADMS; the "short term" mode does not allow for percentile values and objective limit exceedences to be calculated.

12.4.56 With respect to emissions of NO_x, these were modelled using guidance issued by the Environment Agency's Air Quality Modelling and Assessment Unit (AQMAU) (Ref. 12.42). The Air Quality Modelling Report (Ref. 12.2) contains a full description of this guidance but, in summary, emissions of NO_x were modelled as NO_x (as NO_2) with subsequent factors applied to the modelled predictions to calculate the resulting ambient concentration of NO_2. The 'Worst-Case' factors in the AQMAU guidance were applied for the purposes of predicting NO_2 concentrations.

12.4.57 The predominant route by which emissions will affect land in the vicinity of a process is by deposition of atmospheric emissions. Potential ecological receptors can be sensitive to the deposition of pollutants, particularly nitrogen and sulphur compounds, which can affect the character of the habitat through eutrophication and acidification.

12.4.58 Deposition processes in the form of dry and wet deposition remove material from a plume and alter the plume concentration. Dry deposition occurs when particles and gases are brought towards the ground by gravitational settling and turbulence. They are then removed from the atmosphere by deposition on the land surface. Wet deposition occurs due to rainout (within cloud) scavenging and washout (below cloud) scavenging of the material in the plume. These processes lead to a variation with downwind distance of the plume strength and may alter the shape of the vertical concentration profile as dry deposition only occurs at the surface.

12.4.59 Near to sources of pollutants, dry deposition is the predominant removal mechanism (Ref. 12.43). For the purposes of the quantitative prediction of air pollutant deposition, dry deposition rates of nitrogen and acidic equivalents have been calculated by applying the short vegetation deposition velocities detailed in Environment Agency (draft) technical guidance (Ref. 12.44) to the modelled annual mean concentrations of NO_x NH_3 and SO_2. Wet deposition has not been assessed since this is not a significant contributor to total deposition over shorter ranges (Ref. 12.43 and Ref. 12.44). Detailed descriptions of the algorithms used to quantify deposition rates are provided in the Air Quality Modelling Report (Ref. 12.2).

v. Assessment of Impacts from Marine Vessels

12.4.60 Given the low numbers of vessels that would be used during the construction of the temporary jetty, air quality impacts associated with jetty construction are not considered to be significant and therefore no further detailed assessment of these impacts has been undertaken.

12.4.61 During operation of the temporary jetty, however, there is the potential for emissions to have significant impacts to air from marine vessel movements. It is anticipated that vessels would include self-discharging dredgers and cement carriers used to supply the aggregate, sand and cement for concreting. There may also be periodic dredging to maintain the required berthing pocket depth, which will be dependent upon the rate of sediment accumulation.

12.4.62 A dispersion modelling exercise was thus undertaken in order to estimate the maximum long-term and short-term air pollutant concentrations (NO_x/NO_2, PM_{10}, $PM_{2.5}$ and SO_2) generated by marine vessel exhaust emissions. The quantitative assessment was undertaken using the same dispersion model as described for the operational (non-vehicular) assessment described above.

12.4.63 A single model scenario was considered; including long-term and short-term air pollutant concentrations generated by marine vessel exhaust emissions whilst manoeuvring and at berth during the operation of the temporary jetty. Marine vessel emissions were assumed to occur within the temporary jetty seaward harbour limits (see **Figure 12.6**). Emissions at sea were not calculated, on the basis that the location and magnitude of environmental impacts will be dependent on each vessel’s route, and environmental effects at berth are considered more significant than those at sea, since vessels are stationary and downwind receptors will be affected for a longer period.

12.4.64 To provide a worst-case assessment of potential air quality impacts, it was assumed that there would be one vessel berthing at the temporary jetty each day, as opposed to the likely 18 vessels per month. Furthermore, emissions have been calculated assuming a generic vessel of approximately 5,000dwt, the largest size of vessel likely to use the jetty; smaller vessels will have smaller engines and emissions would be lower.

12.4.65 Published pollutant emission factors for main and auxiliary engines of marine vessels (Ref. 12.45) were utilised for this study in order to calculate appropriate pollutant emission rates. Other emissions parameters were based on relevant studies (Ref. 12.46 and 12.47). Details of the potential releases, including the pollutant discharge rate, volumetric flux, and temperature are provided in the Air Quality Modelling Report (Ref. 12.2).

12.4.66 Information on additional model treatments, including those relating to the treatment of terrain, surface roughness, formulation of the receptor gird and exposure groups can be found in the Air Quality Modelling Report (Ref. 12.2). The approach with regards to selection of meteorological data, deposition and conversion of NO to NO_2 is consistent with that described for the operational (non-vehicular) assessment.

vi. Assessment of Impacts from Vehicle Emissions

12.4.67 Within the UK, assessments of air quality impacts related to emissions from road traffic focus only upon NO_2 and fine particulate matter (PM_{10} and $PM_{2.5}$) concentrations in the atmosphere. This is because exhaust emissions of the other pollutants associated with road traffic (SO_2, carbon monoxide (CO) and hydrocarbons, including benzene and 1,3-butadiene) are only released in relatively small quantities and urban roadside concentrations are all well within the relevant UK AQOs. It is only NO_2, PM_{10} and $PM_{2.5}$ that currently pose a human health concern where road traffic is the dominant source of air pollution, and which are close to and, in some traffic-congested urban areas, above AQOs. All the AQMAs in the UK that have been declared as a result of road traffic emissions have been declared either for NO_2 or for both NO_2 and PM_{10}. In this way, local authority review and assessment can be cost-effectively targeted at the pollutants of real concern and the insignificant pollutants can be scoped out of the assessment. This applies equally to the EIA process.

12.4.68 Consequently, detailed dispersion modelling and subsequent assessment of NO_x/NO_2, PM_{10} and $PM_{2.5}$ emissions to air arising from road traffic has been undertaken.

12.4.69 For the prediction of air quality impacts due to emissions arising from road traffic associated with the proposed development, the air pollutant dispersion model ADMS-Roads has been used. This model, developed by Cambridge Environmental Research Consultants (CERC), uses detailed information regarding traffic flows and composition on the local road network, combined with local meteorological conditions, to predict pollution concentrations at specific locations selected by the user. ADMS-Roads version 3.0 with Surfer version 9 was used for this study.

12.4.70 Full details of the ADMS-Roads dispersion modelling study which has been undertaken are presented in the Air Quality Modelling Report (Ref. 12.2). In summary, the traffic data used for the road traffic air quality impact assessment has been taken from the validated Paramics micro-simulation traffic model built to assess the effect of the HPC Project proposals (see **Volume 2**, **Chapter 10**). For each modelling scenario the output traffic data from the Paramics model were factored using Automatic Traffic Count data to provide 24-hour Annual Average Daily Traffic (AADT) data for Light Duty Vehicles (LDVs) and Heavy Duty Vehicles (HDVs). In line with LAQM.TG(09) (Ref. 12.14) HDVs represent all vehicles over 3.5 tonnes unladen weight, and therefore include all Heavy Goods Vehicles (HGVs) and Buses. The 24-

hour AADT traffic input data relevant to the assessment is presented in **Appendix 12E**.

12.4.71 Given the large spatial extent of the road network to be considered within the modelling domain (which includes all the associated development sites and HPC), three ADMS-Roads models were set-up and run, encompassing the three main geographical areas within the overall HPC Project study area; one for the road network around Cannington (the ‘Cannington model’), one for the road network around Bridgwater (the ‘Bridgwater model’), and one for the road network around Williton (the ‘Williton model’). The proposed HPC development site was included within the ‘Cannington model’ (see the Air Quality Modelling Report (Ref. 12.2) for further information), however the impacts of the HPC Project on all three model areas are considered in this chapter.

12.4.72 Annual mean pollutant concentrations (NO_x/NO_2, PM_{10} and $PM_{2.5}$) were predicted at human receptor locations, which include locations adjacent, or near, to the routes that are likely to experience a change in traffic flow or composition as a result of the proposed development. These human receptor locations have been selected to be representative of the likely worst-case impacts which may occur in the area surrounding the road network where traffic flows and/or composition may be affected by the proposed development.

12.4.73 Exceedences of the short-term relevant human health AQOs were predicted by utilising published relationships between the annual mean and short-term pollutant concentrations. LAQM.TG(09) (Ref. 12.14) advises that it is valid to assume that exceedences of the 1-hour mean AQO for NO_2 are only likely to occur where annual mean concentrations are 60µg/m^3 or greater.

12.4.74 An empirical relationship between the annual mean and the number of exceedences of the 24-hour mean AQO for PM_{10} is also provided within LAQM.TG(09) (Ref. 12.14):

$$\text{Number of 24-hour mean exceedences} = -18.5 + 0.00145 \times \text{annual mean}^3 + \frac{206}{\text{annual mean}}$$

12.4.75 This relationship was used to determine whether exceedences of the short-term PM_{10} AQO are likely, based upon the annual PM_{10} concentrations predicted by the model.

12.4.76 For impacts to ecological receptors, annual and 24-hour mean NO_x concentrations were predicted at selected specific receptor points, which are representative of worst-case ecological designated site exposure (i.e. given that pollutant concentrations drop off rapidly with increasing distance from the road source). The locations of these specific receptors relative to the ecological designated sites are illustrated in **Figure 12.4**.

12.4.77 The model-predicted pollutant concentrations were verified against available monitoring data, following the methodology published in LAQM.TG(09) (Ref. 12.14), in order to minimise modelling uncertainty and systematic error. This involved correcting modelled results by an adjustment factor to gain greater confidence in the final results. Full details of the verification procedure are presented in the Air Quality Modelling Report (Ref. 12.2), however, in summary, adjustment factors of 2.838, 6.589 and 9.413 were applied to the modelled road NO_x contributions predicted by the Bridgwater, Cannington and Williton models respectively. In the absence of roadside monitoring data for particulate matter and in line with the recommendations provided in LAQM.TG(09) (Ref. 12.18), the same verification factors were also applied to PM_{10} and $PM_{2.5}$ modelled road contributions. The impact assessment was undertaken using these verified results, and all discussion herein therefore refers to verified model outputs.

12.4.78 Quantitative assessment of the impacts on local air quality from vehicular emissions associated with traffic generated by the proposed HPC Project was then completed through a comparison of modelled pollutant concentrations with the current statutory standards and objectives set out in **Appendix 12B**. This chapter provides a summary of the overall air quality impacts predicted at all identified worst-case sensitive receptor group locations within the HPC Project study area as a whole.

12.4.79 For the assessment, seven scenarios have been modelled:

- 2009 'model verification/baseline'.
- 2013 'without development'.
- 2013 'with development'.
- 2016 'without development'.
- 2016 'with development'.
- 2021 'without development'.
- 2021 'with development'.

12.4.80 2009 was selected as the model verification/baseline year (model verification is discussed in further detail within the Air Quality Modelling Report (Ref. 12.2)), as this is the most recent year for which monitoring data, meteorological data, traffic data and emissions factors were all available at the time the assessment was undertaken.

12.4.81 2013 was selected as an assessment year as it represents the year with peak HDV movements relating to the proposed HPC Project, prior to operation of the majority of the associated development sites, which will reduce adverse impacts on the highway network during the construction of HPC. This assessment year therefore represents the time of construction of the majority of the associated development sites.

12.4.82 The 2013 'without development' scenario represents the future 2013 baseline scenario, and includes forecast traffic growth with committed development only (see **Volume 2**, **Chapter 10** for information on what committed development has been included).

12.4.83 The 2013 'with development' scenario includes:

- forecast traffic growth including committed development;
- construction of the proposed HPC nuclear power station; and
- construction of the majority of the associated development sites.

12.4.84 2016 was selected to represent the year with peak construction related traffic movements associated with the HPC Project (peak workforce on the HPC development site), following the commencement of operation of the associated development sites. This assessment year therefore includes the operation of the associated development sites.

12.4.85 The 2016 'without development' scenario represents the future 2016 baseline scenario, and includes forecast traffic growth with only committed development (see **Volume 2**, **Chapter 10**).

12.4.86 The 2016 'with development' scenario includes:

- forecast traffic growth including committed development;
- construction of the proposed HPC nuclear power station (peak workforce on the HPC development site); and
- operation of the associated development sites.

12.4.87 2021 was selected to represent the early operational phase traffic movements associated with the HPC Project, and the post-operational phase of the associated development sites where relevant.

12.4.88 The 2021 'without development' scenario represents the future 2021 baseline scenario, and includes forecast traffic growth with only committed development (see **Volume 2**, **Chapter 10**).

12.4.89 The 2021 'with development' scenario includes:

- forecast traffic growth including committed development;
- early operation of the proposed HPC nuclear power station;
- operation of the Cannington bypass; and
- post-operation of the associated development sites.

12.4.90 Car parks have not been included within the ADMS models on the basis of their size and intended usage. During HPC construction, 200 parking spaces will be provided at the HPC development site for use by EDF Energy staff and their contractors, with a further 100 on-site parking spaces to be provided for business visitors, VIP visitors, disabled visitors and bus parking for the Public Information Centre. Similarly, during HPC operation, total parking spaces on the HPC development site will be limited to 1,193 (plus six coach spaces). Similar parking restrictions have been also applied at the various associated development sites (see **Volumes 3** to **10**, **Chapter 10**) and, furthermore, parking spaces at the associated development sites will generally not be used in a similar manner to, for example, a supermarket car park, whereby multiple users will use the same space within one day. At the associated development sites occupancy of each space will be defined by the number of construction working shifts at the HPC development site, i.e. each space will be used by a maximum of three different vehicles per day and vehicle movements associated with the occupancy of these spaces will occur over a short time period.

12.4.91 A description of the traffic data scenarios used in the assessment is contained within **Volume 2**, **Chapter 10**. Whilst certain traffic mitigation measures (such as the highways improvements schemes) are proposed that will help to reduce congestion issues, they can encourage higher traffic flows in some locations as driver behaviour patterns change. Subsequently, changes (increases or decreases) in vehicular exhaust emissions may result from these measures. Consideration has also been given to non-work (i.e. leisure) vehicle movements of the HPC construction staff using the road network, and the impacts associated with such movements are included within the air quality assessment.

vii. Assessment of Impacts during On-Site Construction Activities

12.4.92 A qualitative assessment of the potential air quality impacts due to the generation and dispersion of fugitive dust and particulates from the HPC development site has been undertaken using information in guidance documents produced by the following organisations:

- Building Research Establishment (BRE) (Ref. 12.36).
- Quality of Urban Air Review Group (QUARG) (Ref. 12.37).
- GLA and London Councils (Ref. 12.35).

12.4.93 As there are no formal assessment criteria for fugitive dust and particulates generation and dispersion, the significance of impacts associated with this phase of the proposed development has been determined qualitatively by:

- identifying the site construction works activities that could generate fugitive dust and particulates and their likely duration;
- identifying sensitive receptors (e.g. schools, residential properties, statutory designated ecological sites) within 200m of the defined site boundary or closest area of site construction activity; and
- taking account of the prevailing wind direction and wind speed.

12.4.94 The potential impact of fugitive dust and particulates on the closest human and ecological receptors to the HPC development site has been considered. As described above, these receptors are illustrated in **Figures 12.1** and **12.2**.

12.4.95 Emissions to air from the exhausts of on-site construction plant and machinery were also assessed qualitatively, based upon the assumed number of items of equipment and plant expected on-site during the site construction works, and their likely duration of use. The significance of these emissions was then determined in accordance with the assessment methodology described herein.

viii. Assessment of Impacts from Highway Improvements

12.4.96 As part of the HPC Project, eleven improvement schemes are proposed to existing public highways (see **Volume 1**, **Chapter 2**).

12.4.97 With the exception of the construction of new roundabouts; at the junction of the A39 and B3190 at Washford Cross near the proposed Williton park and ride site, and at the junction of the A39 and B3339 at Sandford Corner south of Cannington, all proposed highways improvement schemes will require small-scale works lasting for very short periods, and will be completed within the existing highway boundaries.

12.4.98 Construction of the Washford Cross and Sandford Corner roundabouts, which will replace the existing priority junction(s), is expected to last a maximum of 6 months.

The closest receptor to the proposed works is Tropiquaria Zoo and a single residential dwelling, both approximately 25m from the proposed roundabouts. The nature of the construction works would mean that works at this separation distance may exist for only a matter of days, or even hours at a time. There would be regular periods, even during the course of a single day, when the assumed construction plant would not be in operation, for example during breaks or changes of working routine. Therefore, despite this proximity, given the nature of the proposed construction activities, the likelihood of fugitive dust and particulate matter impacts at these receptors is considered to be very low, as are any potential air quality impacts associated with emissions from construction plant and machinery.

12.4.99 As such, air quality impacts during the construction phases of the highway improvements are not considered to be significant and have therefore not been subject to detailed assessment. Air quality impacts from the resultant operation of the highway improvements are inherently considered in the assessment of vehicular exhaust emissions associated with the overall HPC Project, as the traffic input data assumes their operation.

ix. Cumulative Impacts

12.4.100 **Volume 1**, **Chapter 7** of this ES sets out the methodology used to assess cumulative impacts. Additive and interactive effects between site-specific impacts are considered within this chapter. The assessment of cumulative impacts with other elements of the HPC Project and other proposed and reasonably foreseeable projects are considered in **Volume 11** of this ES. The only exception is cumulative air quality impacts from off-site vehicle emissions, which are presented within this chapter as the traffic data used for the assessment includes both development related traffic associated with all aspects of the HPC Project and other committed development in the study area.

e) Limitations, Assumptions and Uncertainties

12.4.101 Whilst average speeds of queuing traffic specific to each link and scenario have been applied to each ADMS-Roads modelled scenario, queuing distances determined for the 2009 scenario were applied to all of the scenarios. However, sensitivity analysis which has been undertaken indicates that queuing distances do not significantly impact the model predicted pollutant concentration results obtained (see Air Quality Modelling Report (Ref. 12.2)).

12.4.102 The entire modelled road network was input within the ADMS-Roads models at an elevation of 0m without terrain elevation due to the study area being relatively flat. This is consistent with recommendations made by CERC, which state that terrain effects need only to be included where the gradient exceeds 1 in 10.

12.4.103 ADMS 4.2 cannot model dispersion for meteorological data lines (hourly data within the meteorological input file) with calm wind conditions, if either the puff, fluctuations, hills or coastlines model options are selected. Meteorological data lines with wind speed at a height of 10m which are less than 0.75m/s were therefore skipped in the modelling runs.

12.4.104 The coastline module option in ADMS 4.2 was not implemented for the purposes of this assessment. The module requires additional meteorological parameters which were not available, such as the difference in temperature between the sea surface temperature and the near surface temperature over land.

12.4.105 Pollutant emissions associated with the backup diesel generators only occur for a limited number of hours of the year. Despite the assessment focussing upon predicted pollutant concentrations against short-term air quality standards, such standards are based upon the number of exceedences of a threshold concentration over a full calendar year. Pollutant concentrations have therefore been calculated for each 1-hour line of meteorological data for a year, assuming pollutant release for each hour, and in the case of predicted annual mean concentrations have been multiplied by the fraction of number of hours per year of operation for each scenario to obtain the contribution of diesel generator emissions to the annual mean. It is not possible to apply such a procedure to the predicted short-term pollutant concentrations. Had the testing schedule of the diesel generators been known with greater precision, it would have been possible to use the "time-varying source" option of the ADMS 4.2 model to produce pollutant concentration data resembling the "real" likely exceedences expected for an operating scenario, for both long-term and short-term pollutant emissions.

12.4.106 Assumptions have been made about the type of equipment and machinery to be used during the construction works based upon likely methods to be adopted and previous development project experience, but contractors may adopt different working methods to reach the same goals. The assessment presented herein has adopted a worst-case approach.

12.4.107 Assumptions have been made about the type of marine vessel that will use the temporary jetty during its operation, based upon previous project experience, but contractors may adopt the use of different types of vessels to reach the same goals. The assessment presented herein has adopted a worst-case approach.

12.4.108 Despite the limitations, assumptions and uncertainties noted above, the approach and methodology adopted for this chapter is both transparent and consistent with the relevant UK EIA legislation and key guidance. The assessment approach is considered to be fit for purpose and an appropriate representation of the assessment scenarios; the approach has also been discussed and agreed with the relevant local authorities.

12.5 Baseline Environmental Characteristics

a) Introduction

12.5.1 This section describes the baseline environmental characteristics for the HPC development site and surrounding areas with specific reference to air quality.

b) Study Area Description

i. Environmental Setting

12.5.2 The HPC development site is located in a rural setting on the coastline of Bridgwater Bay. This location provides favourable conditions for pollutant dilution and dispersion, with an on-shore breeze dominating from the west-north-west (see **Figure 12.8**). The topography of the study area is also conducive to efficient pollutant dispersion, with the immediate area surrounding the HPC development site being predominantly undulating countryside. The Quantock Hills is the main topographical feature in a regional context, located approximately 6km to the west and south of the HPC development site with the main ridge rising to approximately 350m Above Ordnance Datum (AOD).

12.5.3 There are several statutory designated ecological sites within immediate proximity to the HPC development site and these are identified in **Figure 20.2**, **Volume 2, Chapter 20**. The sites include the Severn Estuary Ramsar site, SPA and SAC, the Bridgwater Bay NNR, and the Bridgwater Bay SSSI. There are also several non-statutory designated ecological sites within close proximity to the application site, including the Hinkley County Wildlife Site (CWS).

12.5.4 Residential dwelling ‘Doggetts’ to the south-east is the property closest to the HPC development site, whilst other residential dwellings nearby include those in the villages of Burton, Shurton to the south and Wick located to the south-east, and Stolford to the east of the HPC development site. **Figures 12.1**, **12.2** and **12.6** illustrate those residential dwellings that are located in close proximity to the HPC development site. The main residential areas located along the principal roads to the HPC development site include Cannington and Bridgwater.

12.5.5 The main arterial road in the study area is the A39 that lies approximately 6km south of Hinkley Point. It provides a route through the towns of Cannington and Bridgwater that lie to the south-east of the HPC development site, connecting to the M5 which runs approximately 11km east of Hinkley Point. Roads in closer proximity to the HPC development site comprise less heavily trafficked minor B and C class roads.

ii. Local Emission Sources

12.5.6 WSC and SDC have not identified any industrial sources of emissions which may significantly impact air quality (Ref. 12.27 and Ref. 12.26) within their districts. This was confirmed by an Environment Agency ‘What’s in your backyard?’ search undertaken in August 2011 (Ref. 12.48).

12.5.7 Within the district of West Somerset, industrial pollution sources are limited to two Part-A processes (Hinkley Point B power station and Wansbrough Paper Mill) and seven Part-B processes regulated under the Environmental Permitting Regulations 2010. The Wansbrough Paper Mill is located approximately 7km from the HPC development site and is thus not expected to significantly impact the air quality in the locality of the site. There are limited emissions to air arising from the operation of Hinkley Point B, although these will be principally limited to particulate, SO_2, NO_2 and CO emissions released during the periodic testing of backup diesel generators. Consequently, industrial pollutant sources to air in the locality of the HPC development site will not have substantive impact on local air quality.

12.5.8 WSC has identified the A39 as the most significant source of vehicle emissions to air in the district, and as a consequence, in 2007, they established a new roadside monitoring site in Williton, and also relocated a background NO_2 monitoring site to Washford, both situated along the A39. WSC currently undertakes air quality monitoring for NO_2 at two roadside locations within Williton along the A39. Their diffusion tube monitoring identified 2009 annual mean NO_2 concentrations at these two locations to be below the annual mean NO_2 AQO limit concentration of 40µg/m^3 (34.9µg/m^3 and 35.0µg/m^3 at “Williton County Stores” and “Williton P.O.” respectively (Ref. 12.26)).

12.5.9 Within the district of Sedgemoor, the main existing source of air pollutants is road traffic. The highest vehicle flows result from traffic on the M5, which has an AADT flow of approximately 80,000 vehicles per day. In addition to the M5 motorway, SDC has identified the A38 and A39 as the most significant sources of vehicle emissions to air in the district, however SDC has also indicated that the steady increase of traffic volume on the Northern Distributor Road since it opened in 2003 is of concern with regards to air quality. SDC currently undertakes air quality monitoring for NO_2 at ten roadside locations within Bridgwater. Their diffusion tube monitoring identified 2009 annual mean NO_2 concentrations at these locations to be below the annual mean NO_2 AQO limit concentration of 40µg/m^3.

12.5.10 Fugitive dust and particulates also arise in the locality of the HPC development site, both as a natural consequence (wind turbulence and subsequent suspension) and due to agricultural operations such as ploughing. The significance of these existing sources increases during periods of continuous dry weather and increased wind speeds. Furthermore, due to the coastal location of the HPC development site, the presence of marine aerosols may also constitute a significant natural local source of particulates.

iii. Existing Air Quality

UK Air Quality Information Resource

12.5.11 Estimated background pollutant concentrations are provided in Defra's UK-AIR (Ref. 12.33). Concentrations are provided for each 1km x 1km grid square for the entire UK. These background concentrations have been calculated from a base year of 2008 (or 2001 in the case of some pollutants, including SO_2), with projections provided for all years up to and including 2020, using the National Atmospheric Emissions Inventory (NAEI) and associated projections.

12.5.12 Estimated background concentrations from Defra's UK-AIR are available for PM_{10}, $PM_{2.5}$, NO_2, NO_x, SO_2, CO, benzene and 1,3-butadiene. **Table 12.5** below summarises the NO_x, NO_2, PM_{10}, $PM_{2.5}$, SO_2 and CO background concentrations obtained for 2009 from Defra's UK-AIR for the four grid-squares located closest to the HPC development site (for the purposes of this assessment, data are only required for these pollutants - see section 12.4).

Table 12.5: Summary of Annual Mean NO_x, NO_2, PM_{10}, $PM_{2.5}$, SO_2 and CO Background Concentrations at the Proposed Development Site Obtained for 2009 from Defra's UK Air Quality Information Resource

OS National Grid Reference	2009 Annual Mean Background Concentration (µg/m^3)					
	NO_2	NO_x	PM_{10}	$PM_{2.5}$	CO [a]	SO_2 [a]
320500,146000	5.8	7.5	12.2	7.7	-	-
321500,146000	6.1	8.0	12.3	7.7	-	-
320500,145000	6.0	7.9	13.1	7.9	78.5	2.4
321500,145000	9.3	12.6	13.6	8.3	79.1	2.7
Average	**6.8**	**9.0**	**12.8**	**7.9**	**78.8**	**2.6**

[a] *In the absence of annual adjustment factors for SO_2, the 2001 background concentrations for SO_2 obtained from Defra's UK Air Quality Information Resource have been taken to represent the 2009 background SO_2 concentration. 2001 SO_2 and CO concentrations are not available for 320500,146000 and 321500,146000 due to their falling just offshore.*

12.5.13 Averaging the concentrations for these four squares provides 2009 annual mean background concentrations for NO_x, NO_2, PM_{10} and $PM_{2.5}$ of 9.0µg/m^3, 6.8µg/m^3, 12.8µg/m^3 and 7.9µg/m^3 respectively. The 2009 annual mean background CO concentration was calculated as 78.8µg/m^3. In the absence of annual adjustment factors for SO_2, the background SO_2 annual mean concentration from 2001 has been taken to represent the 2009 background, with a value of 2.6µg/m^3. This value for SO_2 is likely to be an overestimate of the current background concentration, in light of tighter restrictions being imposed regarding the sulphur content of fuels since 2001, thus decreasing SO_2 emissions to air. The UK annual mean NO_2 and PM_{10} AQOs are both set at 40µg/m^3, whilst the annual mean $PM_{2.5}$ AQO is set at 25µg/m^3. There is no annual mean UK AQO for SO_2 or CO. The UK annual mean NO_x and SO_2 AQOs (for the protection of vegetation and ecosystems) are set at 30µg/m^3 and 20µg/m^3 respectively.

Council Air Quality Progress Reports

12.5.14 WSC's 2011 Air Quality Progress Report (Ref. 12.26) provides the latest published review and assessment of air quality in the West Somerset district. WSC currently undertakes passive diffusion tube monitoring for NO_2 at six locations within the settlements of Minehead, Washford and Williton. These represent roadside, urban centre and background locations. No other air pollutants are monitored.

12.5.15 The 2010 annual mean (bias adjusted) NO_2 concentrations for the six WSC monitoring sites ranged between 20.9µg/m^3 to 39.2µg/m^3. Study of the diffusion tube results has not identified any locations within the district that are expected to exceed the annual mean NO_2 AQO of 40µg/m^3. There are also therefore no potential exceedences of the 1-hour mean NO_2 AQO of 200µg/m^3.

12.5.16 The WSC NO_2 diffusion tube monitoring data from two roadside monitoring sites located in Williton was used for verification purposes for the Williton ADMS Roads model output (see the Air Quality Modelling Report - Ref. 12.2). Concentrations at these two roadside locations have been decreasing each year between 2007 and 2009.

12.5.17 SDC's 2010 Air Quality Progress Report (Ref. 12.28) provides the latest published review and assessment of air quality in the Sedgemoor district. SDC currently undertakes passive diffusion tube monitoring for NO_2 at 22 locations within the towns of Bridgwater, Highbridge, Cheddar, and at a number of bridges along the M5. These represent roadside, urban centre and background locations. No other air pollutants are monitored.

12.5.18 The 2009 annual mean (bias adjusted) NO_2 concentrations for the 22 SDC monitoring sites ranged between 9.2µg/m^3 and 39.2µg/m^3. Study of the diffusion tube results has not identified any locations within the district that are expected to exceed the annual mean NO_2 AQO of 40µg/m^3. There are also therefore no potential exceedences of the 1-hour mean NO_2 AQO of 200µg/m^3.

12.5.19 The SDC NO_2 diffusion tube monitoring data from three roadside monitoring sites located in Bridgwater was used for verification purposes for the Bridgwater ADMS Roads model output (see the Air Quality Modelling Report - Ref. 12.2).

c) Baseline Air Quality Monitoring Campaign

12.5.20 Full details and results of the air quality monitoring programme are presented in the Air Quality Monitoring Report (Ref. 12.1). In summary, following the methodology provided in LAQM.TG(09) (Ref. 12.14) in order to calculate annual background concentrations from monitoring data of less than a full year, background baseline pollutant concentrations of 11.5µg/m^3, 6.8µg/m^3, 18.2µg/m^3 and 1.8µg/m^3 were obtained for the year 2009 at Hinkley Point, for NO_x, NO_2, PM_{10} and SO_2 respectively.

12.5.21 Comparison of the 2009 pollutant background concentrations obtained from the monitoring results with the 2009 pollutant background concentrations obtained for the locality of the development site from Defra's UK-AIR, show that the NO_x monitoring derived 2009 background concentration is 27.8% higher, and the PM_{10} monitoring derived 2009 background concentration is 42.2% higher than Defra derived background pollutant levels. The NO_2 monitoring derived 2009 background concentration is the same as the UK-AIR background value. The monitoring derived SO_2 value confirms the earlier conclusion that actual 2009 values are less (30.8% lower) than those estimated for 2001.

12.5.22 This comparison confirms that use of the baseline pollutant concentrations, as determined from the baseline air quality monitoring programme, constitutes a worst-case approach for assessment purposes within the HPC commissioning/operational ADMS model (see the Air Quality Modelling Report) (Ref. 12.2). Given the similar characteristics of Hinkley Point and the ADMS Roads 'Williton model' and 'Cannington model' areas (i.e. comparable UK-AIR background concentrations and both being of a rural nature), background concentrations as derived from the baseline monitoring programme are also considered to be representative of the background air quality in these model areas and have thus been used for modelling and assessment purposes. As a worst-case approach, the highest UK-AIR background pollutant concentrations for those grid squares located within the entire ADMS-Roads 'Bridgwater model' area were used for modelling and assessment purposes (see the Air Quality Modelling Report (Ref. 12.2).

12.5.23 The baseline air quality monitoring programme confirmed that the ambient background air quality in the immediate vicinity to the HPC development site can be generally categorised as good, with both annual mean NO_2 and PM_{10} background concentrations well below the 40µg/m^3 annual mean UK AQO limits.

12.5.24 Monitoring data from a single roadside diffusion tube monitoring site located along the C182 near Hill Farm Cottage, as obtained during the baseline air quality monitoring programme, was used for verification purposes for the Cannington ADMS Roads model output (see the Air Quality Modelling Report - Ref. 12.2).

d) Receptors and Identified Value and Sensitivity

12.5.25 The human receptors considered in this assessment, i.e. both residents local to the HPC development site (as illustrated in **Figures 12.1**, **12.2** and **12.6**) and those located along the road network, as illustrated in **Figures 12.3**, **12.4** and **12.5**, are all of high value and high sensitivity in terms of local air quality impacts.

12.5.26 **Table 12.6** below provides a summary of the sensitivity of the assessed human receptors to potential air quality impacts from the proposed development. The value and sensitivity of ecological receptors is discussed in **Volume 2**, **Chapters 19** and **20**.

Table 12.6: Summary of Receptor Sensitivity

Receptor	Exposure	Sensitivity	Justification
Human receptors at residential locations near to the development site boundary (as illustrated in **Figures 12.1, 12.2** and **12.6**) and along the affected road network (as illustrated in **Figures 12.3, 12.4** and **12.5**)	Continuous long-term	High	Potential adverse health impacts may be possible as a result of continuous long-term exposure to potentially elevated air pollutant concentrations
Users of footpaths and Public Rights of Way (PRoW) (human receptors - casual walkers and hikers) (as illustrated in **Figure 12.6**)	Transient short-term	Low	Potential adverse health impacts are not expected as a result of transient short-term exposure to potentially elevated air pollutant concentrations

e) 'Without development' Scenario

12.5.27 Should the HPC Project not proceed, and HPC not be developed, future baseline conditions over the duration of the project (but without the development) would be expected to marginally improve year on year. While it is expected that the study area would continue with its current use minor improvements to baseline air quality conditions are anticipated with time as a result of technological improvements (to vehicle engines and industrial processes), legislative measures and government incentives to improve air quality.

12.6 Assessment of Impacts

a) Introduction

12.6.1 The impact assessment with respect to air quality on the existing environment covers the following issues:

- qualitative assessment of fugitive dust and particulate emissions during the HPC development site construction works;
- qualitative assessment of exhaust emissions of on-site plant and machinery, during the HPC development site construction works;
- quantitative assessment of off-site road traffic emissions during the construction and operation of HPC;
- quantitative assessment of marine vessel emissions during the operation of the temporary jetty; and
- quantitative assessment of potential air quality impacts during HPC on-site commissioning/operational activities.

12.6.2 Whilst this chapter also presents the additional air pollutant deposition flux (of both nitrogen and acidic equivalents) as a result of the construction and commissioning/operational phases of HPC, at both statutory and non-statutory designated ecological sites, the significance of associated impacts to the ecological receptors is discussed within **Volume 2**, **Chapter 20**.

12.6.3 EDF Energy is committed to implementing best practice to reduce dust impacts to acceptable levels. However, to make the impact assessment more transparent, impacts from dust are assessed prior to implementation of best practices for dust control. These dust control measures (best practices) have been listed under the mitigation section in this chapter.

b) Construction Impacts

12.6.4 Potential impacts will vary during the construction phase for the HPC development according to the activities being undertaken, which include:

- mobilisation;
- excavation, levelling and preparation of working platforms;
- construction of the temporary jetty;
- construction of temporary and permanent access roads and parking areas;
- construction of the sea wall;
- deep excavations and tunnelling;
- construction of a workers accommodation campus;
- building construction; and
- construction of the National Grid 400kV substation.

12.6.5 Whilst the potential impact may vary throughout these stages of the construction phase, the primary air pollution sources will be those typical of any industrial construction site that may cause dust and particulate matter to be emitted to the atmosphere. These sources relate to activities which will include (but not be limited to) earthworks; excavations, drilling and compacting; crushing and grinding and cement batching.

12.6.6 Dust comprises particulate matter typically in the size range 1-75µm in aerodynamic diameter and is mostly created through the action of crushing and abrasive forces on materials. The larger dust particles fall out of the atmosphere quickly after initial release and therefore tend to be deposited in close proximity (10 to 20m) to the source of emission. The smaller particles of dust (typically less than 10µm in aerodynamic diameter) are known as particulate matter (PM_{10}) and represent only a small proportion of total dust released. As these particles are at the smaller end of the size range of dust particles they remain suspended in the atmosphere for a longer period of time than the larger dust particles of greater than 10µm, and can be transported by wind over a wider area. It is the particles of greater than 10µm in size that generally fallout within 100m of the source, and this is what is known as the dust 'annoyance' component. If such dust is deposited on washing, window sills and cars, for example, it can cause 'soiling and discolouration', which may result in complaints of annoyance through amenity loss or perceived damage caused, which is usually temporary but can be episodic.

12.6.7 Dust and particulates generated by construction activities could theoretically also have an adverse impact on ecological receptors, smothering the leaves of plants and affecting photosynthesis, respiration and transpiration. The literature suggests that the most sensitive species appear to be affected by dust deposition at levels approximately five times greater than the level at which most dust deposition may start to cause a perceptible annoyance to humans, but most species appear to be unaffected until dust deposition rates are at levels considerably higher than this (Ref. 12.40).

12.6.8 In addition to fugitive dust and PM_{10}, there is also the potential for on-site emissions to air from the exhausts of associated on-site plant and machinery (known as Non-Road Mobile Machinery – NRMM), such as excavators and dozers, generators and compressors, plus exhaust emissions from the movements of marine vessels associated with the operation of the temporary jetty facility. These emissions would comprise airborne PM, and NO_X and SO_2.

12.6.9 Throughout the construction phase, the volume of construction traffic on local roads will vary considerably, with the potential to affect receptors sensitive to air quality along the roads connecting the development site with the M5 motorway to the south-east. The main pollutants of concern for road traffic are generally considered to be NO_2, PM_{10}, $PM_{2.5}$, CO and benzene. Based upon the baseline air quality environment and experience in undertaking air quality assessments, emissions of NO_x/NO_2, PM_{10} and $PM_{2.5}$ are most likely to result in exceedences of the relevant air quality standards or objectives in the study area.

12.6.10 During the construction phase there is also the potential for increased deposition of air pollutants to ecological receptors in proximity to the proposed HPC development. Emissions to air generated by on-site plant and machinery exhaust emissions, off-site road vehicle exhaust emissions, and marine vessel exhaust emissions associated with the operation of the temporary jetty during the HPC construction phase may all contribute towards annual nitrogen and acid deposition fluxes. Given that air pollutant deposition from on-site plant and machinery associated with the HPC construction phase are considered to be insignificant when compared to the likely deposition associated with off-site road vehicle exhaust emissions and marine vessel exhaust emissions, deposition from these construction sources has not been considered further. Deposition of air pollutants from off-site road vehicle exhaust emissions and marine vessel exhaust emissions associated with the operation of the temporary jetty during the HPC construction phase have therefore been considered, however the significance of associated impacts to the ecological receptors is discussed within **Volume 2**, **Chapter 20**.

i. Fugitive Dust and Particulate Matter Generated by Construction Activities

12.6.11 The extent to which dust and particulate matter generation, and possible annoyance, arising from construction activities might occur is difficult to assess quantitatively. Dust and particulate levels due to emissions directly from the development site and any roadways including haulage roads (if dry), would depend upon various factors at any one time, including:

- nature of work being undertaken;
- wind direction;
- wind speed;
- precipitation;
- type and quantity of material being handled;
- particle size distribution of the material being handled; and
- moisture content of the material being handled.

12.6.12 Although dust levels will be greatest when there is a plentiful supply of fine, dry particles, the majority of these influencing factors are dependent upon both site working methods and weather conditions. As a consequence, the uncertainties associated with estimated emission factors and therefore any numerical predictions are too great for such estimates to be useful. A qualitative approach has therefore been taken to assessing the impact of dust emissions from the construction works as a whole.

12.6.13 The assessment presented within this chapter considers the potential impact of fugitive dust and particulate matter. Assessment of the potential implications of contaminated dust arising from any contaminated soils during the construction activities is presented within **Volume 2**, **Chapter 14**.

Assumed Construction Plant

12.6.14 In order to evaluate fugitive dust and particulate generation during the construction phase, it is necessary to define the various activities that will be undertaken. It is possible to undertake a generic assessment of air quality impacts based on expected methods of working gained from experience with previous similar developments. In undertaking this assessment, a worst-case approach has been taken by considering the upper range estimates for required plant numbers, which therefore provides a conservative basis for assessment of potential air quality impacts. This assessment also considers all combined elements of construction at the development site, as opposed to each in isolation, i.e. consideration has been given to any potential overlap as a result of multiple activities being undertaken at the same time.

12.6.15 Typical construction plant and equipment that is likely to be used on-site includes the following:

- excavators;
- cranes;
- earthmoving plant;
- batching plant;
- compressors;
- diesel generators;
- road-going HGVs moving spoil and delivering material (to be minimised by the construction of a jetty to be used for aggregates and cement delivery);
- hand held tools such as disc cutters, grinders and nut runners;

- piling plant;
- concrete pumping plant and trucks;
- rock breakers and crushing plant;
- dewatering pumps; and
- tunnel boring plant.

12.6.16 In addition to the above, blasting of fresh rock may be required during excavation. Whilst these operations might generate increased fugitive emissions of dust and PM_{10}, they will be infrequent and of an extremely short-term duration.

Local Climate Conditions

12.6.17 Meteorological data covering the period 1 January 2005 to 31 December 2009 were obtained for the Hinkley Point site from the United Kingdom Meteorological Office (UKMO) Numerical Weather Prediction model to provide an indication of prevailing wind directions and the frequency of moderate to strong winds. These wind data and accompanying precipitation rate data were used to assess the likelihood of receptors located in the vicinity of the development site being affected by fugitive dust and particulate emissions.

12.6.18 Wind sectors have been assigned for the hourly meteorological data for Hinkley Point (covering the period 2005 to 2009), based upon the reported wind direction (degrees). Each wind sector category represents the mid-point of each wind sector ±11.25°, e.g. the mid-point of north-north-west (NNW) is 326.25°, and therefore any winds with a bearing ranging from 337.50° to 348.75° have been classified as NNW. Each of the 16 wind sectors thus represents 22.5°.

12.6.19 The wind-rose for 2005 to 2009 (see **Figure 12.8**) illustrates a predominant wind direction from the west-north-west (WNW) at 18.0% of the time, with winds from the west also occurring frequently at 10.5% of the time. These are followed by southerly and west-south-westerly (WSW) winds, both at a frequency of 7.2%. Wind directions from the north and NNW occur relatively infrequently (2.4% and 2.6% of the time, respectively).

12.6.20 **Table 12.7** presents the frequency of winds as a percentage of all winds at Hinkley Point between 2005 and 2009, for each wind direction within specified wind speed categories. Calm conditions (<0.5m/s) occur for only 0.4% of the time. Wind speeds between 0.5 and 5.0m/s occur for approximately 45.7% of the time, whilst winds of above 5m/s occur for around 53.9% of the time.

12.6.21 Although the critical wind speed for raising particles into the air will be dependent upon the physical condition of the surface and the size range of particles present, the potential for the generation of airborne dust will increase with elevated wind speed.

12.6.22 A wind-rose showing the frequency of winds of a speed greater than 5m/s is presented in **Figure 12.9** (wind-blown dust arising, for example as a result of erosion of stockpiled material, typically occurs with winds in excess of 5.4m/s (Ref. 12.35). Wind directions from the WNW and westerly sectors occur most frequently for the higher wind speeds, accounting for 23.3% and 15.0% of winds above 5m/s, respectively.

Table 12.7: Frequency of Winds as a Percent
+age of all Winds at Hinkley Point between 2005 and 2009

Wind Speed (m/s)	Wind direction (°)																TOTAL (%)
	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	
0-0.5	0.02	0.03	0.03	0.04	0.01	0.01	0.03	0.02	0.03	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.38
0.5-5.0	1.47	1.9	2.61	2.65	2.3	2.69	3.1	3.42	3.95	3.69	2.95	2.27	2.38	5.36	3.27	1.68	45.69
5.0-7.5	0.6	1.25	1.68	1.7	0.99	0.83	1.2	1.32	2.14	2.05	2.35	2.39	3.1	6.65	2.25	0.6	31.10
7.5-10.0	0.21	0.45	0.8	0.64	0.19	0.24	0.33	0.5	0.85	0.83	0.99	1.73	2.87	3.97	1.15	0.18	15.93
>10.0	0.1	0.11	0.17	0.14	0.06	0.03	0.07	0.12	0.28	0.27	0.23	0.78	2.12	1.96	0.35	0.1	6.89
TOTAL %	**2.40**	**3.75**	**5.28**	**5.17**	**3.56**	**3.80**	**4.72**	**5.38**	**7.24**	**6.87**	**6.54**	**7.20**	**10.49**	**17.96**	**7.04**	**2.59**	**100.00**

12.6.23 Airborne dust levels are also more likely to be elevated during periods of prolonged warm, dry weather. During periods of wetter weather, precipitation not only minimises the amount of fugitive dust and PM_{10} that becomes airborne, but also enhances the removal of airborne dust and PM_{10} from the atmosphere via washout and rainout. Analysis of precipitation rate data between 2005 and 2009 for Hinkley Point indicates that dry conditions are prevalent for 67.0% of time. Thus, for the remaining 33.0% of the time, airborne fugitive dust and PM_{10} levels are not likely to be significant.

Construction Scenarios

12.6.24 Three construction phase scenarios were considered, each representing a point in time during the HPC construction phase:

- Scenario A – 2011/2012 Preliminary Site Preparation Works. During this phase, the following key construction activities will take place:
  - removal of vegetation;
  - stripping of topsoil and subsoil;
  - soil and rock stockpiling in the Southern Construction Phase Area (SCPA) (north of latitude 144750mN) and at the western boundary of the SCPA;
  - establishment of platform areas in the northern part of the development site;
  - preparation works for construction of the northern roundabout close to Pixies Mound and the southern roundabout; and
  - construction of the temporary jetty.
- Scenario B – 2013. During this phase, the following key construction activities will take place:
  - deep (rock) excavation at UK EPR Units 1 and 2;
  - excavated materials transported to the stockpiles within the SCPA;
  - vehicles using circular haul route between northern and southern areas of the development site;
  - construction of sea wall;
  - construction of on-site workers accommodation campus;
  - early landscaping in the land to the south of latitude 144750mN within the SCPA;
  - construction of bridge over Bum Brook; and
  - construction of emergency access road in south of the HPC site.
- Scenario C – Late 2014. During this phase, the following construction activities will take place:
  - construction of buildings for UK EPR Unit 1 and shared (UK EPR Units 1 and 2) buildings and excavations back-filled;
  - on-going construction of roads and networks; and
  - construction of the National Grid 400kV substation.

Receptor Location Relative to Source

12.6.25 The distance from the dust source to the sensitive receptor location is also critical. Both airborne dust and particulate concentrations, and dust deposition rates, decrease rapidly with distance from the source.

12.6.26 The worst-case (i.e. closest) human receptors to the HPC construction site areas were identified for the three construction phase scenarios as described above. Distance and bearing from potential dust generating construction activities, direction and frequency of winds carrying airborne particles from construction activities to the receptor, and the frequency of dry days were calculated. Distance has been calculated from the receptor to the closest point of on-site construction activity for each of the scenarios. **Table 12.8** presents a summary of these results.

12.6.27 It can be seen from **Table 12.8** that the lowest frequency of occurrence of meteorological conditions that may carry airborne fugitive dust and PM_{10} from on-site construction activities towards sensitive receptors (unfavourable wind directions, wind speed greater than 5m/s and no precipitation) is for receptors affected by predominantly northerly winds, namely Shurton Village and Bishops Farm House (2.4%). These two receptors are therefore the least likely to experience meteorological conditions that may carry airborne dust and PM_{10} from the development site, with “unfavourable” conditions occurring only 2.4% of the time.

12.6.28 In contrast, “unfavourable” conditions are most frequent for the receptors affected by predominantly NW winds, namely Point west of Wick, Gunter’s Grove and Wick Village. This is evidenced by a frequency of wind with speed greater than 5m/s and no precipitation of 13.1%, which suggests that meteorological conditions that may lead to fugitive dust and PM_{10} at this location are prevalent 13.1% of the time. However, the closest receptors (Point west of Wick) is almost 500m away from the closest construction activities. Given that the majority of fugitive dust and PM_{10} is deposited within 200m of the source, these receptors are therefore at sufficient distance from the development site for substantial dispersion, dilution and deposition of dust and PM_{10} to occur between the development site and the receptor locations. It is therefore unlikely that fugitive dust and particulates will be significant at these receptors.

Scenario A – 2011/2012 Preliminary Site Preparation Works

12.6.29 The potential for fugitive dust and PM_{10} generation will be greatest during this phase of the construction works whilst the main earthworks are undertaken. This will involve an initial site strip of vegetation and removal of topsoil and subsoil, followed by site levelling and terracing. Soils will be transported to temporary storage areas located in the SCPA. Some of the soils will be used to construct a bund along the development site’s western boundary south of Green Lane.

12.6.30 During site levelling/terracing, there may be a limited requirement for blasting of the bedrock. If required, this is likely to involve drilling of a number of holes within a rock face, into which are placed the necessary explosive charges. Blast events would be localised and, therefore, a minimum explosive charge would be used to achieve the required rock extraction rate. However, blasting and the other methods used for the removal of rock deposits (principally ripping and breaking) may lead to increased levels of airborne dust and PM_{10}. Given the large area to undergo stripping and the considerable volume of soil and rock material to be moved around site during the earthworks, there is the potential that elevated levels of airborne dust and PM_{10} will be generated by mechanical disturbance of the soil and rock materials during this period.

12.6.31 However, during this period, land to the south of latitude 144750mN and within the development site boundary of the proposed on-site workers accommodation campus will remain undisturbed.

12.6.32 There are 15 identified human receptor locations that are within 1km from the proposed construction activities during this phase of the works. With the exception of Doggetts, all of the human receptor locations are greater than 200m from the closest point of site activity. Following the methodology presented in section 12.4, the development site is classified as high risk site with respect to fugitive dust and PM_{10} generation (the proposed development covers greater than 15,000m^2 of land and there is the potential for emissions and dust to have a significant or likely impact on sensitive receptors). Therefore, excluding Doggetts, the significance of this impact is predicted to be **negligible** at all assessed human receptor locations during this phase of the construction works. The impact from dust at these receptors would be local, direct, unlikely and medium-term.

12.6.33 Doggetts is situated approximately 128m from the closest point of site activity. Following the methodology presented in section 12.4, the significance of fugitive dust and PM_{10} impacts at Doggetts are predicted to be **minor** during this phase of the construction works, in the absence of mitigation. Meteorological conditions that may lead to elevated levels of fugitive dust and PM_{10} at this location are prevalent for only 4.2% of the time (see **Table 12.8**). The potential frequency that fugitive dust and PM_{10} may be experienced at this receptor is therefore limited by the reduced occurrence of meteorological conditions that are conducive to elevated dust levels. The impact from dust at this receptor would be local, direct, possible and medium-term.

12.6.34 **Figure 12.1** illustrates the area of potential fugitive dust and PM_{10} impacts based on the extent of site construction activities that would be undertaken during Scenario A.

Table 12.8: Human Receptor Locations that may Experience Elevated Fugitive Dust and PM_{10} Emissions during HPC Construction

Receptor	Grid Reference		Bearing from Construction Site (°) [1]	Distance to Receptor from Closest Point of Site Activity (m) [2]			Dominant Wind Sector Affecting each Receptor [3]	Frequency of Occurrence (% of Hourly Values) [4]		
	X	Y		Scenario A - 2011/2012 Preliminary Site Preparation Works	Scenario B - 2013	Scenario C – Late 2014		All Weather Conditions	Wind with Speed >5 m/s	Wind with Speed >5 m/s, no Precipitation
Bishops Farm House	320,092	144,406	189	344	10	344	N	8.7	3.6	2.4
Doggetts	320,599	144,714	157	128	26	128	NNW	12.0	5.5	4.2
Shurton village	320,186	144,256	184	494	105	494	N	8.7	3.6	2.4
Warren`s Farm	319,850	143,981	195	769	339	769	NNE	11.4	5.4	3.6
Knighton Farm	319,375	144,512	222	475	479	475	NE	14.2	6.9	4.7
Point west of Wick	319,250	144,250	131	595	487	595	NW	27.6	17.2	13.1
Newnham Bridge	320,661	144,169	163	610	561	610	NNW	12.0	5.5	4.2
Point south of Knighton	319,250	144,250	219	733	659	733	NE	14.2	6.9	4.7
Burton village	319,350	144,050	212	825	668	825	NNE	11.4	5.4	3.6
Bullen Farm	319,150	144,550	230	716	688	716	NE	14.2	6.9	4.7
Gunter`s Grove	321,158	144,115	147	929	748	929	NW	27.6	17.2	13.1
Wick village	321,550	144,550	126	908	802	908	NW	27.6	17.2	13.1

[1] *'Bearing from construction site' calculated based upon the angle from the approximate centre of the proposed HPC development site to the receptor.*

[2] *'Distance to receptor from closest point of site activity' calculated by measuring the minimum distance from the receptor to the extent of proposed HPC development site activity, and therefore represents a worst-case approach.*

[3] *'Dominant wind sector affecting each receptor' derived assuming that the wind originating from opposite each receptor (i.e. 'Bearing from construction site' ±180°) is most likely to affect that particular receptor.*

[4] *'Frequency of occurrence' values calculated based upon the sum of the frequency of particular weather conditions within the hourly meteorological dataset, for the 'Dominant wind sector affecting each receptor' plus the two adjacent wind sectors, e.g. if the dominant wind sector affecting a receptor is NNW, then 'frequency of occurrence' represents the total frequency of the particular weather condition occurring within the hourly meteorological dataset, for the wind sectors NW, NNW, and N, calculated as a percentage of all 43,848 hourly meteorological data values).*

Scenario B – 2013

12.6.35 The potential for fugitive dust and PM_{10} impacts will be greatest during this phase at the time when the early landscaping works are being undertaken to the south of latitude 144750mN. The early landscaping will provide screening of the construction works from the south and it is proposed that these works including the reprofiling will be undertaken at the earliest opportunity. This will involve the use of excavated soils to produce a landform with levels up to a finished level of 35m Above Ordnance Datum (AOD). Final landscaping and planting of this area will then have time to develop and mature during the construction works.

12.6.36 During the period whilst the bund is being constructed, fugitive dust and PM_{10} may be more of an potential concern at the closest human receptors. However, once the bund and early landscaping land profiling are completed, these works will result in an increase in the separation distance between potential dust and PM_{10} generating construction activities and the human receptors during later construction phase works, thus having an overall effect of reducing potential long-term construction phase impacts.

12.6.37 Similarly, the on-site accommodation campus located in the south-east of the SCPA would also be under construction using this phase, there is therefore the potential for elevated airborne dust and PM_{10} levels to be experienced, particularly at the nearby residential receptor Doggetts. Once completed, however, the early landscaping will provide separation between potential fugitive dust and PM_{10} generating construction activities and the receptors, and will also provide some screening. There will therefore be an overall effect of reducing the potential for long-term fugitive dust and PM_{10} impacts at Doggetts post construction of the on-site accommodation campus.

12.6.38 Construction of the emergency access road and the bridge over Bum Brook during this phase of works could also lead to the generation of limited amounts of airborne fugitive dust and PM_{10}.

12.6.39 The majority of the identified human receptors, however, will be located over 200m from the closest point of site activity during this period of construction. Only Bishops Farm House, Doggetts and Shurton village will be closer than 200m, located at a minimum distance of 10m, 26m and 105m, respectively, from the closest point of site activity. Therefore, with the exception of these three receptors, following the methodology presented in section 12.4, the significance of fugitive dust and PM_{10} impacts at human receptors is predicted to be **negligible** during this phase of the construction works. The impact from dust at these receptors would be local, direct, unlikely and medium-term.

12.6.40 Following the methodology presented in section 12.4, the significance of fugitive dust and PM_{10} impacts at Shurton Village are considered to be of **minor** significance during this phase of the construction works. Potential impacts at Bishops Farm House and Doggetts would be considered to be of **major** significance during this phase of the construction works without mitigation. Meteorological conditions that may lead to elevated dust and PM_{10} at Doggetts and Bishops Farm House from on-site construction activities are prevalent for only 4.2% and 2.4% of the time, respectively. The impact from dust at these three human receptors would be local, direct, likely and medium-term.

12.6.41 **Figure 12.2** illustrates the area of potential fugitive dust and PM_{10} impacts based on the extent of site construction activities that would be undertaken during Scenario B.

Scenario C – Late 2014

12.6.42 Similar to the Scenario A construction phase scenario assessed above, activities during this phase of the HPC construction works will be limited to the north of latitude 144750mN and to the north of the completed on-site workers accommodation campus. Impacts during this period would therefore be expected to be similar as those predicted during Scenario A.

12.6.43 Doggetts is the only human receptor location which is closer than 200m from the closest point of site activity at this time (located at a distance of approximately 128m). Following the methodology presented in section 12.4, fugitive dust and PM_{10} impacts at Doggetts would be considered to be of **minor** significance during this phase of the construction works, in the absence of mitigation, and **negligible** at other assessed human receptor locations. There will, however, be a screening effect from the on-site workers accommodation campus that will reduce the potential for dust impacts by acting as a separation barrier between the receptor and source of dust generation. After 2014, no substantive construction activities will take place any closer to the human receptors than during this phase. This therefore represents the long-term potential fugitive dust and PM_{10} impacts. The impact from dust at these receptors would be local, direct, unlikely and long-term but temporary.

12.6.44 **Figure 12.1** also illustrates the area of potential fugitive dust and PM_{10} impacts based on the extent of site construction activities that would be undertaken during Scenario C.

Ecological Receptors

12.6.45 The assessment process presented above was repeated for ecological receptors, i.e. the distance and bearing from the development site boundary, direction and frequency of winds carrying airborne particles from activities to the receptor, and the frequency of dry days were calculated. **Table 12.9** presents a summary of these calculations.

12.6.46 Given the geographical distribution of the ecological receptors (i.e. non-point receptors), there is the potential for a range of wind directions to carry fugitive dust and PM_{10} generated by the construction works to the receptors. Any winds with a prevailing direction between south-easterly to west north-westerly could potentially transport dust to the ecological receptors.

12.6.47 It can be seen from **Table 12.9** that the frequency of occurrence of meteorological conditions that may carry airborne fugitive dust and PM_{10} from the development site towards ecological receptors ("unfavourable" wind directions, wind speed greater than 5m/s and no precipitation), is less than 28% of the time. Therefore, for the majority of the duration of the construction works, meteorological conditions would not be conducive to transporting airborne dust from the development site to these ecological receptors. Furthermore, there is only a small likelihood of dust generating activities occurring during these worst-case meteorological conditions and, typically, even the most sensitive of plant species are only likely to be affected by dust deposition at levels approximately five times greater than the level at which most dust deposition may start to cause a perceptible annoyance to humans (Ref. 12.40).

Table 12.9: Ecological Receptor Locations that may Experience Elevated Fugitive Dust and PM_{10} Emissions during HPC Construction

Receptor	Bearing from Construction Site (°) [1]	Distance to Receptor from Construction Site (m) [2]	Dominant Wind Sector Affecting each Receptor [3]	Frequency of Occurrence (% of Hourly Values) [4]		
				All Weather Conditions	Wind with Speed >5 m/s	Wind with Speed >5 m/s, No Precipitation
Bridgwater Bay NNR & Severn Estuary SAC	311-67	0	SE-WSW	52.2	27.6	13.7
Bridgwater Bay SSSI and Severn Estuary SPA/Ramsar	311-113	0	SE-WNW	82.2	45.7	27.4
Hinkley CWS	64-85	0	W-SW	42.7	29.3	19.4

[1] *'Bearing from construction site' calculated based upon the angle from the approximate centre of the proposed HPC development site to the receptor. Bearing is provided as a range (assuming a clockwise rotation) due to the geographical spread of the ecological receptors.*

[2] *'Distance to receptor from construction site' calculated by measuring the minimum distance from the receptor to the proposed HPC development site boundary, and therefore represents a worst-case approach.*

[3] *'Dominant wind sector affecting each receptor' derived assuming that the wind originating from opposite each receptor (i.e. 'Bearing from construction site' ±180°) is most likely to affect that particular receptor. Dominant wind sector is provided as a range (assuming a clockwise rotation) due to the geographical spread of the ecological receptors.*

[4] *'Frequency of occurrence' values calculated based upon the sum of the frequency of particular weather conditions within the hourly meteorological dataset, for the 'Dominant wind sector affecting each receptor' plus the two adjacent wind sectors, e.g. if the dominant wind sector affecting a receptor is NNW, then 'frequency of occurrence' represents the total frequency of the particular weather condition occurring within the hourly meteorological dataset, for the wind sectors NW, NNW, and N, calculated as a percentage of all 43,848 hourly meteorological data values).*

12.6.48 Following the methodology presented in section 12.4, as the development site has been classified, for the purposes of this assessment, as high risk with respect to fugitive dust and PM_{10} generation, the significance of potential fugitive dust and PM_{10} impacts at the ecological receptors 'Bridgwater Bay SSSI/NNR', 'Severn Estuary SPA/SAC/Ramsar' and 'Hinkley CWS' is predicted to be **major**. Meteorological conditions that may lead to elevated fugitive dust and PM_{10} at these locations from on-site construction activities are prevalent for up to 27.4% of the time. The potential frequency that fugitive dust and PM_{10} may be experienced at these receptors is therefore limited by the limited occurrence of meteorological conditions that are conducive to elevated dust levels. Furthermore, the impact would also be limited to the proportion of the ecological receptor sites which are within 25m from the closest point of site activity (the majority of the ecological sites will not be impacted by fugitive dust at all). The impact from dust at these receptors would be local, direct, adverse, possible and long-term during the construction works, but temporary.

12.6.49 Further discussion of the potential fugitive dust and PM_{10} impacts upon biodiversity receptors, is presented in **Volume 2**, **Chapter 20**.

Summary

12.6.50 During the early HPC construction phase Scenario A, activities will be restricted to the north of latitude 144750mN and also outside of the footprint of the proposed on-site workers accommodation campus, and therefore fugitive dust and PM_{10} impacts are predicted to be of either **negligible** or **minor** significance at all human receptors during this period. During Scenario B when the bulk of the earthworks and construction of the on-site workers accommodation campus are taking place in the SCPA, in the absence of any mitigation, fugitive dust and PM_{10} impacts are predicted to be of **major** significance at Doggetts and Bishops Farm House. However, following the completion of these activities and the conclusion of works with substantive dust generating potential in the SCPA by late 2014, given the resultant effective separation distance increase between potential dust and PM_{10} generating construction activities and the receptors, the fugitive dust and PM_{10} impacts are predicted to be of either **negligible** or **minor** significance at all human receptors. Therefore post 2014, the long-term potential fugitive dust and PM_{10} impacts from the HPC construction works are considered to be no more than **minor** significance at human receptors, prior to the implementation of any mitigation. The potential for major fugitive dust and PM_{10} impacts at human receptor locations, in the absence of mitigation, will therefore be limited to the period between Scenario A and Scenario C, i.e. between 2011/2012 and late 2014.

12.6.51 Given the immediate proximity of the ecological receptors to the HPC development site boundary, the significance of fugitive dust and PM_{10} impacts at the ecological receptors 'Bridgwater Bay SSSI/NNR', 'Severn Estuary SPA/SAC/Ramsar' and 'Hinkley CWS' are predicted to be **major**. However, this level of impact would be limited to the proportion of the ecological sites which are within 25m from the closest point of site activity, with the potential impact significance reducing to no more than **minor** at distances greater than 50m from the development site (i.e. most of the ecological site areas will not be impacted by fugitive dust at all). **Volume 2, Chapter 20** discusses this issue further in the context of specific sensitive species within the designated ecological sites.

12.6.52 Measures will be taken to minimise fugitive dust and PM_{10} generation at source, and to monitor the fugitive dust and PM_{10} impacts at the most sensitive receptor location(s). Details of these management measures and associated monitoring will be provided in the **Air Quality Management Plan (AQMP)**. The application of best practice guidance and control measures employed on construction sites would minimise dust generation and mitigation measures would ensure that any potential impacts would be at an acceptable level at the identified human and ecological receptor locations (see section 12.7).

ii. Exhaust Emissions from On-site Plant and Machinery Utilised during Construction

12.6.53 Diesel powered off-road construction plant and machinery (NRMM) are not currently subject to the same stringent controls as normal road vehicles. It is therefore appropriate to assess the potential air quality impacts associated with exhaust emissions from NRMM used during construction. However, there are various European Directives which have been implemented to control NRMM emissions and progressively reduce their potential impact.

12.6.54 European Directive 2002/88/EC (Ref. 12.49) relates to measures to control the emission of gaseous and particulate pollutants from internal combustion engines to be installed in NRMM, and implements two stages of emission limit values for compression ignition engines. The two stages of emissions limits for new diesel engines set the maximum allowable emissions of NO_X, particulate matter, hydrocarbons and carbon monoxide. Stage I is already in force for all engine categories and Stage II has now been implemented for almost all engines.

12.6.55 Directive 2004/26/EC9 (Ref. 12.50) of the European Parliament and of the Council (amending Directive 97/68/EC (NRMM Directive) and Directive 2002/88/EC), implements three stages of future emissions limits (Stage IIIA, IIIB & IV) that apply to equipment already within the scope of Directive 97/68/EC (Ref. 12.51).

12.6.56 All engines installed that are not already available in the market will have to comply with the emission limits before 2015 (with the exception of Stage IV for engines other than constant speed engines with a production date prior to 31 December 2013 and 30 September 2014, where the compliance date may be postponed by two years).

12.6.57 Directive 98/70/EC (Ref. 12.52) (as amended by Directive 2003/17/EC (Ref. 12.53)) relating to the quality of petrol and diesel fuels establishes minimum specifications for petrol and diesel to be placed on the market in the EU, including gas oils intended for use by NRMM. These are required to contain less than 2,000mg/kg of sulphur decreasing to 1,000mg/kg by 1 January 2008 at the latest.

12.6.58 For small engines (37-75kW), the predicted technology required to meet Stage IIIA controls includes engine modifications, adoption of electronic engine control, improved fuel pumps and limited, un-cooled Exhaust Gas Recirculation (EGR). For larger engines which already utilise electronic engine control, the predicted technologies required are engine modifications, common rail injection, air-air charge cooling and limited, un-cooled EGR. Further reductions for small engines (i.e. 18 - 37kW) are considered impractical (Ref. 12.54).

12.6.59 For engines to meet Stage IIIB controls it is expected that Diesel Particulate Filters (DPFs) will be fitted. To ensure reliable operation of DPFs, the use of low sulphur content fuels will be needed (approximately 10mg/kg sulphur, whilst gas oil has 2,000mg/kg sulphur, decreasing to 1,000mg/kg from 2008) (Ref. 12.54).

12.6.60 Stage IV controls are expected to force the adoption of Selective Catalytic Reduction (SCR) de-NO_X after-treatment systems in addition to DPFs.

12.6.61 A summary of the implementation dates for the emission standards is presented in **Table 12.10**.

Table 12.10: Summary of the Implementation Dates for NRMM Emission Standards

Net Power, kW	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
130 – 560											
75 – 130											
56 – 75											
37 – 56											
18/19 – 37											

Stage I (1999)

Stage II (2001-2004)

Stage IIIA (2006-2008)

Stage IIIB (2011-2013)

Stage IV (2014)

12.6.62 For the purposes of this assessment, given the indicative plant and machinery required on site, a qualitative assessment approach of NRMM emissions to air of principal concern (NO_x, PM_{10} and SO_2) is considered appropriate. The adopted qualitative approach considers the likely quantities and type of NRMM to be used during the construction works, combined with the locations of sensitive receptor groups.

12.6.63 Given the likely numbers of plant items working on-site, their frequency and anticipated duration of operation, the magnitude of increase in pollutant concentrations associated with exhaust emissions from the numbers of NRMM operating would likely be either imperceptible or small, even at Bishops House Farm and Doggetts located approximately 10m and 26m from the development site boundary respectively (works at this separation distance to the receptors would be infrequent and of an intermittent nature). Therefore, there are no human receptors that have the potential to be significantly impacted by NRMM emissions generated by the HPC construction works.

12.6.64 Background pollutant concentrations in the development site locality are well below the relevant AQOs; there is therefore a significant amount of 'headroom' before any of the relevant short-term and long-term AQOs would potentially be exceeded (see section 12.5 and **Appendix 12B**). Given the above, on-site exhaust emissions to air as a result of NRMM associated with construction are predicted to be of small magnitude, and thus **negligible** in terms of impact at the assessed human receptors. This impact is therefore considered to be **not significant**. Impacts from on-site exhaust emissions from NRMM would be local, adverse, direct, unlikely and long-term but temporary in nature.

Ecological Receptors

12.6.65 With respect to ecological receptors, background air quality pollutant concentrations in the development site locality are well below the relevant AQOs for the protection of vegetation and ecosystems (see section 12.5 and **Appendix 12B**). Given the above and the numbers of plant and machinery likely to be required, on-site exhaust emissions to air as a result of NRMM associated with the construction works are also considered to be of either imperceptible or small magnitude, and therefore **negligible**, in terms of their potential impact on the assessed ecological receptors. Impacts from on-site exhaust emissions from NRMM would be local, adverse, direct, unlikely and long-term but temporary. Impact would also be limited only to the proportion of the ecological receptor which is within 200m from the development site boundary (i.e. the majority of the ecological sites would not be impacted by exhaust emissions from NRMM at all).

12.6.66 Further discussion of the potential impacts from on-site NRMM exhaust emissions upon biodiversity receptors, is presented in **Volume 2**, **Chapter 20**.

iii. Emissions from Marine Vessels Associated with Temporary Jetty Operation

12.6.67 This section presents the assessment of marine vessel emissions to air associated with the operation of the temporary jetty. The jetty will be a temporary structure, utilised during the construction of HPC to supply aggregate and cement for concreting.

12.6.68 It is forecast that up to 18 self-discharging vessels (13 aggregate dredgers and up to 5 cement carriers) would berth at the jetty head per month, to meet a peak concrete demand of 30,000m^3 per month (6 month period) during the construction of the proposed power station. During low concrete demand periods, other freight goods and materials may be delivered to the development site via the jetty once the second phase (larger) jetty is constructed, although the precise quantity of these additional movements is yet to be quantified.

12.6.69 Whilst the selection of operational vessels would be made by the works contractor, it is estimated that the jetty would accommodate vessels of up to 5,000 deadweight tonnes (dwt), using marine diesel oil, taking approximately one hour to berth, 30 minutes for departure and six hours moored alongside the jetty.

12.6.70 Based upon these assumptions, the potential impacts on human and ecological receptors from exhaust emissions to air resulting from marine vessel movements during operation of the jetty were predicted using the air pollutant dispersion model ADMS 4.2. The input data and further information used in the modelling study is presented in **Appendix 12F**.

12.6.71 The results of the dispersion modelling and an assessment of the significance of the potential impacts on ground level concentrations in relation to ambient air quality standards are presented in this section. The pollutant concentrations resulting from emissions from marine vessels have been combined with background concentrations and the percentage contribution that the total predicted air concentrations will make towards the relevant AQO calculated. Full results of the dispersion modelling exercise are presented in **Appendix 12F**.

12.6.72 Results are presented for the meteorological year resulting in the highest ground level concentrations, as a worst-case assumption. 2005 was identified to be the worst-case meteorological year for pollutant dispersion from the marine vessel source (i.e. it led to the highest pollutant concentrations at receptor locations) and therefore meteorological data for this year were used in this study. Results and associated impacts using meteorological data for 2005 are reported in the following sections.

Human Receptors

12.6.73 The pollutant concentration results and associated impacts predicted at the 31 human receptor locations as illustrated in **Figure 12.6**.

12.6.74 In addition to these 31 human receptors locations that represent residential locations in proximity to the HPC development site boundary, potential impacts at four additional transient human receptor locations have been assessed. These represent locations of recreation and amenity activity (i.e. Public Rights of Way and sites of archaeological interest) where humans would be present relatively infrequently and for only short periods of time. Exposure at these locations is therefore only considered over short-term averaging periods. These transient human receptor locations are also illustrated in **Figure 12.6**.

12.6.75 **Table 12.11** summarises the pollutant concentration results and associated impacts predicted at the 31 human receptor locations and the 4 transient human receptor locations. The table provides a summary of the maximum Process Contributions (PCs) and the maximum Predicted Environmental Concentrations (PECs) (i.e. the sum of the PC and the background concentration) from the marine vessels. A full set of results for all human receptor locations is presented in **Appendix 12F**.

12.6.76 The PCs of long-term NO_2, PM_{10} and $PM_{2.5}$ and short-term NO_2, PM_{10} and SO_2 marine vessel exhaust emissions (as detailed in **Appendix 12F**, **Tables 3**, **4**, **5** and **6**) are of imperceptible magnitude. The PEC values of long-term NO_2, PM_{10} and $PM_{2.5}$ and short-term NO_2, PM_{10} and SO_2 are all well below the objective/limit value and so are predicted to be **negligible**. Their impact on the human receptor locations is therefore **not significant**.

Table 12.11: Maximum Predicted Marine Vessel Exhaust Pollutant Concentrations and Impacts at Human Receptor Locations

Pollutant and Averaging Period	AQO/EAL Limit Value ($\mu g/m^3$)	Maximum Concentration Increase due to Development (PC) ($\mu g/m^3$) and as Percentage of AQO/EAL (%)	Maximum Concentration with Development (PEC) ($\mu g/m^3$) and as Percentage of AQO/EAL (%)	Magnitude of Change	Impact Descriptor
Human Receptors					
NO_2 annual mean	40	0.03 (0.1%)	6.83 (17.1%)	Imperceptible	Negligible
NO_2 1-hour mean	200	0.47 (0.2%)	14.07(7.0%)	Imperceptible	Negligible
PM_{10} annual mean	40	0.02 (0.1%)	18.22 (45.6%)	Imperceptible	Negligible
PM_{10} 24-hour mean	50	0.08 (0.2%)	36.48 (73.0%)	Imperceptible	Negligible
$PM_{2.5}$ annual mean	25	0.02 (0.1%)	7.92 (31.7%)	Imperceptible	Negligible
SO_2 15-minute mean	266	0.90 (0.3%)	4.50 (1.7%)	Imperceptible	Negligible
SO_2 1-hour mean	350	0.62 (0.2%)	4.22 (1.2%)	Imperceptible	Negligible
SO_2 24-hour mean	125	0.27 (0.2%)	3.87 (3.1%)	Imperceptible	Negligible
Transient Human Receptors					
NO_2 1-hour mean	200	2.59 (1.3%)	16.19 (8.1%)	Small	Negligible
SO_2 15-minute mean	266	4.30 (1.6%)	7.90 (3.0%)	Small	Negligible
SO_2 1-hour mean	350	3.55 (1.0%)	7.15 (2.0%)	Small	Negligible

iv. Transient Human Receptors

12.6.77 The PCs of short-term NO_2 and SO_2 marine vessel exhaust emissions (as detailed in **Appendix 12F**, **Tables 3** and **6**) are of no more than small magnitude. The PEC values of short-term NO_2 and SO_2 are all well below the objective/limit value and so are predicted to be **negligible**. Their impact on the transient human receptor locations is therefore **not significant**.

Summary

12.6.78 For all assessed pollutants, the potential impact of exhaust emissions from the commissioning of HPC on the identified human receptors is local, adverse, direct, likely and long-term but temporary. The impact on the human receptor (including transient human receptor) locations for all assessed pollutants is determined to be **not significant**.

Ecological Receptors

12.6.79 This section presents the pollutant concentrations results and associated impacts predicted at the following ecological receptor locations (see **Figure 12.6**):

- Bridgwater Bay SSSI/NNR.
- Severn Estuary SPA/SAC/Ramsar.

12.6.80 Given that the separation distance between the closest non-statutory designated ecological site (Hinkley CWS) and the location of potential marine vessel exhaust emissions is approximately 1.6km, marine vessel exhaust emissions at these locations have not been subject to a detailed assessment as potential impacts are considered to be insignificant.

12.6.81 **Table 12.12** summarises the pollutant concentrations results and associated impacts predicted at the statutory designated ecological receptor locations. The table provides a summary of the maximum PC and PEC concentrations from the marine vessels. A full set of results for all ecological receptor locations is presented in the **Appendix 12F**.

12.6.82 The PCs of long-term NO_x and SO_2 marine vessel exhaust emissions (as detailed in **Appendix 12F**, **Tables 7** and **8**) are of no more than small magnitude. The PEC values of long-term NO_x and SO_2 are all well below the objective/limit value and so are predicted to be **negligible**.

12.6.83 The PCs of 24-hour mean NO_x marine vessel exhaust emissions (as detailed in **Appendix 12F**, **Table 7**) are of up to medium magnitude. The PEC values of 24-hour mean NO_x are all well below the objective/limit value and so are predicted to be **negligible**.

Table 12.12: Maximum Predicted Marine Vessel Exhaust Pollutant Concentrations and Impacts at Ecological Receptor Locations

Pollutant and Averaging Period	AQO/EAL Limit Value ($\mu g/m^3$)	Maximum Concentration Increase due to Development (PC) ($\mu g/m^3$) and as Percentage of AQO/EAL (%)	Maximum Concentration with Development (PEC) ($\mu g/m^3$) and as Percentage of AQO/EAL (%)	Magnitude of Change	Impact Descriptor
Statutory Designated Ecological Receptors					
NO_x annual mean	30	1.06 (3.5%)	12.56 (41.9%)	Small	Negligible
NO_x 24-hour mean	75	7.48 (9.9%)	30.48 (30.5%)	Medium	Negligible
SO_2 annual mean	20	0.51 (2.6%)	2.31 (11.6%)	Small	Negligible

Summary

12.6.84 For all assessed pollutants, the potential impact of exhaust emissions from marine vessels associated with the temporary jetty operation on statutory ecological receptors is local, adverse, direct, likely and long-term but temporary.

12.6.85 The significance of these predictions of NO_x and SO_2 emissions, from marine vessels associated with the operation of the temporary jetty during HPC construction, upon biodiversity receptors is presented **Volume 2**, **Chapter 20**.

Deposition of Nutrifying and Acidifying Pollutants

12.6.86 The maximum additional deposition rates of nutrifying and acidifying pollutants at the statutory designated ecological receptor sites, due to the exhaust emissions from marine vessels associated with jetty operation during the proposed HPC development construction phase, are summarised in **Table 12.13** below.

Table 12.13: Maximum Deposition Rates at Statutory Designated Ecological Receptors from Marine Vessel Emissions

Site Designation	Nitrogen Deposition Rate – Commissioning (kg N/ha/y)	Acid Deposition Rate – Commissioning (keq/ha/y)
Statutory (Severn Estuary SPA/SAC/Ramsar and Bridgwater Bay SSSI)	0.15	0.07

12.6.87 Assessment of potential impacts, taking into account the relevant critical loads and existing background deposition rates, is provided in **Volume 2, Chapter 20**.

c) Operational Impacts (Non-Vehicular)

i. H1 Screening Assessment

12.6.88 The direct impacts on human and ecological receptor locations of point source emissions to air released from the proposed UK EPR reactor units during the operational (including commissioning) phase were initially screened following the methodology of the Environment Agency's H1 Environmental Risk Assessment guidance (Ref. 12.30).

12.6.89 The results of the H1 assessments are presented in **Appendix 12D**. The short-term and long-term Process Contributions to Air (PC_{air}) calculated for both the commissioning scenario and the routine test scenario are provided in this **Appendix 12D**.

12.6.90 The outcome of the H1 assessment is summarised below.

Human Receptors

12.6.91 When assessing the results from the H1 assessment, the following criteria, as defined in the H1 guidance note (Ref 12.30), have been applied:

- For long-term PCs less than 1% of the AQS/AQO/EAL, and short-term PCs less than 10% of the AQS/AQO/EAL, the PC is defined as **insignificant**.

- For those PCs that do not meet the above significance criteria, but where long-term PECs are less than 70% of the AQS/AQO/EAL, and where short-term PECs are less than 20% of the model headroom (i.e., the AQS/AQO/EAL concentration minus twice the annual mean background concentration), the PECs is defined as **not significant**.
- For those PCs or PECs that do not meet either of the above criteria, the predicted result is potentially significant and requires further assessment using detailed dispersion modelling of emissions.

12.6.92 Following the H1 methodology, the PC_{air} values calculated for the commissioning scenario were compared with the relevant human health AQS/AQOs//EALs in order to determine their potential significance and screen out insignificant emissions. This showed that, with the exception of long-term H_2CO emissions (which are defined as **insignificant**), emissions of all pollutants could not be screened out as being insignificant. Further consideration of the other air emissions associated with the commissioning scenario was required in order to determine if detailed air modelling was necessary. From those emissions identified above that could not be screened as insignificant, detailed air modelling was required for all remaining pollutants.

12.6.93 For the routine test scenario, only long-term H_2CO emissions could be screened out as being **insignificant**. Further consideration of the other emissions associated with the routine test scenario was therefore required with regards to human receptors, in order to determine if detailed air modelling was necessary. From those emissions identified that could not be screened out as being insignificant (all emissions except long-term H_2CO), detailed air modelling was then found to be required for all remaining pollutants with the exception of long-term NH_3, PM_{10} and $PM_{2.5}$ emissions. Long-term emissions of H_2CO associated with the routine test scenario are therefore considered to be **insignificant**, whilst long-term NH_3, PM_{10} and $PM_{2.5}$ emissions associated with the routine test scenario are considered to be **not significant**.

Ecological Receptors

12.6.94 Comparison of the relevant ecological EALs with the calculated PC_{air} values showed that long-term emissions of SO_2 and NO_x from the commissioning of the UK EPR Units and ancillary buildings could not be screened out as being insignificant. These emissions therefore required further consideration in order to determine if detailed modelling was necessary. For these emissions, detailed air modelling was required for all pollutants.

12.6.95 Considering the routine test operation scenario, comparison of the relevant ecological EALs with the calculated PC_{air} values showed that no emissions could be defined as insignificant. These emissions therefore required further consideration in order to determine if detailed air modelling was necessary. From those emissions identified above that could not be defined as insignificant, detailed air modelling was required for all pollutants.

H1 Assessment Summary

12.6.96 The H1 assessments undertaken did not screen out the majority of operational emissions from requiring detailed dispersion modelling. As a result, the detailed operational dispersion modelling considered all potential emissions that may occur during the commissioning and routine test scenarios.

ii. Detailed Dispersion Modelling

12.6.97 This section sets out the results of the dispersion modelling exercise and compares predicted ground level concentrations to ambient air quality standards. The predicted concentrations resulting from the modelling process are presented with background concentrations and the percentage contribution that the predicted environmental concentrations would make towards the relevant AQS/AQO/EAL.

12.6.98 Results and associated impacts are presented for the meteorological year resulting in the highest ground level concentrations, as a worst-case assumption. The worst-case was determined separately for long-term and short-term concentrations, based on NO_x process contributions at the human receptor experiencing the maximum process contribution during the commissioning scenario (**Table 12.14**).

Table 12.14: Identification of Worst-Case Meteorological Year for Pollutant Dispersion

Year	Predicted Ground Level Concentration due to Process Emissions (µg/m³) [a]	
	NO_x Annual Mean	NO_x 1-hour Mean
2005	2.41	77.83
2006	2.24	71.19
2007	2.38	74.15
2008	2.25	**79.00**
2009	**2.50**	78.74

[a] Determination based on maximum predicted NO_x process contribution at any human receptor during commissioning and without consideration of annual operational hours.

12.6.99 From **Table 12.14** it can be seen that 2009 meteorological data results in the highest predicted concentrations for long-term means, whilst the 2008 meteorological data results in the highest predicted concentrations for short-term means. Therefore, as a worst-case assumption, results using 2009 and 2008 data for long-term and short-term means, respectively, are presented below.

12.6.100 Results from all dispersion modelling undertaken, along with detailed discussion of the outputs, are presented in the Air Quality Modelling Report (Ref. 12.2).

12.6.101 It is important to note that the model-predicted number of exceedences of the short-term air quality objective limit values represents an extreme worst-case, as concentrations have been calculated by the model for each line of 1-hour meteorological data over a full year (i.e. 8,760 hours), assuming emissions are being discharged continuously throughout the year. Although the precise operating schedule for the UK EPR Units and ancillary buildings is not yet known and it is acknowledged that routine testing of the backup diesel generators could occur at any time during the year, it is known that testing will take place for approximately 60 hours per year per generator, with testing limited to one generator at any time. Therefore, the number of exceedences predicted by the model does not represent a likely scenario. It is extremely unlikely that backup diesel generators will be tested at exactly those times during which meteorological conditions are unfavourable and lead to pollutant concentrations above the short-term air quality objective limits at sensitive receptors. Thus, even if the potential impact is predicted to be significant, mitigation is unlikely to be required due to the very small likelihood of occurrence.

Human Receptors

12.6.102 This section presents the pollutant concentration results and associated impacts predicted at the 31 human receptor locations as illustrated in **Figure 12.6**.

12.6.103 In addition to these 31 human receptor locations that represent residential locations in proximity to the HPC development site boundary, potential impacts at four additional transient human receptor locations have been assessed. These represent locations of recreation and amenity activity (i.e. Public Rights of Way and sites of archaeological interest) where people would be present relatively infrequently and for only short periods of time. Exposure at these locations is therefore only considered over short-term averaging periods. These transient human receptor locations are also illustrated in **Figure 12.6**.

iii. Commissioning Impacts on Human Receptors

12.6.104 **Table 12.15** summarises the pollutant concentration results and associated impacts predicted at the 31 human receptor locations and the four transient human receptor locations for the HPC commissioning scenario. A summary of the maximum predicted PC and PEC concentrations for this scenario is presented. A full set of results for all human receptor locations is presented in **Appendix 12D**.

12.6.105 The PCs of long-term PM_{10}, $PM_{2.5}$ and H_2CO, and short-term PM_{10}, H_2CO and CO emissions from HPC commissioning (as detailed in **Appendix 12D, Tables 12, 13, 14 and 16**) are of imperceptible magnitude. Maximum PC values are observed at 'Trighern Farm' for long-term PM_{10} and $PM_{2.5}$, and short-term PM_{10}, and at 'Doggetts' for long-term H_2CO and short-term H_2CO and CO. The PEC values of long-term PM_{10}, $PM_{2.5}$ and H_2CO and short-term PM_{10}, H_2CO and CO are all well below the AQS/AQO/EAL and so are predicted to be **negligible**. Their impact on the human receptor locations is therefore **not significant**.

12.6.106 The PCs of long-term NO_2 and short-term SO_2 emissions from HPC commissioning (as detailed in **Appendix 12D, Tables 11 and 15**) are of no greater than small magnitude. Maximum PC values are observed at 'Trighern Farm' for long-term NO_2, and at 'Doggetts' for short-term SO_2. The PEC values of long-term NO_2 and short-term SO_2 are all well below the AQS/AQO/EAL and so are predicted to be **negligible**. Their impact on the human receptor locations is therefore **not significant**.

12.6.107 The PCs of short-term NO_2 emissions from HPC commissioning (as detailed in **Appendix 12D, Table 11**) are of no greater than medium magnitude. Maximum PC values are observed at 'Doggetts' for short-term NO_2. The PEC values of short-term NO_2 are all well below the AQS/AQO/EAL and so are predicted to be **negligible**. Their impact on the human receptor locations is therefore **not significant**.

Table 12.15: Maximum Predicted Pollutant Concentrations and Impacts at Human Receptor Locations from HPC Commissioning (Commissioning Scenario)

Pollutant and Averaging Period	AQO/EAL Limit Value ($\mu g/m^3$)	Maximum Concentration Increase due to Development (PC) ($\mu g/m^3$) and as Percentage of AQO/EAL (%)	Maximum Concentration with Development (PEC) ($\mu g/m^3$) and as Percentage of AQO/EAL (%)	Magnitude of Change	Impact Descriptor
Human Receptors					
NO_2 annual mean	40	0.59 (1.5%)	7.39 (18.5%)	Small	Negligible
NO_2 1-hour mean	200	18.37 (9.2%)	31.97 (16.0%)	Medium	Negligible
PM_{10} annual mean	40	0.02 (0.1%)	18.22 (45.6%)	Imperceptible	Negligible
PM_{10} 24-hour mean	50	0.18 (0.4%)	36.58 (73.2%)	Imperceptible	Negligible
$PM_{2.5}$ annual mean	25	0.02 (0.1%)	7.92 (31.7%)	Imperceptible	Negligible
CO 1-hour mean	30,000	6.33 (<0.1%)	163.33 (0.5%)	Imperceptible	Negligible
CO rolling 8-hour mean	10,000	4.99 (<0.1%)	161.99 (1.6%)	Imperceptible	Negligible
SO_2 15-minute mean	266	6.73 (2.5%)	10.33 (3.9%)	Small	Negligible
SO_2 1-hour mean	350	4.92 (1.4%)	8.52 (2.4%)	Small	Negligible
SO_2 24-hour mean	125	2.51 (2.0%)	6.11 (4.9%)	Small	Negligible
H_2CO annual mean	5	<0.01 (<0.01%)	<0.01 (<0.01%)	Imperceptible	Negligible
H_2CO 1-hour mean	100	0.71 (0.7%)	0.71 (0.7%)	Imperceptible	Negligible
Transient Human Receptors					
NO_2 1-hour mean	200	102.71 (51.4%)	116.31 (58.2%)	Large	Slight Adverse
CO 1-hour mean	30,000	25.89 (<0.1%)	182.89 (0.6%)	Imperceptible	Negligible
SO_2 15-minute mean	266	32.23 (12.1%)	35.83 (13.5%)	Large	Slight Adverse
SO_2 1-hour mean	350	27.82 (7.9%)	31.42 (9.0%)	Medium	Negligible
H_2CO 1-hour mean	100	1.04 (1.0%)	1.04 (1.0%)	Small	Negligible

Transient Human Receptors

12.6.108 The PCs of short-term CO (1-hour mean) emissions from HPC commissioning (as detailed in **Appendix 12D, Table 14**) are of imperceptible magnitude. Maximum PC values are observed at 'Footpath - Coastal' for short-term CO (1-hour mean). The PEC values of short-term CO (1-hour mean) are all well below the EAL and so are predicted to be **negligible**. Their impact on the transient human receptor locations is therefore **not significant**.

12.6.109 The PCs of short-term H_2CO emissions from HPC commissioning (as detailed in **Appendix 12D, Table 16**) are of no greater than small magnitude. Maximum PC values are observed at 'Footpath - Coastal' for short-term H_2CO. The PEC values of short-term CO are all well below the EAL and so are predicted to be **negligible**. Their impact on the transient human receptor locations is therefore **not significant**.

12.6.110 The PCs of short-term SO_2 (1-hour mean) emissions from HPC commissioning (as detailed in **Appendix 12D, Table 15**) are of no greater than medium magnitude. Maximum PC values are observed at 'Footpath - Coastal' for short-term SO_2 (1-hour mean). The PEC values of short-term SO_2 (1-hour mean) are all well below the AQS/AQO and so are predicted to be **negligible**. Their impact on the transient human receptor locations is therefore **not significant**.

12.6.111 The PCs of short-term NO_2 and SO_2 (15-minute mean) emissions from HPC commissioning (as detailed in **Appendix 12D, Tables 11 and 15**) are of up to large magnitude. Maximum PC values are observed at 'Footpath - Coastal' for short-term NO_2 and SO_2 (15-minute mean). The PEC values of short-term NO_2 and SO_2 (15-minute mean) are all well below the AQS/AQO/EAL and so are predicted to be **slight adverse**. Their impact on the transient human receptor locations is therefore **not significant**.

Summary

12.6.112 For all assessed pollutants, the potential impact of emissions from HPC commissioning on the identified human receptors is local, adverse, direct, likely and short-term but temporary. The impact on the human receptor (including transient human receptor) locations for all assessed pollutants is determined to be **not significant**.

iv. Routine Test Scenario Impacts on Human Receptors

12.6.113 **Table 12.16** summarises the pollutant concentration results and associated impacts predicted at the 31 human receptor locations and the 4 transient human receptor locations for the routine test scenario. A summary of the maximum predicted PC and PEC concentrations for this scenario is presented. A full set of results for all human receptor locations is presented in **Appendix 12D**.

Table 12.16: Maximum Predicted Pollutant Concentrations and Impacts at Human Receptor Locations from HPC Routine Operation (Routine Test Scenario)

Pollutant and Averaging Period	AQS/AQO/EAL ($\mu g/m^3$)	Maximum Concentration Increase due to Development (PC) ($\mu g/m^3$) and as Percentage of AQS/AQO/EAL (%)	Maximum Concentration with Development (PEC) ($\mu g/m^3$) and as Percentage of AQS/AQO/EAL (%)	Magnitude of Change	Impact Descriptor
Human Receptors					
NO_2 annual mean	40	0.14 (0.4%)	6.94 (17.4%)	Imperceptible	Negligible
NO_2 1-hour mean	200	18.37 (9.2%)	31.97 (16.0%)	Medium	Negligible
PM_{10} annual mean	40	0.01 (<0.1%)	18.21 (45.5%)	Imperceptible	Negligible
PM_{10} 24-hour mean	50	0.18 (0.4%)	36.58 (73.2%)	Imperceptible	Negligible
$PM_{2.5}$ annual mean	25	0.01 (<0.1%)	7.91 (31.6%)	Imperceptible	Negligible
CO 1-hour mean	30,000	6.33 (<0.1%)	163.33 (0.5%)	Imperceptible	Negligible
CO rolling 8-hour mean	10,000	4.95 (<0.1%)	161.95 (1.6%)	Imperceptible	Negligible
SO_2 15-minute mean	266	6.73 (2.5%)	10.33 (3.9%)	Small	Negligible
SO_2 1-hour mean	350	4.92 (1.4%)	8.52 (2.4%)	Small	Negligible
SO_2 24-hour mean	125	2.51 (2.0%)	6.11 (4.9%)	Small	Negligible
H_2CO annual mean	5	<0.01 (<0.1%)	<0.01 (<0.1%)	Imperceptible	Negligible
H_2CO 1-hour mean	100	0.51 (0.5%)	0.51 (0.5%)	Imperceptible	Negligible
NH_3 annual mean	180	0.05 (<0.1%)	1.15 (0.6%)	Imperceptible	Negligible
NH_3 1-hour mean	2,500	167.97 (6.7%)	170.17 (6.8%)	Medium	Negligible

Pollutant and Averaging Period	AQS/AQO/EAL (μg/m^3)	Maximum Concentration Increase due to Development (PC) (μg/m^3) and as Percentage of AQS/AQO/EAL (%)	Maximum Concentration with Development (PEC) (μg/m^3) and as Percentage of AQS/AQO/EAL (%)	Magnitude of Change	Impact Descriptor
Transient Human Receptors					
NO_2 1-hour mean	200	102.71 (51.4%)	116.31 (58.2%)	Large	Slight adverse
CO 1-hour mean	30,000	25.89 (<0.1%)	182.89 (0.6%)	Imperceptible	Negligible
SO_2 15-minute mean	266	32.23 (12.1%)	35.83 (13.5%)	Large	Slight adverse
SO_2 1-hour mean	350	27.82 (7.9%)	31.42 (9.0%)	Medium	Negligible
H_2CO 1-hour mean	100	0.74 (0.7%)	0.74 (0.7%)	Imperceptible	Negligible
NH_3 1-hour mean	2,500	498.60 (19.9%)	500.80 (20.0%)	Large	Slight adverse

12.6.114 The PCs of long-term NO_2, PM_{10}, $PM_{2.5}$, H_2CO and NH_3, and short-term PM_{10}, H_2CO and CO emissions from HPC routine operation (as detailed in **Appendix 12D**, **Tables 17**, **18**, **19**, **20**, **22** and **23**) are of imperceptible magnitude. Maximum PC values are observed at 'Trighern Farm' for long-term NO_2, PM_{10} $PM_{2.5}$ and NH_3, and short-term PM_{10}, and at 'Doggetts' for long-term H_2CO and short-term H_2CO and CO. The PEC values of long-term NO_2, PM_{10}, $PM_{2.5}$ H_2CO and NH_3, and short-term PM_{10}, H_2CO and CO are all well below the AQS/AQO/EAL and so are predicted to be **negligible**. Their impact on the human receptor locations is therefore **not significant**.

12.6.115 The PCs of short-term SO_2 emissions from HPC routine operation (as detailed in **Appendix 12D**, **Table 21**) are of no greater than small magnitude. Maximum PC values are observed at 'Doggetts' for short-term SO_2. The PEC values of short-term SO_2 are well below the AQS/AQO/EAL and so are predicted to be **negligible**. Their impact on the human receptor locations is therefore **not significant**.

12.6.116 The PCs of short-term NO_2 and NH_3 emissions from HPC routine operation (as detailed in **Appendix 12D**, **Tables 17** and **23**) are of no greater than medium magnitude. Maximum PC values are observed at 'Doggetts' for short-term NO_2 and NH_3. The PEC values of short-term NO_2 and NH_3 are well below the AQS/AQO/EAL and so are predicted to be **negligible**. Their impact on the human receptor locations is therefore **not significant**.

Transient Human Receptors

12.6.117 The PCs of short-term CO (1-hour mean) and H_2CO emissions from HPC routine operation (as detailed in **Appendix 12D**, **Tables 20** and **22**) are of imperceptible magnitude. Maximum PC values are observed at 'Footpath - Coastal' for short-term CO (1-hour mean) and H_2CO. The PEC values of CO (1-hour mean) and H_2CO are all well below the EAL and so are predicted to be **negligible**. Their impact on the transient human receptor locations is therefore **not significant**.

12.6.118 The PCs of short-term SO_2 (1-hour mean) emissions from HPC routine operation (as detailed in **Appendix 12D**, **Table 21**) are of no greater than medium magnitude. Maximum PC values are observed at 'Footpath - Coastal' for short-term SO_2 (1-hour mean). The PEC values of short-term SO_2 (1-hour mean) are all well below the AQS/AQO value and so are predicted to be **negligible**. Their impact on the transient human receptor locations is therefore **not significant**.

12.6.119 The PCs of short-term NO_2, NH_3 and SO_2 (15-minute mean) emissions from HPC routine operation (as detailed in **Appendix 12D**, **Table 17**, **21** and **23**) are of up to large magnitude. Maximum PC values are observed at 'Footpath - Coastal' for short-term NO_2, NH_3 and SO_2 (15-minute mean). The PEC values of short-term NO_2, NH_3 and SO_2 (15-minute mean) are all well below the AQS/AQO/EAL and so are predicted to be **slight adverse**. Their impact on the transient human receptor locations is therefore **not significant**.

Summary

12.6.120 For all assessed pollutants, the potential impact of emissions from HPC routine operation (Routine Test Scenario) on the identified human receptors is local, adverse, direct, likely and long-term. The impact on the human receptor (including transient human receptor) locations for all assessed pollutants is determined to be **not significant**.

Ecological Receptors

12.6.121 This section presents the pollutant concentration results and associated impacts predicted at the following ecological receptor locations (see **Figure 12.6**):

- Bridgwater Bay SSSI/NNR.
- Severn Estuary SPA/SAC/Ramsar.
- Hinkley CWS.

v. Commissioning Impacts on Ecological Receptors

12.6.122 **Table 12.17** summarises the pollutant concentration results and associated impacts predicted at the statutory and non-statutory designated ecological receptor locations for the commissioning scenario. A summary of the maximum predicted PC and PEC concentrations for this scenario is presented. A full set of results for all ecological receptor locations is presented in **Appendix 12D**.

Statutory Designated Ecological Receptors

12.6.123 The PCs of long-term SO_2 emissions from HPC commissioning (as detailed in **Appendix 12D**, **Table 25**) are of no greater than small magnitude. Maximum PC values are observed at 'Bridgwater Bay SSSI/Severn Estuary SPA/SAC/Ramsar' for long-term SO_2. The PEC values for long-term SO_2 are well below the AQS/EAL and so are predicted to be **negligible**.

12.6.124 The PCs of long-term NO_x emissions from HPC commissioning (as detailed in **Appendix 12D**, **Table 24**) are of up to large magnitude. Maximum PC values are observed at 'Bridgwater Bay SSSI/Severn Estuary SPA/SAC/Ramsar' for long-term NO_x. The PEC values for long-term NO_x are well below the AQS/EAL and so are predicted to be **slight adverse**.

12.6.125 The PCs of short-term NO_x emissions from HPC commissioning (as detailed in **Appendix 12D**, **Table 24**) are also of up to large magnitude. Maximum PC values are observed at 'Bridgwater Bay SSSI/Severn Estuary SPA/SAC/Ramsar' for short-term NO_x. The PEC values for short-term NO_x are above the EAL and so are predicted to be **moderate adverse**. However, the 24-hour mean values are derived based on continuous operation of an EDG over an entire 24-hour period, which is very unlikely to represent the actual operational profile. Furthermore, the 75µg/m^3 daily mean EAL is derived from the 2000 WHO Air Quality Guidelines for Europe (Ref. 12.55). The WHO state in this document that, with reference to the daily mean NO_x guideline level:

> *"There is insufficient data to provide these levels with confidence at present."*

12.6.126 Consequently, it is considered that greater emphasis should be placed on achievement of the more established annual mean NO_x AQS/EAL, which in this case is not exceeded.

Table 12.17: Maximum Predicted Pollutant Concentrations and Impacts at Ecological Receptor Locations from HPC Commissioning (Commissioning Scenario)

Pollutant and Averaging Period	AQS/EAL (µg/m^3)	Maximum Concentration Increase due to Development (PC) (µg/m^3) and as Percentage of AQS/AQO/EAL (%)	Maximum Concentration with Development (PEC) (µg/m^3) and as Percentage of AQS/AQO/EAL (%)	Magnitude of Change	Impact Descriptor
Statutory Designated Ecological Receptors					
NO_x annual mean	30	7.30 (24.3%)	18.80 (62.7%)	Large	Slight Adverse
NO_x 24-hour mean	75	189 (252%)	212 (282.7%)	Large	Substantial Adverse
SO_2 annual mean	20	0.70 (3.5%)	2.50 (12.5%)	Small	Negligible
Non-statutory Designated Ecological Receptors					
NO_x annual mean	30	16.57 (55.2%)	28.07 (93.6%)	Large	Moderate Adverse
NO_x 24-hour mean	75	251 (334.7%)	274 (365.3%)	Large	Substantial Adverse
SO_2 annual mean	20	1.71 (8.6%)	3.51 (17.6%)	Medium	Negligible

Non-statutory Designated Ecological Receptors

12.6.127 The PCs of long-term SO_2 emissions from HPC commissioning (as detailed in **Appendix 12D**, **Table 25**) are of no greater than medium magnitude. Maximum PC values are observed at 'Hinkley CWS' for long-term SO_2. The PEC values for long-term SO_2 are well below the AQS/EAL and so are predicted to be **negligible**.

12.6.128 The PCs of long-term NO_x emissions from HPC commissioning (as detailed in **Appendix 12D**, **Table 24**) are of up to large magnitude. Maximum PC values are observed at 'Hinkley CWS' for long-term NO_x. The PEC values for long-term NO_x are just below the AQS/EAL and so are predicted to be **moderate adverse**.

12.6.129 The PCs of short-term NO_x emissions from HPC commissioning (as detailed in **Appendix 12D**, **Table 24**) are of up to large magnitude. Maximum PC values are observed at 'Hinkley CWS' for short-term NO_x. The PEC values for short-term NO_x are above the EAL and so are predicted to be **substantial adverse**. However, as for statutory designated ecological receptors, it is considered that greater emphasis should be placed on achievement with the more established annual mean NO_x AQS/EAL, which in this case is not exceeded.

Summary

12.6.130 For all assessed pollutants, the potential impact of emissions from HPC commissioning (Commissioning Scenario) on the statutory and non-statutory designated ecological receptors for the commissioning scenario is local, adverse, direct, likely and short-term but temporary.

12.6.131 The significance of these predictions of NO_x and SO_2 emissions from HPC commissioning upon biodiversity receptors is assessed in **Volume 2**, **Chapter 20**.

vi. Routine Test Scenario Impacts on Ecological Receptors

12.6.132 **Table 12.18** summarises the pollutant concentration results and associated impacts predicted at the statutory and non-statutory designated ecological receptor locations for the routine test scenario. A summary of the maximum predicted PC and PEC concentrations for this scenario is presented. A full set of results for all ecological receptor locations is presented in **Appendix 12D**.

Statutory Designated Ecological Receptors

12.6.133 The PCs of long-term SO_2 emissions from HPC routine operation (as detailed in **Appendix 12D**, **Table 27**) are of imperceptible magnitude. Maximum PC values are observed at 'Bridgwater Bay SSSI/Severn Estuary SPA/SAC/Ramsar' for long-term SO_2. The PEC values for long-term SO_2 are well below the AQS/EAL and so are predicted to be **negligible**.

12.6.134 The PCs of long-term NO_x emissions from HPC routine operation (as detailed in **Appendix 12D**, **Table 26**) are of up to medium magnitude. Maximum PC values are observed at 'Bridgwater Bay SSSI/Severn Estuary SPA/SAC/Ramsar' for long-term NO_x. The PEC values for long-term NO_x are well below the AQS/EAL and so are predicted to be **negligible**.

Table 12.18: Maximum Predicted Pollutant Concentrations and Impacts at Ecological Receptor Locations from HPC Routine Operation (Routine Test Scenario)

Pollutant and Averaging Period	AQS/EAL Limit Value ($\mu g/m^3$)	Maximum Concentration Increase due to Development (PC) ($\mu g/m^3$) and as Percentage of AQO/EAL (%)	Maximum Concentration with Development (PEC) ($\mu g/m^3$) and as Percentage of AQO/EAL (%)	Magnitude of Change	Impact Descriptor
Statutory Designated Ecological Receptors					
NO_x annual mean	30	1.79 (6.0%)	13.29 (44.3%)	Medium	Negligible
NO_x 24-hour mean	75	189 (252%)	212 (282.7%)	Large	Substantial Adverse
SO_2 annual mean	20	0.17 (0.9%)	1.97 (9.9%)	Imperceptible	Negligible
NH_3 annual mean	3	0.73 (24.3%)	1.83 (61.0%)	Large	Slight Adverse
Non-statutory Designated Ecological Receptors					
NO_x annual mean	30	4.06 (13.5%)	15.56 (51.9%)	Large	Slight Adverse
NO_x 24-hour mean	75	251 (334.7%)	274 (365.3%)	Large	Substantial Adverse
SO_2 annual mean	20	0.42 (2.1%)	2.22 (11.1%)	Small	Negligible
NH_3 annual mean	3	0.55 (18.3%)	1.65 (55.0%)	Large	Slight Adverse

12.6.135 The PCs of long-term NH_3 emissions from HPC routine operation (as detailed in **Appendix 12D**, **Table 28**) are of up to large magnitude. Maximum PC values are observed at 'Bridgwater Bay SSSI/Severn Estuary SPA/SAC/Ramsar' for long-term NH_3. The PEC values for long-term NH_3 are well below the EAL and so are predicted to be **slight adverse**.

12.6.136 The PCs of short-term NO_x emissions from HPC routine operation (as detailed in **Appendix 12D**, **Table 26**) are of up to large magnitude. Maximum PC values are observed at 'Bridgwater Bay SSSI/Severn Estuary SPA/SAC/Ramsar' for short-term NO_x. The PEC values for short-term NO_x are above the EAL and so are predicted to be **substantial adverse**. However, as for the commissioning scenario, it is considered that greater emphasis should be placed on achievement of the more established annual mean NO_x AQS/EAL, which in this case is not exceeded.

Non-statutory Designated Ecological Receptors

12.6.137 The PCs of long-term SO_2 emissions from HPC routine operation (as detailed in **Appendix 12D**, **Table 27**) are of no greater than small magnitude. Maximum PC values are observed at 'Hinkley CWS' for long-term SO_2. The PEC values for long-term SO_2 are well below the AQS/EAL and so are predicted to be **negligible**.

12.6.138 The PCs of long-term NO_x and NH_3 emissions from HPC routine operation (as detailed in **Appendix 12D**, **Tables 26** and **28**) are of up to large magnitude. Maximum PC values are observed at 'Hinkley CWS' for long-term NO_x and NH_3. The PEC values for long-term NO_x and NH_3 are well below the AQS/EAL and so are predicted to be **slight adverse**.

12.6.139 The PCs of short-term NO_x emissions from HPC routine operation (as detailed in **Appendix 12D**, **Table 26**) are of up to large magnitude. Maximum PC values are observed at 'Hinkley CWS' for short-term NO_x. The PEC values for short-term NO_x are above the EAL and so are predicted to be **substantial adverse.** However, as for the commissioning scenario, it is considered that greater emphasis should be placed on achievement of the more established NO_x annual mean AQS/EAL, which in this case is not exceeded.

Summary

12.6.140 For all assessed pollutants, the potential impact of emissions from HPC routine operation (Routine Test Scenario) on the statutory and non-statutory designated ecological receptors for the routine test scenario is local, adverse, direct, likely and long-term but temporary.

12.6.141 The significance of these predictions of NO_x, SO_2 and NH_3 emissions from HPC routine operation upon biodiversity receptors is assessed in **Volume 2**, **Chapter 20**.

vii. Deposition of Nutrifying and Acidifying Pollutants

12.6.142 The maximum additional deposition rates of nutrifying and acidifying pollutants at the statutory and non-statutory designated sites, due to the commissioning (Commissioning Scenario) and routine operation (Routine Test Scenario) of HPC, are summarised in **Table 12.19** below.

Table 12.19: Maximum Deposition Rates at Statutory and Non-statutory Designated Ecological Receptors from the Commissioning and Operation of HPC

Site Designation	Nitrogen Deposition Rate – Commissioning (kg N/ha/y)	Nitrogen Deposition Rate – Routine Test (kg N/ha/y)	Acid Deposition Rate – Commissioning (keq/ha/y)	Acid Deposition Rate – Routine Test (keq/ha/y)
Statutory (Severn Estuary SPA/SAC/ Ramsar and Bridgwater Bay SSSI)	1.05	3.99	0.16	0.30
Non-statutory (Hinkley CWS)	2.13	3.14	0.36	0.29

12.6.143 Assessment of potential impacts, taking into account the relevant critical loads and existing background deposition rates, is provided in **Volume 2**, **Chapter 20**.

d) Vehicular Exhaust Emissions Impacts

12.6.144 The impacts on both human and ecological receptors of exhaust emissions to air resulting from vehicle movements associated with the HPC Project (including baseline traffic and traffic associated with committed development) during the 2013 (construction), 2016 (construction with peak workforce on the HPC development site) and 2021 (early operation) scenarios were predicted using the air pollutant dispersion model ADMS Roads. The traffic input data and further information used in the ADMS Roads assessment is presented in **Appendix 12E**. Additional details of the modelling methodology are provided in the Air Quality Modelling Report (Ref. 12.2).

12.6.145 Estimates of vehicle pollutant concentrations (NO_x/NO_2, PM_{10} and $PM_{2.5}$) were predicted and assessed for the 2013, 2016 and 2021 scenarios identified in section 12.4, for ‘with development’ (i.e. with all road traffic associated with the HPC Project) and ‘without development’ (i.e. future baseline without HPC) scenarios. Pollutant concentrations were also predicted for the 2009 model verification/baseline scenario. Comparison of these modelled scenarios allowed the specific impacts of exhaust emissions to air generated by vehicle movements associated with the combined HPC Project to be assessed, and also evaluated against the existing and future baseline air quality in the study area.

12.6.146 For the HPC accommodation campus, pollutant concentrations at four receptors (‘HPC Accommodation 1’, ‘HPC Accommodation 2’, ‘HPC Accommodation 3’ and ‘HPC Accommodation 4’) have been predicted for the 2016 scenario (i.e. during the operation of the HPC accommodation campus). These locations are considered to be representative of worst-case air pollutant concentrations likely to be experienced by the on-site residential workforce.

12.6.147 A full set of results from all vehicular emissions dispersion modelling undertaken, along with detailed discussion of the outputs, is presented in the Air Quality Modelling Report (Ref. 12.2).

i. Human Receptors

12.6.148 This section presents the pollutant concentrations results and associated impacts predicted at the 104 human receptor locations as illustrated in **Figures 12.3**, **12.4** and **12.5**.

12.6.149 A summary of the main results relating to these human receptors located adjacent to the affected roads are provided below in **Table 12.20**, whilst pollutant concentrations predicted at all the assessed human receptor locations are presented in **Appendix 12E**.

2013 Scenario – Construction of HPC and the Associated Development Sites

12.6.150 **Table 12.21** summarises the pollutant concentration results and associated impacts predicted at the 104 human receptor locations for the 2013 'with development' scenario. The table provides a summary of the maximum vehicular pollutant contributions from road traffic movements associated with the HPC Project and the maximum ambient pollutant concentrations (i.e. the sum of the vehicular contribution and the background concentration) for the 2013 'with development' scenario. A full set of results for all human receptor locations is presented in **Appendix 12E**.

12.6.151 The annual mean PM_{10} and $PM_{2.5}$ vehicular contributions in both the Bridgwater and Williton models (as detailed in **Appendix 12E**, **Tables 32**, **35**, **56** and **59**) are of imperceptible magnitude. Maximum vehicular contributions are observed at '131 The Drove' in the Bridgwater model and 'Williton County Stores' in the Williton Model for annual mean PM_{10} and $PM_{2.5}$. The 'with development' ambient concentration values for annual mean PM_{10} and $PM_{2.5}$ in both the Bridgwater and Williton models are all well below the objective/limit value and so are predicted to be **negligible**. Their impact on the human receptor locations is therefore **not significant**.

12.6.152 The annual mean NO_2 vehicular contributions in the Williton model, and PM_{10} and $PM_{2.5}$ vehicular contributions in the Cannington model (as detailed in **Appendix 12E, Tables 44**, **47** and **50**) are of no greater than small magnitude. Maximum vehicular contributions are observed at 'Williton County Stores' for annual mean NO_2 in the Williton model and at 'The Lodge, Withycombe' for annual mean PM_{10} and $PM_{2.5}$ in the Cannington Model. The 'with development' ambient concentration values for annual mean NO_2 in the Williton model, and annual mean PM_{10} and $PM_{2.5}$ in the Cannington model, are all below the objective/limit value. Annual mean NO_2 in the Williton model, and PM_{10} and $PM_{2.5}$ in the Cannington model, are therefore predicted to be **negligible**. Their impact on the human receptor locations is therefore **not significant**.

12.6.153 The annual mean NO_2 vehicular contributions in the Bridgwater model (as detailed in **Appendix 12E**, **Table 26**) are of no greater than medium magnitude. Maximum vehicular contributions are observed at '131 The Drove' for annual mean NO_2 in the Bridgwater model. The 'with development' ambient concentration values for annual mean NO_2 in the Bridgwater model are all well below the objective/limit value and so are predicted to be **negligible**. Their impact on the human receptor locations is therefore **not significant**.

Table 12.20: Maximum Predicted Annual Mean Pollutant Concentrations at Human Receptor Locations for all Modelled ADMS Roads Scenarios.

	2009 'Model Verification/ Baseline'	2013 'Without Development'	2013 'With Development'	2016 'Without Development'	2016 'With Development'	2021 'Without Development'	2021 'With Development'
Bridgwater Model							
Maximum annual mean NO_2 concentration (µg/m^3)	32.05	29.05	29.73	23.48	25.01	19.82	20.64
Maximum annual mean PM_{10} concentration (µg/m^3)	19.89	19.27	19.28	18.30	18.56	18.12	18.38
Maximum annual mean $PM_{2.5}$ concentration (µg/m^3)	12.39	11.72	11.73	10.96	11.12	10.68	10.83
Cannington Model							
Maximum annual mean NO_2 concentration (µg/m^3)	22.22	18.27	23.78	15.27	19.54	11.35	12.50
Maximum annual mean PM_{10} concentration (µg/m^3)	20.78	19.50	19.95	18.84	19.35	18.19	18.39
Maximum annual mean $PM_{2.5}$ concentration (µg/m^3)	9.88	8.90	9.22	8.37	8.72	7.87	7.99
Williton Model							
Maximum annual mean NO_2 concentration (µg/m^3)	39.46	34.27	35.37	27.67	28.46	18.84	19.49
Maximum annual mean PM_{10} concentration (µg/m^3)	23.56	21.98	22.30	20.98	21.18	19.94	20.11
Maximum annual mean $PM_{2.5}$ concentration (µg/m^3)	12.01	10.67	10.90	9.81	9.95	8.94	9.05

Table 12.21: Maximum Predicted Pollutant Concentrations and Impacts At Human Receptor Locations During the 2013 'With Development' Scenario

Pollutant and Averaging Period	AQO Limit Value ($\mu g/m^3$)	Maximum Vehicular Contribution due to Development ($\mu g/m^3$) and as Percentage of AQO (%)	Maximum Ambient Concentration 'with development' ($\mu g/m^3$) and as Percentage of AQO (%)	Magnitude of Change	Impact Descriptor
Bridgwater Model					
NO_2 annual mean	40	3.15 (7.9%)	29.73 (74.3%)	Medium	Negligible
PM_{10} annual mean	40	0.22 (0.6%)	19.28 (48.2%)	Imperceptible	Negligible
$PM_{2.5}$ annual mean	25	0.17 (0.7%)	11.73 (46.9%)	Imperceptible	Negligible
Cannington Model					
NO_2 annual mean	40	7.85 (19.6%)	23.78 (59.5%)	Large	Slight Adverse
PM_{10} annual mean	40	0.57 (1.4%)	19.95 (49.9%)	Small	Negligible
$PM_{2.5}$ annual mean	25	0.41 (1.7%)	9.22 (36.9%)	Small	Negligible
Williton Model					
NO_2 annual mean	40	1.10 (2.8%)	35.37 (88.4%)	Small	Negligible
PM_{10} annual mean	40	0.32 (0.8%)	22.30 (55.8%)	Imperceptible	Negligible
$PM_{2.5}$ annual mean	25	0.23 (0.9%)	10.90 (43.6%)	Imperceptible	Negligible

12.6.154 The annual mean NO_2 vehicular contributions in the Cannington model (as detailed in **Appendix 12E**, **Table 38**) are of up to large magnitude. Maximum vehicular contributions are observed at '41 High Street' for annual mean NO_2 in the Cannington model. The 'with development' concentration values for annual mean NO_2 in the Cannington model are all well below the objective/limit value and so are predicted to be **slight adverse**. Their impact on the human receptor locations is therefore **not significant**.

Summary

12.6.155 For all assessed pollutants, the potential impact of vehicular emissions from road traffic movements associated with the HPC Project on human receptors for the 2013 'with development' scenario is local, adverse, direct, likely and medium-term but temporary. The impact on the human receptor locations for all assessed pollutants is determined to be **not significant**.

2016 Scenario – Construction of HPC with Peak Workforce On-site

12.6.156 **Table 12.22** summarises the pollutant concentration results and associated impacts predicted at the 104 human receptor locations for the 2016 'with development' scenario. The table provides a summary of the maximum vehicular pollutant contributions from road traffic movements associated with the HPC Project and the maximum ambient pollutant concentrations (i.e. the sum of the vehicular contribution and the background concentration) for the 2016 'with development' scenario. A full set of results for all human receptor locations is presented in **Appendix 12E**.

12.6.157 The annual mean PM_{10} and $PM_{2.5}$ vehicular contributions in both the Bridgwater and Williton models (as detailed in **Appendix 12E**, **Tables 33**, **36**, **57** and **60**) are of imperceptible magnitude. Maximum vehicular contributions are observed at '86 Bath Road' in the Bridgwater model and 'Williton County Stores' in the Williton Model for annual mean PM_{10} and $PM_{2.5}$. The 'with development' ambient concentration values for annual mean PM_{10} and $PM_{2.5}$ in both the Bridgwater and Williton models are all well below the AQS/AQO/EAL and so are predicted to be **negligible**. Their impact on the human receptor locations is therefore **not significant**.

12.6.158 The annual mean NO_2 vehicular contributions in the Bridgwater and Williton models, and PM_{10} and $PM_{2.5}$ vehicular contributions in the Cannington model (as detailed in **Appendix 12E**, **Tables 28**, **45**, **48** and **52**) are of no greater than small magnitude. Maximum vehicular contributions are observed for annual mean NO_2 at 'Williton County Stores' and '131 The Drove' in the Williton and Bridgwater models respectively, and at 'Grange Lodge' for annual mean PM_{10} and $PM_{2.5}$ in the Cannington Model. The 'with development' ambient concentration values for annual mean NO_2 in the Williton and Bridgwater models, and annual mean PM_{10} and $PM_{2.5}$ in the Cannington model, are all well below the AQS/AQO/EAL. Annual mean NO_2 in the Williton and Bridgwater models, and PM_{10} and $PM_{2.5}$ in the Cannington model, are therefore predicted to be **negligible**. Their impact on the human receptor locations is therefore **not significant**.

Table 12.22: Maximum Predicted Pollutant Concentrations and Impacts at Human Receptor Locations during the 2016 'With Development' Scenario

Pollutant and Averaging Period	AQS/AQO/EAL ($\mu g/m^3$)	Maximum Vehicular Contribution due to Development ($\mu g/m^3$) and as Percentage of AQS/AQO/EAL (%)	Maximum Ambient Concentration 'with development' ($\mu g/m^3$) and as Percentage of AQS/AQO/EAL (%)	Magnitude of Change	Impact Descriptor
Bridgwater Model					
NO_2 annual mean	40	1.79 (4.5%)	25.01 (62.5%)	Small	Negligible
PM_{10} annual mean	40	0.26 (0.7%)	18.56 (46.4%)	Imperceptible	Negligible
$PM_{2.5}$ annual mean	25	0.16 (0.6%)	11.12 (44.5%)	Imperceptible	Negligible
Cannington Model					
NO_2 annual mean	40	4.27 (10.7%)	19.54 (48.9%)	Large	Slight Adverse
PM_{10} annual mean	40	0.51 (1.3%)	19.35 (48.4%)	Small	Negligible
$PM_{2.5}$ annual mean	25	0.35 (1.4%)	8.72 (34.9%)	Small	Negligible
Williton Model					
NO_2 annual mean	40	0.79 (2.0%)	28.46 (71.2%)	Small	Negligible
PM_{10} annual mean	40	0.20 (0.5%)	21.18 (53.0%)	Imperceptible	Negligible
$PM_{2.5}$ annual mean	25	0.14 (0.5%)	9.95 (39.8%)	Imperceptible	Negligible
HPC Accommodation Campus On-site Receptors					
NO_2 annual mean	40	0.74 (1.9%)	6.76 (16.9%)	Small	Negligible
PM_{10} annual mean	40	0.07 (0.2%)	17.40 (43.5%)	Imperceptible	Negligible
$PM_{2.5}$ annual mean	25	0.04 (0.2%)	7.37 (29.5%)	Imperceptible	Negligible

12.6.159 The annual mean NO_2 vehicular contributions in the Cannington model (as detailed in **Appendix 12E**, **Table 40**) are of up to large magnitude. Maximum vehicular contributions are observed at ‘Grange Lodge’ for annual mean NO_2 in the Cannington model. This large magnitude increase is due to traffic using the proposed Cannington bypass to the west of Cannington village, in an area that is otherwise predominantly of an agricultural nature. The purpose of the proposed Cannington bypass is to minimise adverse effects on the local highway network, particularly through the centre of the village, during the HPC construction phase. There will be a benefit with respect to air quality associated with the operation of the Cannington bypass within the village, as HPC development traffic will be routed away from the centre of Cannington. In addition some of the non-HPC traffic that would have previously used the existing roads through Cannington will in preference travel along the bypass. The ‘with development’ concentration values for annual mean NO_2 in the Cannington model are all well below the AQS/AQO/EAL and so are predicted to be **slight adverse**. Their impact on the human receptor locations is therefore **not significant**.

HPC Accommodation Campus On-site Receptors

12.6.160 **Table 12.22** summarises the pollutant concentration results and associated impacts predicted at the four HPC accommodation campus on-site human receptor locations for the 2016 ‘with development’ scenario. The table provides a summary of the maximum vehicular pollutant contributions from road traffic movements associated with the HPC Project and the maximum ambient pollutant concentrations (i.e. the sum of the vehicular contribution and the background concentration) for the 2016 ‘with development’ scenario. A full set of results for all human receptor locations is presented in **Appendix 12E**.

12.6.161 The annual mean PM_{10} and $PM_{2.5}$ vehicular contributions at the on-site HPC accommodation campus receptor locations (as detailed in **Appendix 12E**, **Tables 45** and **48**) are of imperceptible magnitude. Maximum vehicular contributions are observed at ‘HPC Accommodation 2’ for annual mean PM_{10} and $PM_{2.5}$. The ‘with development’ ambient concentration values for annual mean PM_{10} and $PM_{2.5}$ for on-site HPC accommodation campus receptor locations are all well below the AQS/AQO/EAL and so are predicted to be **negligible**. Their impact on the on-site HPC accommodation campus receptor locations is therefore **not significant**.

12.6.162 The annual mean NO_2 vehicular contributions at the on-site HPC accommodation campus receptor locations (as detailed in **Appendix 12E**, **Table 40**) are of no greater than small magnitude. Maximum vehicular contributions values are observed at ‘HPC Accommodation 2’ for annual mean NO_2. The ‘with development’ ambient concentration values for annual mean NO_2 for on-site HPC accommodation campus receptor locations all well below the AQS/AQO/EAL and so are predicted to be **negligible**. Their impact on the on-site HPC accommodation campus receptor locations is therefore **not significant**.

Summary

12.6.163 For all assessed pollutants, the potential impact of vehicular emissions from road traffic movements associated with the HPC Project on human receptors and on-site HPC accommodation campus receptors for the 2016 ‘with development’ scenario is local, adverse, direct, likely and long-term but temporary. The impact on human receptors at the on-site HPC accommodation campus, for all assessed pollutants, is determined to be **not significant**.

2021 Scenario – Early Operation of HPC

12.6.164 **Table 12.23** summarises the pollutant concentration results and associated impacts predicted at the 104 human receptor locations for the 2021 'with development' scenario. The table provides a summary of the maximum vehicular pollutant contributions from road traffic movements associated with the HPC Project and the maximum ambient pollutant concentrations (i.e. the sum of the vehicular contribution and the background concentration) for the 2016 'with development' scenario. A full set of results for all human receptor locations is presented in **Appendix 12E**.

12.6.165 The annual mean PM_{10} and $PM_{2.5}$ vehicular contributions in the Bridgwater, Cannington and Williton models (as detailed in **Appendix 12E**, **Tables 34**, **37**, **46**, **49**, **58** and **61**) are of imperceptible magnitude. Maximum vehicular contributions are observed at '86 Bath Road' in the Bridgwater model, 'Withiel Farm, Withiel Drive' in the Cannington model and 'Williton County Stores' in the Williton model for annual mean PM_{10} and $PM_{2.5}$. The 'with development' ambient concentration values for annual mean PM_{10} and $PM_{2.5}$ in the Bridgwater, Cannington and Williton models are all well below the AQS/AQO/EAL and so are predicted to be **negligible**. Their impact on the human receptor locations is therefore **not significant**.

12.6.166 The annual mean NO_2 vehicular contributions in the Bridgwater, Cannington and Williton models (as detailed in **Appendix 12E**, **Tables 30**, **42** and **54**) are of no greater than small magnitude. Maximum vehicular contributions are observed at '86 Bath Road' in the Bridgwater model, 'Grange Lodge' in the Cannington model and 'Williton County Stores' in the Williton Model for annual mean NO_2. The 'with development' ambient concentration values for annual mean NO_2 in the Bridgwater, Cannington and Williton models are all well below the AQS/AQO/EAL and so are predicted to be **negligible**. Their impact on the human receptor locations is therefore **not significant**.

Summary

12.6.167 For all assessed pollutants, the potential impact of vehicular emissions from road traffic movements associated with the HPC Project on human receptors for the 2021 'with development' scenario is local, adverse, direct, likely, long-term and permanent. The impact on human receptor locations for all assessed pollutants is determined to be **not significant**.

NO_2 1-hour Mean Concentrations

12.6.168 The empirical relationship given in LAQM.TG(09) (Ref. 12.14) states that exceedences of the 1-hour mean NO_2 AQO are only likely to occur where annual mean concentrations are 60µg/m^3 or above. Although it is not possible to determine with precision the number of potential exceedences of the short-term AQO concentration, it is evident that annual mean NO_2 concentrations at all of the identified human receptor locations in proximity to roads affected by the HPC Project are well below this value, for the assessed 2013, 2016 and 2021 'with development' scenarios.

Table 12.23: Maximum Predicted Pollutant Concentrations and Impacts at Human Receptor Locations during the 2021 'With Development' Scenario

Pollutant and Averaging Period	AQS/AQO/EAL ($\mu g/m^3$)	Maximum Vehicular Contribution due to Development ($\mu g/m^3$) and as Percentage of AQS/AQO/EAL (%)	Maximum Ambient Concentration 'with Development' ($\mu g/m^3$) and as Percentage of AQS/AQO/EAL (%)	Magnitude of Change	Impact Descriptor
Bridgwater Model					
NO_2 annual mean	40	0.82 (2.1%)	20.64 (51.6%)	Small	Negligible
PM_{10} annual mean	40	0.26 (0.7%)	18.38 (46.0%)	Imperceptible	Negligible
$PM_{2.5}$ annual mean	25	0.15 (0.6%)	10.83 (43.3%)	Imperceptible	Negligible
Cannington Model					
NO_2 annual mean	40	1.15 (2.9%)	12.50 (31.3%)	Small	Negligible
PM_{10} annual mean	40	0.22 (0.6%)	18.39 (46.0%)	Imperceptible	Negligible
$PM_{2.5}$ annual mean	25	0.14 (0.6%)	7.99 (32.0%)	Imperceptible	Negligible
Williton Model					
NO_2 annual mean	40	0.65 (1.6%)	19.49 (48.7%)	Small	Negligible
PM_{10} annual mean	40	0.17 (0.4%)	20.11 (50.3%)	Imperceptible	Negligible
$PM_{2.5}$ annual mean	25	0.11 (0.4%)	9.05 (36.2%)	Imperceptible	Negligible

12.6.169 Therefore, with regard to potential impact on the 104 human receptor locations along the affected road network, short-term vehicle emissions of NO_2 associated with traffic generated by the combined HPC Project during the 2013 (construction of both HPC and the majority of the associated development sites), 2016 (construction of HPC with peak workforce on-site) and 2021 (early HPC operation) scenarios are of imperceptible magnitude. The potential impact of these emissions on the identified human receptors is local, adverse, direct and likely. Potential impacts will be medium-term but temporary during the 2013 scenario, long-term but temporary during the 2016 scenario, and long-term but permanent during the 2021 scenario. The potential impact is rated as **negligible** and is therefore determined to be **not significant**.

PM_{10} 24-hour Mean Concentrations

12.6.170 The empirical relationship between the annual mean and the predicted number of exceedences of the PM_{10} 24-hour mean AQO given in LAQM.TG(09) (Ref. 12.14), was used to estimate the increase in the number of days exceeding the 24-hour mean PM_{10} AQS/AQO/EAL, at receptor locations located in proximity to the road network.

12.6.171 In all three model areas, there was a maximum of six predicted days exceeding the 50µg/m^3 AQS/AQO/EAL concentration metric for the 2013 'without development' scenario, and seven predicted days exceeding for the 2013 'with development' scenario. A maximum of five days was predicted to exceed the 50µg/m^3 AQS/AQO/EAL concentration metric for both the 2016 'without development' and 2016 'with development' scenarios. A maximum of three days exceeding the 50µg/m^3 AQS/AQO/EAL concentration metric was predicted for the 2021 'without development' scenario, whilst four days were predicted to exceed the 50µg/m^3 AQS/AQO/EAL concentration metric for the 2021 'with development' scenario. Thus, at the 104 human receptor locations located in proximity to the road network, there was a maximum increase of only one day exceeding the short-term PM_{10} AQS/AQO/EAL concentration metric as a result of traffic generated by the HPC Project during the assessed 2013, 2016 and 2021 scenarios.

12.6.172 Therefore, with regard to potential impact on the 104 human receptor locations along the affected road network, short-term vehicle emissions of PM_{10} associated with traffic generated by the HPC Project during the 2013 (construction of both HPC and the majority of the associated development sites), 2016 (construction of HPC with peak workforce on-site) and 2021 (early HPC operation) scenarios are of no more than small magnitude. The potential impact of these emissions on the human receptors is local, adverse, direct, and likely. Potential impacts will be medium-term but temporary during the 2013 scenario, long-term but temporary during the 2016 scenario, and long-term but permanent during the 2021 scenario. The potential impact is rated as **negligible** and is therefore determined to be **not significant**.

Uncertainty in Future Year NO_2 Predictions

12.6.173 The Defra LAQM helpdesk (Ref. 12.56) has identified analyses of historical monitoring data within the UK that show a disparity between measured concentration data and the projected decline in concentrations associated with emission forecasts for future years. Trends in ambient concentrations of NO_x and NO_2 in many urban areas of the UK have generally shown two characteristics; a decrease in concentration from about 1996 to 2002-2004, followed by a period of more stable concentrations from 2002-2004 up until 2009. The main areas showing evidence of a consistent downward trend in either NO_x or NO_2 concentrations that would be supported by UK-AIR and emission inventory estimates, are more rural, less densely trafficked, parts of the UK.

12.6.174 The reason for this disparity is currently not fully understood, but it is thought to be related to the actual on-road performance of diesel road vehicles when compared with calculations based on the Euro emission standards. Preliminary studies suggest the following:

- NO_x emissions from petrol vehicles appear to be in line with current projections and have decreased by 96% since the introduction of 3-way catalysts in 1993.
- NO_x emissions from diesel cars, under urban driving conditions, do not appear to have declined substantially, up to and including Euro 5. There is limited evidence that the same pattern may occur for motorway driving conditions.
- NO_x emissions from HDVs equipped with Selective Catalytic Reduction (SCR) which are much higher than expected when driving at low speeds.

12.6.175 This disparity in the historical national data highlights the uncertainty of future year projections of both NO_x and NO_2. At this stage however, there is no robust evidence upon which to base any revised road traffic emissions projections.

12.6.176 Defra and the devolved administrations are currently investigating these issues, and once the reasons are fully understood updated guidance will be published.

12.6.177 To take account of this uncertainty, for the purposes of this assessment, a worst-case approach was taken through the application of emission factors and background concentrations for 2009 (i.e. base year levels) for all future years. This is in addition to the above assessment approach, for which the currently published guidelines have been followed (i.e. emission factors and background concentrations reduce in future years). This approach provides a means by which to assess the extreme worst-case concentrations that may occur in future years.

Worst-case NO_2 Annual Mean Concentrations

12.6.178 **Table 12.24** summarises the worst-case pollutant concentration results and associated impacts predicted at the 104 human receptor locations for the 2013, 2016 and 2021 ‘with development’ scenarios, assuming emission factors and background concentrations at 2009 levels. The table provides a summary of the maximum worst-case vehicular pollutant contributions from road traffic movements associated with the HPC Project and the maximum ambient pollutant concentrations (i.e. the sum of the vehicular contribution and the background concentration) for the 2013, 2016 and 2021 ‘with development’ scenarios. A full set of results for all human receptor locations is presented in **Appendix 12E**.

Table 12.24: Maximum Predicted Worst-Case Pollutant Concentrations and Impacts at Human Receptor Locations during the 2013, 2016 and 2021 'With Development' Scenarios

Pollutant and Averaging Period	AQS/AQO/EAL ($\mu g/m^3$)	Maximum Vehicular Contribution due to Development ($\mu g/m^3$) and as Percentage of AQS/AQO/EAL (%) (worst-case)	Maximum Ambient Concentration 'with development' ($\mu g/m^3$) and as Percentage of AQS/AQO/EAL (%) (worst-case)	Magnitude of Change (worst-case)	Impact Descriptor (worst-case)
Bridgwater Model					
2013 NO_2 annual mean	40	3.88 (9.7%)	35.70 (89.3%)	Medium	Slight Adverse
2016 NO_2 annual mean	40	3.39 (8.5%)	35.55 (88.9%)	Medium	Slight Adverse
2021 NO_2 annual mean	40	2.80 (7.0%)	36.99 (92.5%)	Medium	Moderate Adverse
Cannington Model					
2013 NO_2 annual mean	40	10.91 (23.7%)	29.79 (74.5%)	Large	Slight Adverse
2016 NO_2 annual mean	40	8.16 (20.4%)	30.48 (76.2%)	Large	Slight Adverse
2021 NO_2 annual mean	40	4.43 (11.1%)	27.49 (68.7%)	Large	Slight Adverse
Williton Model					
2013 NO_2 annual mean	40	1.08 (2.7%)	42.74 (106.9%)	Small	Slight Adverse
2016 NO_2 annual mean	40	0.79 (2.0%)	42.74 (106.9%)	Small	Slight Adverse
2021 NO_2 annual mean	40	0.80 (2.0%)	42.75 (106.9%)	Small	Slight Adverse
HPC Accommodation Campus On-site Receptors					
2016 NO_2 annual mean	40	1.68 (4.2%)	9.97 (20.3%)	Small	Negligible

12.6.179 The worst-case annual mean NO_2 vehicular contributions in the Williton model for the 2013, 2016 and 2021 'with development' scenarios (as detailed in **Appendix 12E**, **Tables 51**, **53** and **55**) are of no greater than small magnitude. Maximum worst-case vehicular contributions are observed at 'Williton County Stores' for the 2013, 2016 and 2021 'with development' scenarios for annual mean NO_2. The worst-case ambient concentration values for annual mean NO_2 for the 2013, 2016 and 2021 'with development' scenarios are all above the AQS/AQO/EAL. However, worst-case ambient concentration values for annual mean NO_2 for the 2013, 2016 and 2021 'without development' scenarios are all also above the AQS/AQO/EAL. This indicates that the 40μg/m^3 annual mean NO_2 AQS/AQO/EAL would be exceeded without HPC Project traffic, and so would thus not be caused by either the construction or operation of the combined HPC Project. The increase in traffic volume when comparing the 2013 'without development' and 'with development' scenarios represents only construction traffic for the Williton park and ride site, hence the extremely small NO_2 concentration increase associated with the HPC development in this assessment year. When comparing 2016 and 2021 'without development' and 'with development' scenarios, the increase in traffic volume represents only operational traffic associated with the Williton park and ride site, which is entirely composed of LDVs, hence the small NO_2 concentration increase. Therefore the impacts of 'with development' NO_2 ambient concentration values are predicted to be **slight adverse**. The worst-case potential impact on the human receptor locations is therefore **not significant**. This does not, therefore, affect the judgement of significance as presented earlier in this section.

12.6.180 The worst-case annual mean NO_2 vehicular contributions in the Bridgwater model for the 2013 and 2016 'with development' scenarios (as detailed in **Appendix 12E**, **Tables 27** and **29**) are of no greater than medium magnitude. Maximum worst-case vehicular contributions are observed at '131 The Drove' for the 2013 and 2016 'with development' scenarios for annual mean NO_2. The worst-case ambient concentration values for annual mean NO_2 for the 2013 and 2016 'with development' scenarios are below the AQS/AQO/EAL and so are predicted to be **slight adverse**. The worst-case potential impact on the human receptor locations is therefore **not significant**. This does not, therefore, affect the judgement of significance as presented earlier in this section

12.6.181 The worst-case annual mean NO_2 vehicular contributions in the Bridgwater model for the 2021 'with development' scenario (as detailed in **Appendix 12E**, **Table 31**) are of no greater than medium magnitude. Maximum worst-case vehicular contributions are observed at '86 Bath Road' for the 2021 'with development' scenario for annual mean NO_2. The worst-case ambient concentration value at '86 Bath Road' for annual mean NO_2 for the 2021 'with development' is just below the AQS/AQO/EAL and so is predicted to be **moderate adverse**. However, concentration values at the other 43 human receptors are below the AQS/AQO/EAL and so are predicted to be either **slight adverse** or **negligible**. Therefore, on the basis of professional judgment and taking into account the factors presented in section 12.4, the worst-case modelling approach taken, that only a single sensitive receptor '86 Bath Road' falls in the 'just below objective/limit value' category and that there are no predicted exceedences of the annual mean NO_2 AQS/AQO/EAL, the worst-case potential impacts are determined to be **not significant**. This does not, therefore, affect the judgement of significance as presented earlier in this section.

12.6.182 The worst-case annual mean NO_2 vehicular contributions in the Cannington model the 2013, 2016 and 2021 'with development' scenarios (as detailed in **Appendix 12E**, **Tables 39**, **41** and **43**) are of up to large magnitude. Maximum worst-case vehicular contributions are observed at '41 High Street' for the 2013 'with development' scenario, and at 'The Lodge, Withycombe' for the 2016 and 2021 'with development' scenarios for annual mean NO_2. The worst-case ambient concentration values for annual mean NO_2 for the 2013, 2016 and 2021 'with development' scenarios are all below the AQS/AQO/EAL and so are predicted to be **slight adverse**. Their worst-case potential impact on the human receptor locations is therefore **not significant**. This does not, therefore, affect the judgement of significance as presented earlier in this section.

HPC Accommodation Campus On-site Receptors

12.6.183 The worst-case annual mean NO_2 vehicular contributions at the on-site HPC accommodation campus receptor locations (as detailed in **Appendix 12E**, **Table 41**) are of no greater than small magnitude. Maximum worst-case vehicular contributions are observed at 'HPC Accommodation 2' for annual mean NO_2. The 'with development' ambient concentration values for annual mean NO_2 for on-site HPC accommodation campus receptor locations all well below the AQS/AQO/EAL and so are predicted to be **negligible**. The worst-case potential impact on the on-site HPC accommodation campus receptor locations is therefore **not significant**. This does not, therefore, affect the judgement of significance as presented earlier in this section.

Worst-case NO_2 1-hour Mean Concentrations

12.6.184 The empirical relationship given in LAQM.TG(09) (Ref. 12.14) states that exceedences of the 1-hour mean objective for NO_2 are only likely to occur where annual mean concentrations are 60µg/m^3 or above. Although it is not possible to determine with precision the worst-case number of potential exceedences of the short-term AQS/AQO/EAL concentration, it is evident that worst-case annual mean NO_2 concentrations at all of the identified human receptor locations in the proximity to roads affected HPC Project traffic are well below this limit, for the assessed worst-case 2013, 2016 and 2021 'with development' scenarios.

12.6.185 Therefore, adopting the worst-case approach (i.e. assuming 2009 emission factors and background pollutant concentrations for future assessment years), with regard to potential impact on the 104 human receptor locations along the affected road network, worst-case short-term vehicle emissions of NO_2 associated with traffic generated by the HPC Project during the 2013 (construction of both HPC and the majority of the associated development sites), 2016 (construction of HPC with peak workforce on-site) and 2021 (early HPC operation) scenarios are of imperceptible magnitude. The potential impact of these emissions on the identified human receptors is local, adverse, direct and likely. Potential impacts will be medium-term but temporary during the 2013 scenario, long-term but temporary during the 2016 scenario, and long-term but permanent during the 2021 scenario. The potential worst-case impact is rated as **negligible** and is therefore determined to be **not significant**.

Summary

12.6.186 Therefore, regardless of which of the two modelling methodologies are adopted for both annual mean and 1-hour mean future year NO_2 concentration predictions, with regard to potential impact on the 104 human receptor locations along those routes associated with traffic generated by the combined HPC Project, vehicular emissions during the construction and operational periods of the combined HPC Project (i.e. 2013, 2016 and 2021 scenarios), are **not significant**.

12.6.187 All predicted pollutant concentrations at the four HPC accommodation campus on-site receptors locations are below the relevant AQOs for the 2016 'with development' scenario, and potential air quality impacts at these locations have been assessed to be **not significant**. The HPC accommodation campus is therefore considered appropriate, in air quality terms, for residential use by the on-site residential workforce.

ii. Ecological Receptors

12.6.188 The Bridgwater Bay SSSI is located immediately to the east of the C182 (Wick Moor Drove), which will be used during the construction and operational phases of the HPC Project to access the HPC development site. The Hinkley CWS also adjoins the C182 close to the HPC development site. There is therefore the potential for vehicular exhaust emissions associated with the HPC Project development traffic to affect these ecological receptor locations.

12.6.189 This section presents the pollutant concentration results and associated impacts predicted at nine selected ecological receptor points, which are representative of worst-case exposure at the Bridgwater Bay SSSI and the Hinkley CWS ecological receptor locations (see **Figure 12.4**). In order to understand how vehicular pollutant concentrations decrease from the C182 roadside within the designated ecological sites, receptor points were selected at distances of approximately 10m, 15m and 20m from the road within the SSSI boundary (the SSSI boundary is approximately 10m from the C182 at its closest point). Pollutant concentrations from vehicular exhausts generally decrease rapidly as a function of increased distance from the road source. Whilst the receptor points themselves are situated within the Bridgwater Bay SSSI, the traffic volume along the C182 will be identical at both locations (i.e. within the SSSI and CWS), and thus pollutant concentrations and potential impacts will be directly comparable.

12.6.190 Pollutant concentrations from vehicular exhaust emissions and associated impacts at the ecological receptor points in proximity to the Combwich associated development site, which are representative of worst-case exposure at the ecological receptors Bridgwater Bay SSSI/NNR and Severn Estuary SPA/SAC/Ramsar, are significantly lower than those presented here, and are described in **Volume 7**, **Chapter 10** and **Volume 7**, **Chapter 14**.

12.6.191 **Table 12.25** summarises the pollutant concentrations and associated impacts at the ecological receptor locations adjacent to the C182 for the 2013, 2016 and 2021 'with development' scenarios. Pollutant concentrations predicted at all of the identified ecological receptors located in proximity to the road network with the potential to be affected by the HPC Project, including those in proximity to the Combwich associated development site, are presented in **Appendix 12E**.

Table 12.25: Maximum Predicted Pollutant Concentrations and Impacts at Ecological Receptor Locations Adjacent to the C182 near the HPC Development Site during the 2013, 2016 and 2021 'With Development' Scenarios

Pollutant and Averaging Period	AQS/AQO/EAL ($\mu g/m^3$)	Maximum Vehicular Contribution due to Development ($\mu g/m^3$) and as Percentage of AQS/AQO/EAL (%)	Maximum Ambient Concentration 'with Development' ($\mu g/m^3$) and as Percentage of AQS/AQO/EAL (%)	Magnitude of Change	Impact Descriptor
2013 Scenario					
NO_x annual mean	30	10.65 (35.5%)	28.66 (95.5%)	Large	Moderate Adverse
NO_x 24-hour mean	75	37.30 (49.7%)	86.48 (115.3%)	Large	Substantial Adverse
2016 Scenario					
NO_x annual mean	30	5.16 (17.2%)	20.24 (67.5%)	Large	Slight Adverse
NO_x 24-hour mean	75	18.00 (24.0%)	58.49 (78.0%)	Large	Slight Adverse
2021 Scenario					
NO_x annual mean	30	1.13 (3.8%)	12.8 (42.7%)	Small	Negligible
NO_x 24-hour mean	75	3.92 (5.2%)	34.28 (45.7%)	Medium	Negligible

12.6.192 The annual mean NO_x vehicular contributions for the 2021 'with development' scenario (as detailed in **Appendix 12E**, **Table 66**) are of no greater than small magnitude. The ambient concentration values for annual mean NO_x in the 2021 'with development' scenario are well below the AQS/AQO/EAL and so are predicted to be **negligible**.

12.6.193 The 24-hour mean NO_x vehicular contributions in the 2021 'with development' scenario (as detailed in **Appendix 12E**, **Table 66**) are of no greater than medium magnitude. The ambient concentration values for 24-hour mean NO_x in the 2021 'with development' scenario are well below the AQS/AQO/EAL and so are predicted to be **negligible**.

12.6.194 The annual mean and 24-hour mean NO_x vehicular contributions in the 2016 'with development' scenario (as detailed in **Appendix 12E**, **Table 64**) are of up to large magnitude. The ambient concentration values for annual mean and 24-hour mean NO_x in the 2016 'with development' scenario are all below the AQS/AQO/EAL and so are predicted to be **slight adverse**.

12.6.195 The annual mean NO_x vehicular contributions in the 2013 'with development' scenario (as detailed in **Appendix 12E**, **Table 62**) are of up to large magnitude. The ambient concentration values for annual mean NO_x in the 2013 'with development' scenario are just below the AQS/AQO/EAL and so are predicted to be **moderate adverse**. However, annual mean NO_x concentrations reduce rapidly with increased distance from the road source, and therefore with an additional 5m separation distance from the roadside, the potential impact is rated as being no more than **slight adverse** ('Main Eco Receptor 3b'). There is therefore only a very small proportion of the designated ecological sites, on the boundary closest to the C182, which will have the potential to be impacted by the long-term NO_x emissions.

12.6.196 The 24-hour mean NO_x vehicular contributions in the 2013 'with development' scenario (as detailed in **Appendix 12E**, **Table 62**) are of up to large magnitude. The ambient concentration values for 24-hour mean NO_x in the 2013 'with development' scenario are above the objective/limit value and so are predicted to be **substantial adverse**. However, 24-hour mean NO_x concentrations also reduce rapidly with increased distance from the road source, and therefore with an additional 10m separation distance from the roadside the potential impact is rated as being no more than **slight adverse** ('Main Eco Receptor 3c'). There is therefore only a very small proportion of the designated ecological sites, on the boundary closest to the C182, which will have the potential to be impacted by the short-term NO_x emissions. For the same reasons as discussed previously, it is also considered that greater emphasis should be placed on achievement of the more established annual mean NO_x AQS/AQO/EAL, which in this case is not exceeded.

Summary

12.6.197 For annual mean and 24-hour mean NO_x concentrations, the potential impact of vehicular emissions from road traffic movements associated with the HPC Project on ecological receptor locations for the 2013, 2016 and 2021 'with development' scenarios is local, adverse, direct and likely. Potential impacts will be medium-term but temporary during the 2013 scenario, long-term but temporary during the 2016 scenario, and long-term but permanent during the 2021 scenario.

12.6.198 The significance of these predictions of short-term and long-term NO_x emissions from vehicles associated with the construction and operational phases of the HPC Project, upon biodiversity receptors, is assessed in **Volume 2**, **Chapter 20**.

Uncertainty in Future Year NO_x Predictions

12.6.199 As for the approach taken to dealing with the uncertainty of future year NO_2 concentration predictions at human receptor locations, a worst-case approach was taken to the prediction of NO_x concentrations at the ecological receptor locations, i.e. through the application of emission factors and background concentrations for 2009 (i.e. base year levels) for all future years. This approach provides a means by which to assess the extreme worst-case upper NO_x concentrations that may prevail in future years. These worst-case results are discussed below.

12.6.200 **Table 12.26** summarises the worst-case NO_x concentration results and associated impacts predicted at the ecological receptor locations for the 2013, 2016 and 2021 ‘with development’ scenarios, assuming emission factors and background concentrations at 2009 levels.

12.6.201 The worst-case annual mean NO_x vehicular contributions in the 2013, 2016 and 2021 ‘with development’ scenarios (as detailed in **Appendix 12E, Tables 63, 65 and 67**) are of up to large magnitude. The worst-case ambient concentration values for annual mean NO_x in the 2013, 2016 and 2021 ‘with development’ scenarios are all above the AQS/AQO/EAL and so are predicted to be **substantial adverse**. However, the worst-case annual mean NO_x concentrations would reduce rapidly with increased distance from the road source; at approximately 10m from the C182, the worst-case annual mean NO_x concentration at ‘Main Eco Receptor 3a’ is 39.30µg/m^3, whilst at 15m the worst-case NO_x concentration reduces to 34.10µg/m^3 (‘Main Eco Receptor 3b’). Concentrations reduce further at 20m from the roadside, with a worst-case concentration of 30.54µg/m^3 predicted at ‘Main Eco Receptor 3c’. The worst-case annual mean NO_x concentration at ‘Main Eco Receptor 3b’ is only marginally above the 30µg/m^3 NO_x annual mean AQS/AQO/EAL. Therefore, at ecological receptor locations at distances of marginally greater than 20m between the road source and receptor, worst-case annual mean NO_x concentrations would be below the 30µg/m^3 AQS/AQO/EAL. There is therefore only a very small proportion of the ecological sites adjacent to the C182, where there will be the potential for exceedence of the annual mean NO_x AQO. Potential impacts will decrease rapidly with increased distance from the road, and thus sensitive biodiversity receptors may not necessarily be present in the locations experiencing the highest worst-case annual mean NO_x concentrations.

12.6.202 The worst-case 24-hour mean NO_x vehicular contributions in the 2013, 2016 and 2021 ‘with development’ scenarios (as detailed in **Appendix 12E, Tables 63, 65 and 67**) are also of up to large magnitude. The worst-case ambient concentration values for 24-hour mean NO_x in the 2013, 2016 and 2021 ‘with development’ scenarios are all above the EAL and so are predicted to be **substantial adverse**. However, for the same reasons as previously discussed, given the lack of confidence in the 75µg/m^3 NO_x 24-hour mean EAL (derived from the 2000 WHO Air Quality Guidelines for Europe) (Ref. 12.55) it is considered that greater emphasis should be placed on achievement of the more established NO_x annual mean AQS/AQO/EAL.

Table 12.26: Maximum Predicted Worst-Case Pollutant Concentrations and Impacts at Ecological Receptor Locations during the 2013, 2016 and 2021 'With Development' Scenarios

Pollutant and Averaging Period	AQS/AQO/EAL ($\mu g/m^3$)	Maximum Vehicular Contribution due to Development ($\mu g/m^3$) and as Percentage of AQS/AQO/EAL (%) (worst-case)	Maximum Ambient Concentration 'with development' ($\mu g/m^3$) and as Percentage of AQS/AQO/EAL (%) (worst-case)	Magnitude of Change (worst-case)	Impact Descriptor (worst-case)
2013 Scenario					
NO_x annual mean	30	16.29 (54.3%)	39.30 (131.0%)	Large	Substantial Adverse
NO_x 24-hour mean	75	57.10 (76.1%)	121.06 (161.4%)	Large	Substantial Adverse
2016 Scenario					
NO_x annual mean	30	12.92 (43.1%)	35.90 (119.7%)	Large	Substantial Adverse
NO_x 24-hour mean	75	45.26 (60.3%)	109.13 (145.5%)	Large	Substantial Adverse
2021 Scenario					
NO_x annual mean	30	6.89 (23.0%)	30.55 (101.8%)	Large	Substantial Adverse
NO_x 24-hour mean	75	24.12 (32.2%)	90.37 (120.5%)	Large	Substantial Adverse

Summary

12.6.203 Adopting the worst-case modelling approach, there may be very small proportions of the ecological sites close to their boundaries to the C182, which could have the potential to exceed the annual mean and 24-hour mean NO_x AQS/AQO/EAL. However, NO_x concentrations and associated potential worst-case impacts decrease rapidly with increased distance from the road, and thus sensitive biodiversity receptors are unlikely to be present in the locations experiencing the highest (and worst-case) NO_x concentrations.

12.6.204 The significance of these worst-case predictions of annual mean and 1-hour NO_x emissions, from vehicular exhaust emissions associated with the HPC Project, upon biodiversity is presented in **Volume 2, Chapter 20**.

Deposition of Nutrifying and Acidifying Pollutants

12.6.205 The maximum additional deposition rates of nutrifying and acidifying pollutants at the statutory and non-statutory designated sites, due to vehicle exhaust emissions associated with the construction and operational phases of the HPC Project, are summarised in **Table 12.27** below.

Table 12.27: Maximum Deposition Rates at Statutory and Non-statutory Designated Ecological Receptors from Vehicular Emissions Associated with the HPC Development

	Nitrogen Deposition Rate – (kg N/ha/y)			Acid Deposition Rate – (keq/ha/y)		
	2013	2016	2021	2013	2016	2021
Maximum predicted rate at ecological receptors	1.53	0.74	0.16	0.11	0.05	0.01
Worst-case maximum predicted rate at ecological receptors	2.35	1.86	0.99	0.17	0.13	0.07

12.6.206 Assessment of potential impacts, taking into account the relevant critical loads and existing background deposition rates, is provided in **Volume 2, Chapter 20.**

e) Cumulative Air Quality Impacts from the HPC Development

12.6.207 There is the potential for site-specific cumulative air quality impacts from different aspects of the proposed HPC development to act additively on a receptor, during both the construction and operational phases.

12.6.208 Due to the inherit uncertainty of short-term events and the small likelihood of worst-case short-term emissions from multiple sources occurring simultaneously, and potentially causing an additive impact on any receptor location, only long-term site-specific cumulative air quality impacts have been considered.

i. Cumulative Impacts during HPC Construction

12.6.209 Potential additive cumulative impacts during the HPC development construction phase may occur on both human and ecological receptor locations.

Human Receptors

12.6.210 During the HPC construction phase, there is the potential for site-specific additive impacts at human receptor locations from the following sources:

- dust and particulate emissions generated during on-site activities;
- exhaust emissions from road vehicles associated with HPC construction;
- exhaust emissions from on-site plant and machinery (NRMM); and
- exhaust emissions from marine vessels associated with the operation of the temporary jetty.

12.6.211 The potential human receptors that may be susceptible to such additive air quality impacts would be limited to a small number of residential locations, sited primarily in close proximity to the HPC development site boundary. The receptor 'Doggetts' has therefore been taken as a representative worst-case location where such cumulative construction impacts may occur.

12.6.212 Annual mean pollutant concentrations from vehicular exhausts at 'Doggetts' were found to be greatest during the 2013 'with development' construction scenario, where process contributions from development-related road traffic were predicted to be 0.41µg/m^3, 0.02µg/m^3 and 0.02µg/m^3 for NO_2, PM_{10} and $PM_{2.5}$ respectively. NO_2 vehicular emissions were found to be of no more than small magnitude, whilst both PM_{10} and $PM_{2.5}$ emissions were found to be of imperceptible magnitude, and thus of negligible potential impact at 'Doggetts'.

12.6.213 Marine vessel pollutant emissions associated with the operation of the temporary jetty were predicted to lead to an increase of no more than 0.02µg/m^3 for the pollutants NO_2, PM_{10} and $PM_{2.5}$. At 'Doggetts', these emissions were identified to be of imperceptible magnitude and their potential impact rated as negligible. Exhaust emissions from NRMM were qualitatively determined to be of small magnitude and of negligible potential impact.

12.6.214 With regard to NO_2 emissions from the above sources, there is therefore no potential for significant additive air quality impacts at 'Doggetts'. Combined NO_2 emissions during the HPC construction phase are considered to be of no more than small magnitude at Doggetts, with the potential cumulative impact rated as **negligible** and therefore **not significant**.

12.6.215 In the context of particulate (PM_{10} and $PM_{2.5}$) emissions during the HPC construction phase, the most significant source of these pollutants at 'Doggetts' will arise from sources on-site during particularly dust-generating construction activities. Dust and particulate impacts at 'Doggetts' during the assessed 2013 construction scenario (Scenario A) were qualitatively rated as being of **major adverse** significance, in the absence of standard good practice and mitigation measures. This source will therefore dominate the overall particulate concentrations at this receptor, with the contribution from the other sources being comparatively insignificant.

12.6.216 Suitable best practice measures to minimise the generation and dispersion of dust and particulates, and to monitor dust and particulate concentrations at this receptor location, as detailed in the **Air Quality Management Plan (AQMP)**, would ensure that any potential cumulative impacts would be minimised.

Ecological Receptors

12.6.217 During the HPC construction phase, there is the potential for additive cumulative air quality impacts at ecological receptor locations from the same sources as outlined above for human receptors. The main potential for additive impacts at ecological receptor locations arises due to combined NO_x emissions from various sources. Consideration has therefore specifically been given to this issue below.

12.6.218 The maximum annual mean NO_x contribution from vehicular exhaust emissions, associated with HPC development-related road traffic during the 2013 ‘with development’ construction scenario at an ecological receptor location, was determined to be 10.65µg/m^3, occurring at both the Bridgwater Bay SSSI and Hinkley CWS site areas which are adjacent to the C182. This increase was considered to be of large magnitude and the potential impact rated as being moderate adverse.

12.6.219 Marine vessel NO_x emissions associated with the operation of the temporary jetty were predicted to lead to a maximum increase of only 1.06µg/m^3, at an ecological receptor location north of the HPC development site, adjacent to the jetty head. These emissions were identified to be of imperceptible magnitude and their potential impact rated as negligible. Exhaust emissions from NRMM were qualitatively determined to be of small magnitude and also of negligible potential impact.

12.6.220 Given the above, and that the locations of the maximum annual mean NO_X process contributions from the above sources do not spatially overlap, the potential for additive cumulative air quality impacts at ecological receptor locations during the HPC construction phase is considered to be low. The worst-case potential NO_x additive cumulative impacts at an ecological receptor location are thus considered to be no worse than the predicted impacts from vehicular exhaust emissions associated with development related road traffic during the 2013 construction scenario.

12.6.221 The maximum annual mean NO_x concentration from all sources is therefore likely to occur at the Bridgwater Bay SSSI and Hinkley CWS immediately adjacent to the C182, where a concentration of 28.66µg/m^3 was predicted as a result of the HPC development-related vehicular exhaust emissions (i.e. just below the 30µg/m^3 NO_x annual mean AQS/AQO/EAL). The potential additive cumulative impact is therefore rated as being **moderate adverse**. However, annual mean NO_x concentrations reduce rapidly with increased distance from the road source, and therefore the potential additive impact is rated as being no more than **slight adverse** within an additional 5m separation distance from the roadside.

ii. Cumulative Impacts during HPC Operation

12.6.222 Potential additive cumulative impacts during the operational phase of the HPC development may occur on both human and ecological receptor locations.

Human Receptors

12.6.223 During the HPC operational phase, there is the potential for additive impacts at human receptor locations from the following sources:

- exhaust emissions from road vehicles associated with HPC operation; and
- emissions from on-site HPC operational activities.

12.6.224 As with the potential cumulative air quality impacts during the HPC construction phase, the human receptors that may potentially be impacted would be limited to a small number of residential locations in close proximity to the HPC development site boundary. The receptor 'Doggetts' has therefore again been taken as a representative worst-case location where such additive cumulative operational impacts may occur.

12.6.225 The additional contribution to annual mean pollutant concentrations from vehicular exhaust emissions at 'Doggetts' from the development-related road traffic during the 2021 'with development' operational scenario, were predicted to be 0.05µg/m^3 for NO_2, and 0.01µg/m^3 for PM_{10} and $PM_{2.5}$. These emissions were found to be of imperceptible magnitude and thus of negligible potential impact at 'Doggetts'.

12.6.226 The routine testing of the backup diesel generators associated with the UK EPR Units and their ancillary buildings during the operation of HPC would lead to additional process contributions at 'Doggetts' of 0.04µg/m^3 for NO_2, and <0.01µg/m^3, for both PM_{10} and $PM_{2.5}$.

12.6.227 Given the above, there is no potential for significant additive cumulative air quality impacts at Doggetts during HPC operation. Combined pollutant emissions during the HPC operational phase are considered to be of no more than imperceptible magnitude at 'Doggetts', with the potential cumulative impact rated as **negligible** and therefore **not significant**.

Ecological Receptors

12.6.228 During the HPC operational phase, there is also the potential for additive cumulative air quality impacts at ecological receptor locations from the same sources as described above for human receptors. Similar to the construction phase, specific focus has been given to additive HPC operational NO_x emissions at ecological receptor locations.

12.6.229 The maximum additional contribution to annual mean NO_x concentrations from HPC development-related vehicular exhaust emissions at an ecological receptor location during the 2021 'with development' operational scenario, was predicted to be 1.13µg/m^3. This was assessed to be of small magnitude and thus of negligible potential impact at ecological receptor locations.

12.6.230 The routine testing of the backup diesel generators associated with the UK EPR Units and their ancillary buildings during the operation of HPC would lead to a maximum additional NO_x process contribution at an ecological receptor location of 4.06µg/m^3, occurring at Hinkley CWS. These emissions were found to be of large magnitude and thus of slight adverse potential impact at ecological receptor locations.

12.6.231 Given the above, the greatest potential additive cumulative impact from NO_x emissions at an ecological receptor location during HPC operation, is rated as no greater than **slight adverse**, with combined NO_x PEC concentrations (i.e. combined process contributions plus background) still well below the 30µg/m^3 NO_x annual mean AQS/AQO/EAL.

12.7 Mitigation of Impacts

12.7.1 For the purpose of this assessment, mitigation measures have been proposed where there is an adverse impact of greater than minor significance and the impact magnitude, spatial scope and temporal nature make it appropriate to do so.

12.7.2 With the exception of dust and particulate impacts at Bishops Farm House and Doggetts in the assessed 2013 scenario, all potential air quality impacts have been rated as negligible, minor or not significant before any best practice or mitigation has been applied. Dust and particulate impacts at Bishops Farm House and Doggetts during the above scenario were considered to be major prior to the implementation of any standard good practice measures or mitigation relating to dust.

12.7.3 Impacts from the on-site NRMM exhaust emissions and marine vessel exhaust emissions during the HPC construction phase have been rated as **not significant** for all pollutants.

12.7.4 Impacts from the commissioning and operation of the HPC nuclear power station have been rated as **not significant** for all pollutants.

12.7.5 Impacts from traffic during the construction and operational phases have also been rated as **not significant** for all pollutants and scenarios.

12.7.6 The following section provides best practice methods and mitigation measures that would be implemented to minimise the predicted air quality impacts, with specific focus given to measures that could be implemented to minimise the dust and particulate matter impacts that may potentially be generated by construction activities.

a) Construction Mitigation

12.7.7 Environmental impacts and disturbance arising from construction activities will be managed through a range of control measures and monitoring procedures the principles of which are outlined in the **Environmental Management and Monitoring Plan (EMMP)** with further information in associated Subject-Specific Management Plans. The control measures for the management of the air quality, including minimisation of dust and particulate generation and dispersion from the HPC development site, are outlined in the **AQMP**.

i. Dust and PM_{10} Generated from Construction Activities

12.7.8 Best practice guidance control methods and mitigation measures that will be implemented to manage dust and PM_{10} emissions during the construction works, and to ensure associated impacts are prevented in areas in proximity to the site, are presented within the **AQMP**.

12.7.9 The **AQMP** makes reference to current best practice guidance and other supporting documentation, including:

- BRE publication 'Control of dust from construction and demolition activities' (2003) (Ref. 12.36).
- QUARG publication 'Airborne Particulate Matter in the UK – Third report of the Quality of Urban Air Review Group' (1996) (Ref. 12.37).
- Office of the Deputy Prime Minister 'Minerals Policy Statement 2: Controlling and Mitigating the Effects of Mineral Extraction in England – Annex 1: Dust' (Ref. 12.39).
- Greater London Authority and London Councils publication 'The control of dust and emissions from construction and demolition - Best Practice Guidance' (2006) (Ref. 12.35).
- CIRIA 'Environmental good practice on site guide' (third edition) (Ref. 12.57).
- Defra Secretary of State's Guidance for Mobile Crushing and Screening - Process Guidance Note 3/16(04) (Ref. 12.58).

12.7.10 The **AQMP** will be implemented throughout the duration of the HPC construction phase, ensuring that dust and particulate emissions are kept to a minimum. Typical good construction practice methods and dust mitigation that will be implemented where appropriate to control dust and PM_{10} generation during the construction works include:

- Vehicles carrying loose materials to be sheeted during periods of dry and windy weather, or if dust emissions become a problem.
- Implementation of design controls for construction equipment and vehicles and use of appropriately designed vehicles for materials handling.
- Completed stockpiles to be covered or seeded as soon as is practicable in order to stabilise surfaces (finished platforms would be covered, external slopes would be seeded and therefore eventually vegetated).
- Use of mobile or fixed spray units to dampen surfaces as dictated by weather conditions.
- Provision and use of wheel washing facilities at all exits as well as procedures for effective cleaning and inspection of vehicles, which should include total vehicle washing and ticketing of vehicles.
- Regular inspection and, if necessary, cleaning of local highways and site boundaries to check for dust deposits (and removal if necessary).
- Use of dust-suppressed tools for all operations, and use of dust extraction techniques where available.
- Ensuring that all construction plant and equipment are maintained in good working order and not left running when not in use.
- Regulating on-site movements to keep dust generating activities to a minimum.

12.7.11 A formal system would need to be put in place during the works which identifies the roles and responsibilities of site staff regarding the procedures to be applied to respond to any complaints or observations which may be made relating to air quality. Site logs will be maintained, detailing all complaints or observations received and the corresponding action taken including the response made to each complainant.

12.7.12 The extent to which dust mitigation measures will be implemented on site during the construction works will be flexible and responsive, with additional recommendations and measures introduced when required during particular activities which have significant dust generating potential, sensitive periods, or upon receipt of valid complaints relating to dust. Working practices will be systematically audited and revised where necessary in order to ensure dust impacts are mitigated to an acceptable level at the identified sensitive receptor locations.

ii. Exhaust Emissions from On-site Plant and Machinery

12.7.13 Best practice guidance control methods and mitigation measures that will be implemented to control on-site exhaust emissions from plant and machinery (NRMM) during the construction phase include:

- minimising idling times of plant and machinery;
- ensuring all equipment is in good working order and working efficiently;
- use of ultra low sulphur diesel (ULSD) in all equipment and plant, where practicable;
- ensuring that all equipment is fitted with appropriate particulate filters or any other appropriate exhaust after-treatments, where practicable; and
- use of equipment that meets the latest emission standards.

iii. Exhaust Emissions from Marine Vessels

12.7.14 Best practice guidance measures that will be implemented where appropriate to control emissions from marine vessels during the operation of the temporary jetty include:

- marine vessels to use fuels with low sulphur content (<1%), where practicable;
- all vessel engines (main and auxiliary) to be maintained in good working order; and
- minimise idling times of all vessel engines (main and auxiliary).

b) Operational Mitigation

12.7.15 The operation of backup diesel generators (EDGs and SBOs) will lead to the discharge of air pollutants, mostly formed by oxidation (fixation) of nitrogen in the combustion air. Many of the Best Available Technique (BAT) options, relative to management of the burner arrangements, are not applicable in compression ignition engines such as those proposed for the plant at HPC.

12.7.16 Optimisation of the diesel generator management with regards to NO_X control will be considered at the engine procurement phase, as reflected in the design specification.

However, these considerations will be considered against equipment reliability which is the priority for diesel generators.

12.7.17 In addition to optimisation at the design and procurement stages, NO_X control will also be addressed by the maintenance programme applied to the backup diesel generators to ensure optimum performance. The maintenance of the EDGs and SBOs will be addressed in the Operator's Maintenance Policy, which will specify the work programme required to maintain the backup diesel generators in the best possible standby state to ensure optimum engine availability. This work programme will be based on engine running hours and manufacturer's recommendations. It should be noted that following maintenance activities, which can significantly affect the engine performance, specific tests, such as stack testing, could be performed following completion of the work if deemed necessary.

12.7.18 Emissions of sulphur (as SO_2) are directly related to the sulphur content of the fuel (i.e. there is no sulphur in the air therefore it is only the sulphur in the fuel that contributes to the SO_2). Combustion management cannot be used to reduce SO_2 releases. The backup diesel generators will use a low sulphur fuel oil, which will ensure low emissions of SO_2. Fuel oil must contain a maximum of 0.1% sulphur by weight, as required under the Sulphur Content of Liquid Fuels (SCOLF) Regulations 2007 (Ref. 12.59) (or the requirements of future legislation).

12.7.19 During the routine testing schedule of the backup diesel generators (approximately 60 hours per year for each of the generators), where possible, effort would be made to ensure that their testing occurred during meteorological conditions that are conducive to good pollutant dispersion, i.e. moderate to strong winds with a northerly component that would disperse the plume in the opposite direction to the majority of the air quality receptor locations. This would minimise the pollutant concentrations occurring at such locations.

c) Vehicular Emissions Mitigation

12.7.20 The **Framework Travel Plan** and the **Freight Management Strategy** are included as an annex to this ES. The plan and strategy will be implemented to minimise traffic volumes during the construction and operational phases of the HPC Project, hence reducing the associated impacts from vehicle exhaust emissions to air relative to the worst-case assessment detailed in section 10.6. Full details of the proposed traffic mitigation measures are provided within the above documents. As relevant air quality criteria for the protection of human health are not predicted to be exceeded for locations in proximity to the highway network, specific air quality mitigation measures are not deemed to be necessary.

12.8 Residual Impacts

12.8.1 With the exception of fugitive dust and particulate impacts at both Bishops Farm House and Doggetts in the assessed 2013 scenario, all potential air quality impacts have been rated as **negligible**, **minor** or **not significant** before any best practice or mitigation has been applied.

12.8.2 Construction activities at the HPC development site will require management to minimise the potential for dust and particulate matter impacts to the nearest neighbouring residential properties. The implementation of the mitigation and best practice measures described above would result in a residual impact from dust and particulate matter impacts at Bishops Farm House and Doggetts, of no more than **minor** significance.

12.8.3 The residual additive impact from combined dust and particulate emissions during the HPC construction phase would also be rated as **minor**, following the implementation of the measures outlined in the **AQMP**.

12.8.4 All residual air quality impacts have, therefore, been determined to be of an acceptable level of significance.

12.9 Summary of Impacts

12.9.1 **Table 12.28** presents a summary of the air quality impacts. Note that the assessment methodology applied to the assessment of impacts from dust and PM_{10} is different to the methodology applied to the assessment of other air quality impacts. Therefore, the descriptors given in the “magnitude/risk and method of determination”, “impact descriptor”, “impact significance” and “residual impact significance” columns for dust/PM_{10} impacts and other air quality impacts are not directly comparable. section 12.4 provides full details of the assessment methodologies employed for the air quality impact assessment.

Table 12.28: Summary of Impacts

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Construction Phase							
Local air quality and amenity at assessed human receptor location - Doggetts	Fugitive dust and PM_{10} originating from construction activities during Scenario A (2011/2012 Preliminary Site Preparation Works)	High Risk (qualitative fugitive dust and PM_{10} assessment)	• Local • Adverse • Direct • Possible • Medium-term • Temporary	N/A	Minor	Measures to minimise fugitive dust and PM_{10} generation are provided in the **AQMP**, and follow best practice guidance and measures typically employed on construction sites	Minor
Local air quality and amenity at assessed human receptor locations – all locations excluding Doggetts	Fugitive dust and PM_{10} originating from construction activities during Scenario A (2011/2012 Preliminary Site Preparation Works)	High Risk (qualitative fugitive dust and PM_{10} assessment)	• Local • Adverse • Direct • Unlikely • Medium-term • Temporary	N/A	Negligible	Measures to minimise fugitive dust and PM_{10} generation are provided in the **AQMP**, and follow best practice guidance and measures typically employed on construction sites	Negligible
Local air quality and amenity at assessed human receptor locations – Bishops Farm House and Doggetts	Fugitive dust and PM_{10} originating from construction activities during Scenario B (2013)	High Risk (qualitative fugitive dust and PM_{10} assessment)	• Local • Adverse • Direct • Likely • Medium-term • Temporary	N/A	Major	Measures to minimise fugitive dust and PM_{10} generation are provided in the **AQMP**, and follow best practice guidance and measures typically employed on construction sites	Minor
Local air quality and amenity at assessed human receptor location - Shurton Village	Fugitive dust and PM_{10} originating from construction activities during Scenario B (2013)	High Risk (qualitative fugitive dust and PM_{10} assessment)	• Local • Adverse • Direct • Possible • Medium-term • Temporary	N/A	Minor	Measures to minimise fugitive dust and PM_{10} generation are provided in the **AQMP**, and follow best practice guidance and measures typically employed on construction sites	Minor

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality and amenity at assessed human receptor locations – all locations excluding Bishops Farm House, Doggetts and Shurton Village	Fugitive dust and PM_{10} originating from construction activities during Scenario B (2013)	High Risk (qualitative fugitive dust and PM_{10} assessment)	• Local • Adverse • Direct • Unlikely • Medium-term • Temporary	N/A	Negligible	Measures to minimise fugitive dust and PM_{10} generation are provided in the **AQMP**, and follow best practice guidance and measures typically employed on construction sites	Negligible
Local air quality and amenity at assessed human receptor location - Doggetts	Fugitive dust and PM_{10} originating from construction activities during Scenario C (Late 2014)	High Risk (qualitative fugitive dust and PM_{10} assessment)	• Local • Adverse • Direct • Possible • Medium-term • Temporary	N/A	Minor	Measures to minimise fugitive dust and PM_{10} generation are provided in the **AQMP**, and follow best practice guidance and measures typically employed on construction sites	Minor
Local air quality and amenity at assessed human receptor locations – all locations excluding Doggetts	Fugitive dust and PM_{10} originating from construction activities during Scenario C (Late 2014)	High Risk (qualitative fugitive dust and PM_{10} assessment)	• Local • Adverse • Direct • Unlikely • Long-term • Temporary	N/A	Negligible	Measures to minimise fugitive dust and PM_{10} generation are provided in the **AQMP**, and follow best practice guidance and measures typically employed on construction sites	Negligible
Local air quality and amenity at assessed ecological receptors - 'Bridgwater Bay SSSI/NNR', 'Severn Estuary SPA/SAC/ Ramsar' and 'Hinkley CWS'	Fugitive dust and PM_{10} originating from construction activities	High Risk (qualitative dust and PM_{10} assessment)	• Local • Adverse • Direct • Possible • Long-term • Temporary	N/A	Major	Measures to minimise dust and PM_{10} generation are provided in the **AQMP**, and follow best practice guidance and measures typically employed on construction sites	Minor

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed human and ecological receptors	Exhaust emissions (PM_{10}, NO_x and SO_2) from on-site plant and machinery (NRMM) associated with construction activities	Imperceptible/Small Magnitude (qualitative on-site exhaust emissions assessment)	• Local • Adverse • Direct • Unlikely • Long-term • Temporary	Negligible	Not significant	Measures to minimise dust and PM_{10} generation are provided in the **AQMP**, and follow best practice guidance and measures typically employed on construction sites, construction traffic management, phasing of construction activities, and use of plant and vehicles compliant with current emissions standards.	Not significant
Local air quality at all assessed human receptor locations	Long-term NO_2, PM_{10} and $PM_{2.5}$, and short-term NO_2, PM_{10}, and SO_2 emissions associated with marine vessels during the construction of HPC	Imperceptible Magnitude (quantitative assessment of marine vessel emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Negligible	Not significant	Measures to minimise dust and PM_{10} generation are provided in the **AQMP**, and follow best practice guidance.	Not significant
Local air quality at all assessed transient human receptor locations	Short-term NO_2 and SO_2 emissions associated with marine vessels during the construction of HPC	Small Magnitude (quantitative assessment of marine vessel emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Negligible	Not significant	Measures to minimise dust and PM_{10} generation are provided in the **AQMP**, and follow best practice guidance.	Not significant

NOT PROTECTIVELY MARKED

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at all assessed ecological receptor locations	Long-term NO_x and SO_2 emissions associated with marine vessels during the construction of HPC	Small Magnitude (quantitative assessment of marine vessel emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Negligible	Not significant	Measures to minimise dust and PM_{10} generation are provided in the **AQMP**, and follow best practice guidance.	Not significant
Local air quality at assessed ecological receptor locations	Short-term NO_x emissions associated with marine vessels during the construction of HPC	Medium Magnitude (quantitative assessment of marine vessel emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Negligible	Impact significance presented in **Volume 2, Chapter 20**	Measures to minimise dust and PM_{10} generation are provided in the **AQMP**, and follow best practice guidance.	Residual impact significance presented in **Volume 2, Chapter 20**
Local air quality at assessed human receptor locations in the Bridgwater model	Long-term NO_2 emissions associated with traffic during the construction of both HPC and the majority of the associated development sites (2013)	Medium Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Medium-term • Temporary	Negligible/ Slight Adverse	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Bridgwater model	Short-term PM_{10} emissions associated with traffic during the construction of both HPC and the majority of the associated development sites (2013)	Small Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Medium-term • Temporary	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant

NOT PROTECTIVELY MARKED

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed human receptor locations in the Bridgwater model	Short-term NO_2 emissions, and long-term PM_{10} and $PM_{2.5}$ emissions associated with traffic during the construction of both HPC and the majority of the associated development sites (2013)	Imperceptible Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Medium-term • Temporary	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Cannington model	Long-term NO_2 emissions associated with traffic during the construction of both HPC and the majority of the associated development sites (2013)	Large Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Medium-term • Temporary	Slight Adverse	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Cannington model	Long-term PM_{10} and $PM_{2.5}$ emissions, and short-term PM_{10} emissions associated with traffic during the construction of both HPC and the majority of the associated development sites (2013)	Small Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Medium-term • Temporary	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Cannington model	Short-term NO_2 emissions associated with traffic during the construction of both HPC and the majority of the associated development sites (2013)	Imperceptible Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Medium-term • Temporary	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed human receptor locations in the Williton model	Long-term NO_2 emissions associated with traffic during the construction of both HPC and the majority of the associated development sites (2013)	Small Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Medium-term • Temporary	Negligible/ Slight Adverse	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Williton model	Short-term PM_{10} emissions associated with traffic during the construction of both HPC and the majority of the associated development sites (2013)	Small Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Medium-term • Temporary	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Williton model	Short-term NO_2 emissions, and long-term PM_{10} and $PM_{2.5}$ emissions associated with traffic during the construction of both HPC and the majority of the associated development sites (2013)	Imperceptible Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Medium-term • Temporary	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed ecological receptor locations	Long-term NO_x emissions associated with traffic during the construction of both HPC and the majority of the associated development sites (2013)	Large Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Medium-term • Temporary	Moderate/ Substantial Adverse	Impact significance presented in **Volume 2, Chapter 20**	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Residual impact significance presented in **Volume 2, Chapter 20**

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed ecological receptor locations	Short-term NO_x emissions associated with traffic during the construction of both HPC and the majority of the associated development sites (2013)	Large Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Medium-term • Temporary	Substantial Adverse	Impact significance presented in **Volume 2, Chapter 20**	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Impact significance presented in **Volume 2, Chapter 20**
Local air quality at assessed human receptor locations in the Bridgwater model	Long-term NO_2 emissions associated with traffic during HPC construction (peak workforce on-site) (2016)	Small/Medium Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Negligible/ Slight Adverse	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Bridgwater model	Short-term PM_{10} emissions associated with traffic during HPC construction (peak workforce on-site) (2016)	Small Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Bridgwater model	Short-term NO_2 emissions, and long-term PM_{10} and $PM_{2.5}$ emissions associated with traffic during HPC construction (peak workforce on-site) (2016)	Imperceptible Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed human receptor locations in the Cannington model	Long-term NO_2 emissions associated with traffic during HPC construction (peak workforce on-site) (2016)	Large Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Slight Adverse	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Cannington model	Long-term PM_{10} and $PM_{2.5}$ emissions and short-term PM_{10} emissions associated with traffic during HPC construction (peak workforce on-site) (2016)	Small Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Cannington model	Short-term NO_2 emissions associated with traffic during HPC construction (peak workforce on-site) (2016)	Imperceptible Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Williton model	Long-term NO_2 emissions associated with traffic during HPC construction (peak workforce on-site) (2016)	Small Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Negligible/ Slight Adverse	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed human receptor locations in the Williton model	Short-term PM_{10} emissions associated with traffic during HPC construction (peak workforce on-site) (2016)	Small Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Williton model	Short-term NO_2 emissions, and long-term PM_{10} and $PM_{2.5}$ emissions associated with traffic during HPC construction (peak workforce on-site) (2016)	Imperceptible Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed ecological receptor locations	Long-term NO_x emissions associated with traffic during HPC construction (peak workforce on-site) (2016)	Large Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Slight Adverse/Substantial Adverse	Impact significance presented in **Volume 2, Chapter 20**	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Impact significance presented in **Volume 2, Chapter 20**
Local air quality at assessed ecological receptor locations	Short-term NO_x emissions associated with traffic during HPC construction (peak workforce on-site) (2016)	Large Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Temporary	Slight Adverse/Substantial Adverse	Impact significance presented in **Volume 2, Chapter 20**	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Impact significance presented in **Volume 2, Chapter 20**

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Operational Phase							
Local air quality at assessed human receptor locations	Long-term PM_{10}, $PM_{2.5}$ and H_2CO and short-term PM_{10}, H_2CO and CO emissions from HPC commissioning (commissioning scenario)	Imperceptible Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Short-term • Temporary	Negligible	Not significant	Measures will include regular inspection, maintenance and optimisation of the backup diesel generator combustion, and the use of fuels with a <0.1% sulphur content.	Not significant
Local air quality at assessed human receptor locations	Long-term NO_2 and short-term SO_2 emissions from HPC commissioning (commissioning scenario)	Small Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Short-term • Temporary	Negligible	Not significant	Measures will include regular inspection, maintenance and optimisation of the backup diesel generator combustion, and the use of fuels with a <0.1% sulphur content.	Not significant
Local air quality at assessed human receptor locations	Short-term NO_2 emissions from HPC commissioning (commissioning scenario)	Medium Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Short-term • Temporary	Negligible	Not significant	Measures will include regular inspection, maintenance and optimisation of the backup diesel generator combustion, and the use of fuels with a <0.1% sulphur content.	Not significant
Local air quality at assessed transient human receptor locations	Short-term CO emissions from HPC commissioning (commissioning scenario)	Imperceptible Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Short-term • Temporary	Negligible	Not significant	Measures will include regular inspection, maintenance and optimisation of the backup diesel generator combustion, and the use of fuels with a <0.1% sulphur content.	Not significant

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed transient human receptor locations	Short-term H_2CO emissions from HPC commissioning (commissioning scenario)	Small Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Short-term • Temporary	Negligible	Not significant	Measures will include regular inspection, maintenance and optimisation of the backup diesel generator combustion, and the use of fuels with a <0.1% sulphur content.	Not significant
Local air quality at assessed transient human receptor locations	Short-term SO_2 (1-hour) emissions from HPC commissioning (commissioning scenario)	Medium Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Short-term • Temporary	Negligible	Not significant	Measures will include regular inspection, maintenance and optimisation of the backup diesel generator combustion, and the use of fuels with a <0.1% sulphur content.	Not significant
Local air quality at assessed transient human receptor locations	Short-term NO_2 and SO_2 (15-minute) emissions from HPC commissioning (commissioning scenario)	Large Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Short-term • Temporary	Slight Adverse	Not significant	Measures will include regular inspection, maintenance and optimisation of the backup diesel generator combustion, and the use of fuels with a <0.1% sulphur content.	Not significant
Local air quality at assessed statutory designated ecological receptor locations	Long-term SO_2 emissions from HPC commissioning (commissioning scenario)	Small Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Short-term • Temporary	Negligible	Impact significance presented in **Volume 2, Chapter 20**	Measures will include regular inspection, maintenance and optimisation of the backup diesel generator combustion, and the use of fuels with a <0.1% sulphur content.	Residual impact significance presented in **Volume 2, Chapter 20**

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed statutory designated ecological receptor locations	Long-term NO_x emissions from HPC commissioning (commissioning scenario)	Large Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Short-term • Temporary	Slight Adverse	Impact significance presented in **Volume 2, Chapter 20**	Measures will include regular inspection, maintenance and optimisation of the backup diesel generator combustion, and the use of fuels with a <0.1% sulphur content.	Residual impact significance presented in **Volume 2, Chapter 20**
Local air quality at assessed statutory designated ecological receptor locations	Short-term NO_x emissions from HPC commissioning (commissioning scenario)	Large Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Short-term • Temporary	Substantial Adverse	Impact significance presented in **Volume 2, Chapter 20**	Measures will include regular inspection, maintenance and optimisation of the backup diesel generator combustion, and the use of fuels with a <0.1% sulphur content.	Residual impact significance presented in **Volume 2, Chapter 20**
Local air quality at assessed non-statutory designated ecological receptor locations	Long-term SO_2 emissions from HPC commissioning (commissioning scenario)	Medium Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Short-term • Temporary	Negligible	Impact significance presented in **Volume 2, Chapter 20**	Measures will include regular inspection, maintenance and optimisation of the backup diesel generator combustion, and the use of fuels with a <0.1% sulphur content.	Residual impact significance presented in **Volume 2, Chapter 20**
Local air quality at assessed non-statutory designated ecological receptor locations	Long-term NO_x emissions from HPC commissioning (commissioning scenario)	Large Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Short-term • Temporary	Moderate Adverse	Impact significance presented in **Volume 2, Chapter 20**	Measures will include regular inspection, maintenance and optimisation of the backup diesel generator combustion, and the use of fuels with a <0.1% sulphur content.	Residual impact significance presented in **Volume 2, Chapter 20**

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed non-statutory designated ecological receptor locations	Short-term NO_x emissions from HPC commissioning (commissioning scenario)	Large Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Short-term • Temporary	Substantial Adverse	Impact significance presented in **Volume 2, Chapter 20**	Measures will include regular inspection, maintenance and optimisation of the backup diesel generator combustion, and the use of fuels with a <0.1% sulphur content.	Residual impact significance presented in **Volume 2, Chapter 20**
Local air quality at assessed human receptor locations	Long-term NO_2, PM_{10} $PM_{2.5}$, H_2CO and NH_3, and short-term PM_{10}, CO and H_2CO emissions from HPC operation (routine test scenario)	Imperceptible Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible	Not significant	Measures will include regular inspection, maintenance and optimisation of the diesel generator combustion, and the use of fuels with a <0.1% sulphur content. During the routine testing of the backup diesel generators, where possible, effort would be made to ensure that their testing occurred during meteorological conditions that are conducive to good pollutant dilution	Not significant

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed human receptor locations	Short-term SO_2 emissions from HPC operation (routine test scenario)	Small Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible	Not significant	Measures will include regular inspection, maintenance and optimisation of the diesel generator combustion, and the use of fuels with a <0.1% sulphur content. During the routine testing of the backup diesel generators, where possible, effort would be made to ensure that their testing occurred during meteorological conditions that are conducive to good pollutant dilution	Not significant
Local air quality at assessed human receptor locations	Short-term NO_2 and NH_3 emissions from HPC operation (routine test scenario)	Medium Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible	Not significant	Measures will include regular inspection, maintenance and optimisation of the diesel generator combustion, and the use of fuels with a <0.1% sulphur content. During the routine testing of the backup diesel generators, where possible, effort would be made to ensure that their testing occurred during meteorological conditions that are conducive to good pollutant dilution	Not significant

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed transient human receptor locations	Short-term CO and H_2CO emissions from HPC operation (routine test scenario)	Imperceptible Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible	Not significant	Measures will include regular inspection, maintenance and optimisation of the diesel generator combustion, and the use of fuels with a <0.1% sulphur content. During the routine testing of the backup diesel generators, where possible, effort would be made to ensure that their testing occurred during meteorological conditions that are conducive to good pollutant dilution	Not significant
Local air quality at assessed transient human receptor locations	Short-term SO_2 (1-hour) emissions from HPC operation (routine test scenario)	Medium Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible	Not significant	Measures will include regular inspection, maintenance and optimisation of the diesel generator combustion, and the use of fuels with a <0.1% sulphur content. During the routine testing of the backup diesel generators, where possible, effort would be made to ensure that their testing occurred during meteorological conditions that are conducive to good pollutant dilution	Not significant

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed transient human receptor locations	Short-term NH_3, NO_2 and SO_2 (15-minute) emissions from HPC operation (routine test scenario)	Large Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Slight Adverse	Not significant	Measures will include regular inspection, maintenance and optimisation of the diesel generator combustion, and the use of fuels with a <0.1% sulphur content. During the routine testing of the backup diesel generators, where possible, effort would be made to ensure that their testing occurred during meteorological conditions that are conducive to good pollutant dilution	Not significant
Local air quality at assessed statutory designated ecological receptor locations	Long-term SO_2 emissions from HPC operation (routine test scenario)	Imperceptible Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible	Impact significance presented in **Volume 2, Chapter 20**	Measures will include regular inspection, maintenance and optimisation of the diesel generator combustion, and the use of fuels with a <0.1% sulphur content. During the routine testing of the backup diesel generators, where possible, effort would be made to ensure that their testing occurred during meteorological conditions that are conducive to good pollutant dilution	Residual impact significance presented in **Volume 2, Chapter 20**

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed statutory designated ecological receptor locations	Long-term NO_x emissions from HPC operation (routine test scenario)	Medium Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible	Impact significance presented in **Volume 2, Chapter 20**	Measures will include regular inspection, maintenance and optimisation of the diesel generator combustion, and the use of fuels with a <0.1% sulphur content. During the routine testing of the backup diesel generators, where possible, effort would be made to ensure that their testing occurred during meteorological conditions that are conducive to good pollutant dilution	Residual impact significance presented in **Volume 2, Chapter 20**
Local air quality at assessed statutory designated ecological receptor locations	Long-term NH_3 emissions from HPC operation (routine test scenario)	Large Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Slight Adverse	Impact significance presented in **Volume 2, Chapter 20**	Measures will include regular inspection, maintenance and optimisation of the diesel generator combustion, and the use of fuels with a <0.1% sulphur content. During the routine testing of the backup diesel generators, where possible, effort would be made to ensure that their testing occurred during meteorological conditions that are conducive to good pollutant dilution	Residual impact significance presented in **Volume 2, Chapter 20**

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed statutory designated ecological receptor locations	Short-term NO_x emissions from HPC operation (routine test scenario)	Large Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Substantial Adverse	Impact significance presented in **Volume 2, Chapter 20**	Measures will include regular inspection, maintenance and optimisation of the diesel generator combustion, and the use of fuels with a <0.1% sulphur content. During the routine testing of the backup diesel generators, where possible, effort would be made to ensure that their testing occurred during meteorological conditions that are conducive to good pollutant dilution	Residual impact significance presented in **Volume 2, Chapter 20**
Local air quality at assessed non-statutory designated ecological receptor locations	Long-term SO_2 emissions from HPC operation (routine test scenario)	Small Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible	Impact significance presented in **Volume 2, Chapter 20**	Measures will include regular inspection, maintenance and optimisation of the diesel generator combustion, and the use of fuels with a <0.1% sulphur content. During the routine testing of the backup diesel generators, where possible, effort would be made to ensure that their testing occurred during meteorological conditions that are conducive to good pollutant dilution	Residual impact significance presented in **Volume 2, Chapter 20**

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed non-statutory designated ecological receptor locations	Long-term NO_x and NH_3 emissions from HPC operation (routine test scenario)	Large Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Slight Adverse	Impact significance presented in **Volume 2, Chapter 20**	Measures will include regular inspection, maintenance and optimisation of the diesel generator combustion, and the use of fuels with a <0.1% sulphur content. During the routine testing of the backup diesel generators, where possible, effort would be made to ensure that their testing occurred during meteorological conditions that are conducive to good pollutant dilution	Residual impact significance presented in **Volume 2, Chapter 20**
Local air quality at assessed non-statutory designated ecological receptor locations	Short-term NO_x emissions from HPC operation (routine test scenario)	Large Magnitude (quantitative assessment of operational emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Substantial Adverse	Impact significance presented in **Volume 2, Chapter 20**	Measures will include regular inspection, maintenance and optimisation of the diesel generator combustion, and the use of fuels with a <0.1% sulphur content. During the routine testing of the backup diesel generators, where possible, effort would be made to ensure that their testing occurred during meteorological conditions that are conducive to good pollutant dilution	Residual impact significance presented in **Volume 2, Chapter 20**

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed human receptor locations in the Bridgwater model	Long-term NO_2 emissions associated with traffic during the early operation of HPC (2021)	Small/Medium Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible/ Moderate Adverse	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Bridgwater model	Short-term PM_{10} emissions associated with traffic during the early operation of HPC (2021)	Small Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Bridgwater model	Short-term NO_2 emissions, and long-term PM_{10} and $PM_{2.5}$ emissions associated with traffic during the early operation of HPC (2021)	Imperceptible Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed human receptor locations in the Cannington model	Long-term NO_2 emissions associated with traffic during the early operation of HPC (2021)	Small/Large Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible/ Slight Adverse	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Cannington model	Short-term PM_{10} emissions associated with traffic during the early operation of HPC (2021)	Small Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Cannington model	Short-term NO_2 emissions, and long-term PM_{10} and $PM_{2.5}$ emissions associated with traffic during the early operation of HPC (2021)	Imperceptible Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed human receptor locations in the Williton model	Long-term NO_2 emissions associated with traffic during the early operation of HPC (2021)	Small Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible/ Slight Adverse	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Williton model	Short-term PM_{10} emissions associated with traffic during the early operation of HPC (2021)	Small Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant
Local air quality at assessed human receptor locations in the Williton model	Short-term NO_2 emissions, and long-term PM_{10} and $PM_{2.5}$ emissions associated with traffic during the early operation of HPC (2021)	Imperceptible Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible	Not significant	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Not significant

Receptor	Potential Impact	Magnitude/Risk and Method of Determination	Description	Impact Descriptor	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Local air quality at assessed ecological receptor locations	Long-term NO_x emissions associated with traffic during the early operation of HPC (2021)	Small/Large Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible/ Substantial Adverse	Impact significance presented in **Volume 2, Chapter 20**	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Impact significance presented in **Volume 2, Chapter 20**
Local air quality at assessed ecological receptor locations	Short-term NO_x emissions associated with traffic during the early operation of HPC (2021)	Medium/Large Magnitude (quantitative assessment of vehicular emissions)	• Local • Adverse • Direct • Likely • Long-term • Permanent	Negligible/ Substantial Adverse	Impact significance presented in **Volume 2, Chapter 20**	The **Freight Management Strategy** and the **Framework Travel Plan** would be implemented to minimise vehicular movements, and use of vehicles compliant with emissions standards	Impact significance presented in **Volume 2, Chapter 20**

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CHAPTER 13: SOILS AND LAND USE

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13. SOILS AND LAND USE

13.1 Introduction

13.1.1 This chapter provides an assessment of the potential impacts on soils, land use and agriculture during the construction, operation and the restoration of land after the construction of the Hinkley Point C (HPC) development. Where required, mitigation measures are identified to prevent, reduce and, where possible off-set any potential adverse impacts that are identified to be of significance.

13.1.2 A glossary of terminology is provided in **Volume 1** of this ES**.**

13.2 Scope and Objectives of Assessment

13.2.1 The scope of the assessment has been determined through the formal EIA scoping process with the Infrastructure Planning Commission (IPC) and the pre-application consultations. The assessment of impacts on soil, land use and agriculture arising from the proposed development has been undertaken adopting the methodologies described in **Volume 1**, **Chapter 7** and Section 13.4 below. The existing baseline conditions, against which the likely environmental effects of the HPC development are assessed, have been determined through soil and land condition surveys which are described in Section 13.5; this section also identifies existing and future receptors. The study area for this assessment, as described in Section 13.4 and illustrated in **Figure 13.1**, comprises the site itself and land within a distance of 100m from the perimeter of the site. The extent of this zone of land adjacent to the site boundary is based on consideration of the scale of development earthworks, the nature of site boundaries, and the type of adjacent land uses. Also included within the study area are any contiguous agricultural drainage ditches and field drainage systems.

13.2.2 Section 13.6 assesses the potential impacts on soils, land use and agricultural receptors.

13.2.3 Appropriate mitigation measures aimed at preventing, reducing or off-setting any potential adverse impacts that are identified to be of significance are presented in Section 13.7. Section 13.8 provides details on residual impacts following implementation of the mitigation measures. The assessment of cumulative impacts of the HPC development with other elements of the HPC C Project and other planned or reasonably foreseeable projects is provided in **Volume 11** of the ES.

13.2.4 The objectives of the assessment are to:

- identify all soils, land use and agricultural receptors within and adjacent to the development site that may be affected by the works;
- characterise the baseline environmental conditions for soils, land use and agriculture within the site;
- assess the impacts of the construction works, and their removal and site restoration, on soil, land use and agriculture;

- recommend mitigation measures, if determined necessary, to reduce the impacts on soil, land use and agriculture; and
- assess the residual impacts of the construction, operation and post operational phases of the proposed development on soil, land use and agriculture.

13.2.5 Due to the fact that many environmental aspects are interrelated there may be a degree of overlap with other chapters in this volume, particularly that concerning geology and land contamination (**Volume 2**, **Chapter 14**), surface water (**Volume 2**, **Chapter 16**) and terrestrial ecology and ornithology (**Volume 2**, **Chapter 20**). Where impacts are identified in the assessment that are addressed in greater depth in relation to other environmental aspects (e.g. potential impacts from contaminated land, alterations to drainage regimes and impacts on biodiversity) these impacts will be considered in this chapter but only in so far as how they may result from changes to soils, land use and agriculture.

13.2.6 Issues relating to changes to farming practices, such as severance of farm holdings or routes, interruption to the operation of current land management units and other effects on farm practices with the potential to affect farm economics, are addressed in **Chapter 9** of this volume.

13.3 Legislation, Policy and Guidance

13.3.1 This section identifies and describes legislation, policy and guidance relevant to the assessment of impacts on soil, land use and agriculture associated with the construction, operational and landscape restoration phases of the proposed development.

13.3.2 The Overarching National Policy Statement (NPS) for Energy (EN-1) when combined with the NPS for Nuclear Power Generation (EN-6) provides the primary basis for decisions by the IPC on applications for nuclear power generation developments that fall within the scope of the NPSs.

13.3.3 Notwithstanding this, the IPC may consider other matters that are both important and relevant to its decision-making. This could include Planning Policy Statements (PPSs), Planning Policy Guidance Notes (PPGs), regional and local policy documents, although, if there is a conflict between these and the NPS, the NPS prevails for the purposes of IPC decision making.

13.3.4 Further, the Planning Act 2008 provides that the IPC must, in making its decision on an application, have regard to any Local Impact Report (LIR) prepared by relevant local authorities. It is anticipated that the LIRs will rely in part on PPSs, PPGs, regional and local policy to provide a context for their assessment. On this basis, regard has been given to these documents (where relevant to the technical assessment) since they are likely to inform the LIRs prepared by the relevant local authorities.

a) International Legislation

13.3.5 The European Commission adopted a Thematic Strategy for Soil Protection (COM (2006) 231)) on September 22, 2006, in order to provide a comprehensive common framework for protecting soils across the European Union (Ref. 13.1). The EU Strategy includes: a proposed legislative framework for the protection and sustainable use of soil, in order to integrate soil protection into national and EU policies; measures to improve knowledge of soil functions; and measures to increase public awareness. It seeks to establish rational land use planning practices at all levels of government to ensure the sustainability of soils, consistent with a "precautionary principle" used by the EU in establishing environmental policy.

13.3.6 The Thematic Strategy includes proposals for an EU Soil Framework Directive requiring Member States to adopt a systematic approach to identifying and combating soil degradation and integrate soil protection into other policies, especially with respect to agriculture, regional development, transport, and research. This proposed Directive has not yet been passed by the European Parliament and Council of Ministers.

b) UK Legislation

i. The Wildlife and Countryside Act 1981 (as amended) (Ref. 13.2)

13.3.7 This Act restricts the introduction of certain animals and plants, for example Japanese knotweed *(Reynoutria japonica)* and giant hogweed *(Heracleum mantegazzianum)* are listed under Schedule 9 and are subject to Section 14 of the Act which makes it an offence to plant, or cause these species to grow in the wild.

ii. The Environmental Protection Act 1990 (Ref. 13.3)

13.3.8 Japanese knotweed and giant hogweed are regarded as a controlled waste under the Environmental Protection Act 1990 and must be disposed at licensed sites or by burning on site.

iii. The Environmental Stewardship (England) Regulations 2005 and the Countryside Stewardship Regulations 2000 (Ref. 13.4)

13.3.9 Countryside Stewardship was introduced as a pilot scheme in 1991 to encourage farmers and land managers to enhance and conserve English landscapes, their wildlife and history. That scheme is now closed to new applicants and has been superseded by the Environmental Stewardship Scheme, which was introduced by the 2005 Regulations. The Environmental Stewardship Scheme is an agri-environment scheme that provides funding to farmers and other land managers in England who deliver effective environmental management on their land.

13.3.10 The Environmental Stewardship Scheme comprises three elements: Entry Level Stewardship (ELS), Organic Entry Level Stewardship (OELS) and Higher Level Stewardship (HLS). The ELS Scheme is open to all farmers and land managers who want to deliver a basic level of environmental management. ELS, requires a basic level of environmental management and participants can choose from a wide range of management options. These cover all farming types and include matters such as hedgerow management, stone wall maintenance, low nutrient input grassland, buffer strips, and arable options. OELS is the strand of ELS that applies to organic farming and is open to farmers who manage all or part of their land organically. HLS aims to deliver significant environmental benefits in high priority situations and areas. It involves more complex environmental management and the preparation of a Farm Environmental Plan.

iv. Commons Act 2006 (Ref. 13.5)

13.3.11 Section 38 of the Commons Act 2006 prohibits the carrying out of certain works on land which is registered as common land, including works that prevent or impede access to or over that land and works for resurfacing that land, without the consent of the Secretary of State. Landowners can apply to the Secretary of State under Section 16 of the Commons Act 2006 for the common to be de-registered. In such cases, the landowner must offer an alternative piece of land to the commoners. An area of common land lies adjacent to the site.

c) National Planning Policy

i. Planning Policy Statement 7 'Sustainable Development in Rural Areas' (PPS7) (2004) (Ref. 13.6)

13.3.12 PPS7 sets out the Government policy on development within the countryside. It sets out policy for promoting development in rural areas whilst conserving the character of the countryside and protecting the best and most versatile agricultural land, defined as Grade 1, 2 and 3a of the Agricultural Land Classification (ALC) (paragraph 28).

13.3.13 Paragraph 28 of PPS7 states:

> *"The presence of best and most versatile agricultural land (defined as land in grades 1, 2 and 3a of the ALC), should be taken into account alongside other sustainability considerations (e.g. biodiversity... including soil quality) when determining planning applications."*

13.3.14 The loss of best and most versatile land (BMVL) is no longer considered to be of *national* importance (as was set out in the precursor to PPS7, Planning Policy Guidance 7 (PPG7)). The loss of BMVL is now a matter to be taken into account at a local level rather than at a national level (via the former Ministry of Agriculture Fisheries and Food (MAFF)) as was the case previously.

ii. Consultation Paper on a New Planning Policy Statement: Planning for a Natural and Healthy Environment (March 2010) (Ref. 13.7)

13.3.15 In March 2010, the Government published a Consultation Paper for a new Planning Policy Statement: Planning for a Natural and Healthy Environment. The document was published in March 2010 and the consultation period expired in June 2010.

13.3.16 At the outset, the document makes clear that in its final form, the PPS will replace PPS7 in so far as it relates to, amongst others, soils and agricultural quality (paragraphs 28 and 29).

13.3.17 With specific reference to agricultural land, proposed Policy NE8.9 states:

> *"When considering applications involving significant areas of agricultural land, local planning authorities should take account of the presence of best and most versatile agricultural land (defined as land in grades 1, 2 and 3a of the ALC) alongside other sustainability considerations. Where significant development of agricultural land is unavoidable, local planning authorities should seek to develop areas of poorer quality land (grades 3b, 4 and 5) in preference to that of a higher quality, except where this would be inconsistent with other sustainability considerations. Little weight should be*

given to the loss of agricultural land in grades 3b, 4 and 5, except in areas (such as uplands) where particular agricultural practices may themselves contribute to the quality and character of the environment or the local economy."

iii. Safeguarding our Soils. A Strategy for England (2009) (Ref. 13.8)

13.3.18 The first Soils Action Plan for England 2004-2006 was published by the Department for Environment, Food and Rural Affairs (Defra) in 2004. This has been developed into "Safeguarding Our Soils. A Strategy for England" which was published by Defra in 2009 (Ref. 13.8). The strategy outlines the Government's approach to safeguarding England's soils for the long-term. It provides a guide to future policy development across a range of areas and sets out the practical steps that need to be taken to prevent further degradation of soils, to enhance, restore and ensure soils resilience, and to improve understanding of the threats to soil and best practice in responding to those threats.

13.3.19 The purpose of the strategy is to support the Thematic Strategy and to achieve Defra's goals of a thriving farming sector and a sustainable, healthy food supply. A supplementary purpose is to increase the value placed on soil and to set a framework for safeguarding the amount and quality of England's soil resource for the future.

iv. Design Manual for Roads and Bridges (DMRB) – Volume 11 Section 3, Part II: Geology and Soils (1993) (Ref. 13.9)

13.3.20 The Highway Agency's 'Design Manual for Roads and Bridges' Volume 11 Section 3 Part II, published in 1993, provided very basic guidance on impact assessment on geology and soils. Since then understanding of the role and importance of soil in the environment has improved greatly and key policy and guidance has been published, including the European Commission's Thematic Strategy for Soil Protection and soil strategies in both England and Scotland.

13.3.21 DMRB Volume 11, Section 3 Part II states:

'...where soils are excavated and stored for reuse the level of damage and deterioration in soil quality will depend upon the types of earthmoving machinery employed, method of handling, weather conditions and provision of storage. In addition to any deterioration in soil quality there may be a loss of valuable seed banks, for example, when soil is taken from a site of nature conservation interest...'.

13.3.22 DMRB Volume 11, Section 3 Part II is currently being updated.

d) Regional Planning Policy

13.3.23 The Government's revocation of regional strategies was quashed in the High Court on 10 November 2010. However, on that same date the Government reiterated in a letter to Chief Planners its intention to revoke regional strategies through the Localism Bill. This letter was also challenged but, on 7 February 2011, the High Court held that the Government's advice to local authorities that the proposed revocation of regional strategies was to be regarded as a material consideration in their planning development control decisions should stand. The decision of the High

Court was upheld by the Court of Appeal on 27 May 2011. Therefore, the regional strategies remain in place but in the case of development control decisions it is for planning decision makers to decide on the weight to attach to the strategies (see **Volume 1, Chapter 4** for a full summary of the position regarding the status of regional planning policy).

i. Regional Planning Guidance 10 for the South West 2001 – 2016 (RPG10) (2001) (Ref. 13.10)

13.3.24 RPG10 sets out the broad development strategy for the period to 2016 and beyond. With specific reference to soil and agricultural land use, paragraph 3.76 explains that land quality is considered in various ways including its value for agricultural production. It goes on to refer to the ALC system which is used to grade agricultural land which forms the basis for classifying best and most versatile agricultural land. It also refers to further guidance contained within PPG7, which as explained above, has now been replaced by more recent guidance contained within PPS7.

13.3.25 Policy SS20 relates to Rural Land (including Urban Fringe) Uses. It states that local authorities and other agencies, in their plans, policies and proposals should, amongst others:

> *"Conserve the region's best and most versatile agricultural land and associated soils in accordance with the guidance in PPG7; land of a poorer quality should be used in preference to higher quality except where other sustainability criteria suggest otherwise.*
>
> *Development Plans should set out policies on the level of protection from development, to be afforded to the best and most versatile agricultural land and associated soils in relation to other considerations such as landscape character, biodiversity and sustainability."*

ii. Draft Revised Regional Spatial Strategy (RSS) for the South West Incorporating the Secretary of State's Proposed Changes for Public Consultation (July 2008) (Ref. 13.11)

13.3.26 Chapter 7 deals with Enhancing Distinctive Environments and Cultural Life. Paragraph 7.13.17 relates to Best and Most Versatile (BMV) land and states:

> *"Best and Most Versatile (BMV) land needs to be taken into account alongside other sustainability considerations when deciding between sites. The BMV agricultural soils need to be protected from development because these are the most flexible in terms of the range of crops or produce that can be grown, and therefore the most valuable for current and future agricultural production. Given changes to Common Agricultural Policies (CAP) and the fact that this is driving businesses to become more economically efficient, it is important that the best land is protected, for possible future agricultural needs. In some circumstances, BMV land may be subject to development pressures, particularly in areas identified for growth in Sections 3 and 4."*

iii. Somerset and Exmoor National Park Joint Structure Plan Review 1991-2011 (2000) (Ref. 13.12) (Policies 'saved' from 27 September 2007)

13.3.27 The Somerset and Exmoor National Park Joint Structure Plan was adopted in 2000 with saved policies from 27 September 2007. All policies have been saved with the exception of Policy 53 which is unrelated to soil, land use and agriculture. The Plan provides a strategic base for all land use planning within the plan area for the period up to 2011.

13.3.28 Policy 7 relates to Agricultural Land and states:

> *“Subject to the overall aims of the strategy, provision should not be made for permanent development, excluding forestry and agriculture, involving the best and most versatile agricultural land (Grades 1, 2 and 3a) unless there are no alternative sites on lower quality agricultural land and there is an overriding need for development in that location. Where land in Grades 1, 2 and 3a does need to be developed and there is a choice between different grades, development should be diverted towards land of the lowest grade.”*

13.3.29 The supporting text to Policy 7 explains that better quality agricultural land can be significantly more productive than other land, whatever the intensity of production, and that its protection from development is a material consideration in assessing proposals. Paragraph 4.31 goes on to state:

> *“Where provision has to be made for permanent development, it should preferably involve land falling into one of the lower grades of the ALC (Grades 3b, 4 or 5), as defined by the Ministry of Agriculture, Fisheries and Food. It must be recognised that this lower quality land can often be the richest in terms of biodiversity, archaeology and its contribution to the quality of the landscape. Where land in Grades 1, 2 and 3a has to be developed, the development should be directed towards land of the lowest grade. Provision for permanent development involving the best and most versatile agricultural land should only be made where there are no alternative sites available on lower quality land and where there is an overriding need for development in that location. Consideration may also need to be given to the ecological value and nature conservation issues, particularly habitat and species protection, which affects lower grade agricultural land. This could inhibit or restrict its development potential and thus increase pressure for development on agricultural land of a higher grade. Where this occurs, a balance will need to be sought between the requirements of this policy and those of Policy 1: Nature Conservation, where the lower grade agricultural land has had a nature conservation designation applied to it.”*

a) Local Planning Policy

i. West Somerset Local Plan (2006-2009) (2004) (Ref. 13.13)

13.3.30 The West Somerset Local Plan forms part of the development plan for West Somerset. The Local Plan was adopted in April 2006 (with relevant policies ‘saved’ from 17 April 2009). The site lies outside of the defined Development Boundary.

13.3.31 The following saved policy is considered to be potentially relevant:

13.3.32 The Local Plan was adopted in April 2006 with relevant policies saved from 17 April 2009. Policy A/2 (Best and Most Versatile Agricultural Land) states:

> *"The best and most versatile agricultural land (grades 1, 2 and 3a) will be protected from development. Planning permission for development affecting such land will only be granted exceptionally if there is an overriding need for the development and either*
>
> *i) sufficient land of a lower grade (grades 3b, 4 and 5) is unavailable; or*
>
> *ii) available lower grade land has an environmental value recognised by a statutory or non-statutory wildlife, historic or archaeological designation and outweighs the agricultural considerations.*
>
> *If best and most versatile land needs to be developed and there is a choice between sites in different grades, land of the lowest grade available should be used."*

ii. West Somerset District Local Development Framework (LDF) Core Strategy (Options Paper) (January 2010) (Ref. 13.14)

13.3.33 The Core Strategy is at a preliminary stage of preparation and the Options Paper does not include any specific policies relating to soils and land use impacts.

iii. Supplementary Planning Guidance

13.3.34 Sedgemoor District Council and West Somerset Council have jointly prepared draft supplementary planning guidance in relation to the HPC Project. Public consultation on the Consultation Draft version of the Hinkley Point C Project Supplementary Planning Document (the draft HPC SPD) commenced on 1 March 2011 and concluded on 12 April 2011. EDF Energy has submitted representations which object to the draft HPC SPD. See **Volume 1**, **Chapter 4** for a full summary of the position regarding the status of the draft HPC SPD.

13.3.35 The draft HPC SPD provides advice in relation to the HPC proposals, expanding upon the policy context for the proposals. This includes associated development.

13.3.36 Box 19 in the draft HPC SPD sets out the approach to masterplanning and design of the Main Site, and sets out a number of requirements that the County Council and Councils will expect of the HPC project promoter. In relation to soils and land use, Box 19 states that the HPC project promoter is expected to, where development is temporary, to reinstate and/ or create, amongst other things, agricultural land (Page 36-37).

13.3.37 Further planning policy context is provided in the Legislative Planning Policy Context chapter (**Volume 1**, **Chapter 4**) and the Introduction chapter (**Volume 2**, **Chapter 1**).

13.4 Methodology

13.4.1 The assessment and all supporting soil and land use surveys, have been conducted in accordance with standard guidance for England and Wales and detailed below.

This chapter addresses the likely impacts of the development during the construction, operation and final restoration of the development site..

a) Study Area

13.4.2 The geographical extent of the study area for this assessment includes:

- all land within the HPC development site boundary, comprising three areas of land defined as: Built Development Area West (BDAW); Built Development Area East (BDAE) and Southern Construction Phase Area (SCPA) (see **Figure 13.1**);
- surrounding land within 100m of the site, as, given the scale of proposed earthworks, surrounding land use and boundary hedgerows and trees, it is within this radius that any potential impacts associated with soil erosion or dust emissions on soil, land use or agricultural receptors are considered likely to occur; and
- the agricultural drainage ditches and field drainage systems which are contiguous with drainage ditches and drainage systems within the site.

13.4.3 The study area described above is illustrated in **Figure 13.1**.

b) Baseline Assessment

13.4.4 Characterisation of the existing soil, land use and agricultural conditions was identified through:

- desk-based studies of web-based resources, published maps and documents;
- field surveys of soils and land use commissioned specifically for this assessment; and
- consultation with appropriate statutory and non-statutory bodies (particularly Natural England, Defra and the site freeholder).

13.4.5 Desk-based studies and field surveys were carried out in accordance with best practice and standard methodologies where applicable.

i. Desk based Review

13.4.6 The following published literature and web-based information was reviewed to characterise baseline environmental conditions:

- Soil types (information obtained from the Soil Survey of England and Wales (1984) Soils and Their Use in South West England. SSEW Bulletin No 14, and associated Map Sheet No 5 (Ref. 13.15).
- Preliminary Agricultural Land Classification (ALC) grades (information obtained from mapping provided on the Multi-Agency Geographic Information for the Countryside (MAGIC) website (www.magic.defra.gov.uk) and accessed on 8 November 2010 (Ref. 13.16).
- Agri-environment schemes (Environmental Stewardship Agreements and Countryside Stewardship schemes). Information obtained from mapping provided on the MAGIC website (www.magic.defra.gov.uk) and accessed on 8 November 2010 (Ref. 13.16).

- Relevant previously published environmental studies and assessments, including West Hinkley Wind Farm ES (2006) (Ref. 13.17), Hinkley A ES (2000) (Ref. 13.18) and Hinkley Point C ES (1987) (Ref. 13.19).
- Defra – June National Census of Agriculture and Horticulture (Land Use and Livestock on Agricultural Holdings at 1 June 2010), England – Final Results. Website accessed on 6 June 2011 at: http://www.defra.gov.uk/statistics/foodfarm/landuselivestock/junesurvey/junesurveyresults. (Ref. 13.20).
- Defra – Regional Results and Datasets 2007-2009. Website accessed 6 June 2011 at: http://www.defra.gov.uk/statistics/foodfarm/landuselivestock/junesurvey/junesurveyresults. (Ref. 13.21).

ii. Field Soil Survey

13.4.7 A preliminary soil survey of the site was conducted in 1988 and further field surveys, commissioned specifically for this assessment, were carried out in 2009 and 2010 (**Appendix 13A**) to provide data on soil type, distribution and ALC across the site. A series of observations were made across the site using both hand dug soil pits, supplemented by hand augering to examine and record soil profiles. At each observation point, the following characteristics (Ref. 13.22) were assessed for each soil horizon up to a maximum depth of 120cm or to the depths of any impenetrable layer:

- soil texture;
- significant stoniness;
- colour (including local grey and mottle colours);
- consistency;
- structural condition;
- free carbonate; and
- depth.

13.4.8 Soil Wetness Class (WC) (definitions of soil wetness, described in **Appendix 13B**) was inferred from the matrix colour, presence or absence of, and depth to, greyish and ochreous gley mottling and/or poorly permeable subsoil layers at least 15cm thick. Soil droughtiness was investigated by the calculation of moisture balance equations. Crop-adjusted Available Profile Water (AP) is estimated from texture, stoniness and depth, and then compared to a calculated moisture deficit (MD) for the standard crops: wheat and potatoes. Eight soil samples were subject to laboratory determination of particle size analysis, pH and total soil nutrients: phosphorous, potassium and magnesium. The samples, collected in 2009 and 2010 (**Appendix 13A**) were also analysed for organic matter content using the Walkley-Black method. Four soil samples were taken north of Holford Stream valley within the BDAW and four samples were taken south of Holford Stream valley within the SCPA.

iii. Agricultural Land Classification (ALC)

13.4.9 The ALC system classifies land into five main categories (Grade 1 to 5) and two subdivisions within Grade 3, i.e. Classes 3a, and 3b. Grade 1 is the highest quality land with no or very limited restriction to agricultural use. Grade 5 is of least agricultural value, usually only of limited grazing use. Under PPS 7, Grades 1, 2 and 3a are defined as the 'best and most versatile' land (BMVL) and are a national resource to be protected. A description of ALC Grades is provided in **Appendix 13C**. To establish the ALC, results from the soil surveys were combined with data on the topography and climate of the area (taken from the Meteorological Office (1989) (Ref. 13.23)) to provide an assessment of the land classification. Land grade is determined by a combination of soils types, drainage status, climatic factors and topography (land gradient) according to the methodology provided in MAFF (1988) (Ref. 13.24).

iv. Land Use Crops and Stock

13.4.10 Land use, including agricultural cropping and stocking, was determined from published data (**Appendix 13A**), photographic evidence and site observations made during initial walkover surveys in 2008 and in subsequent site investigation work in 2009 and 2010.

c) Consultation

13.4.11 There has been ongoing consultation throughout the EIA process (further information may be found in the **Consultation Report).** Consultation on soils, land use and agriculture formed part of the overall consultation process, particularly as there is an interaction with (a) terrestrial ecology, (b) surface water and (c) landscape issues. The following organisations were contacted for available information on soil types, soil and land quality and agricultural land use:

- Department for Environment, Food and Rural Affairs (Defra) (animal burial pits);
- Natural England (agri-environment schemes and ALC data);
- West Somerset Council;
- Somerset County Council; and
- The site freeholder.

13.4.12 Meetings were held with the site freeholder throughout the assessment process to discuss specific aspects of the development such as existing soil conditions and proposed site restoration.

13.4.13 Responses from consultees during both formal and informal consultation have been taken into account.

d) Assessment Methodology

13.4.14 **Volume 1**, **Chapter 7** of this ES describes the assessment methodology for this EIA. Whilst soil loss and land degradation can have adverse consequences, for example in relation to agricultural production, water quality and biodiversity, there are no established or published methods for assessing the impacts of development upon soils, land use and agricultural receptors.

13.4.15 The criteria used in this assessment are the ALC Grades as set out by the former Ministry of Agriculture, Fisheries and Food (MAFF) (1988) (Ref. 13.24), together with professional knowledge of soil conditions and quality.

13.4.16 The assessment follows the approach set out in **Volume 1**, **Chapter 7** involving three key steps: impact assessment (including assessment of cumulative impacts), provision of mitigation measures and assessment of residual impacts. The magnitude of impacts and receptor value/sensitivity are assessed using criteria that are specific for soil, land use and agriculture (set out below); then the significance of impacts is assessed using the impact assessment matrix (IAM) provided in **Volume 1**, **Chapter 7** which combines the magnitude of impact and receptor value/sensitivity assessments specific for soil, land use and agriculture as well as professional judgment. Impacts rated as negligible or minor are considered to be acceptable without requiring further mitigation.

13.4.17 This assessment addresses likely impacts of the HPC development during the construction, operational and landscaping phases. The assessment of impacts on land use and soils relates to the following:

- the soil types and agricultural land classification likely to be affected by the HPC development, evaluated via field soil surveys carried out especially for this assessment;
- the type of farms and farming practices present, including any agri-environment schemes, based on information from field observation and the MAGIC website; and
- the possible presence of crop/soil/animal diseases or noxious weeds, using information on the presence/absence of animal burial pits obtained from the Animal Health Division of Defra and from data on invasive weeds collected during ecological field survey work (see **Volume 2**, **Chapter 20**).

13.4.18 The assessment considers the potential for impacts during commissioning tests, start-up and continued operation of HPC. Based on professional judgement of both engineers and environmental scientists. The operational phase of the development is not expected to have any further impact on land use and soils beyond those caused during construction.

i. Receptor Value and Sensitivity

13.4.19 All of the soil, land and agricultural receptors that have the potential to be impacted by the HPC development have been assigned a level of importance in accordance with the quality of the soil and the ALC grade of land. These are described in **Table 13.1**. Where a receptor can reasonably be placed within more than one value and sensitivity rating, professional judgement has been used to determine which rating would be applicable.

Table 13.1: Guidelines for the Assessment of Value and/or Sensitivity

Value and Sensitivity	Guidelines
High	**ALC and agricultural productivity:** Grade 1 agricultural land and specialised agricultural activity such as horticultural crops, soft fruit, etc. Irrigated agriculture. Higher level Agri-environment scheme lands. **Soil Conditions:** **(i) Value for Agriculture** Soils with low or no wetness limitation affecting workability (wetness class I or II), where drought is not also a limitation. **(ii) Vulnerability to damage** Soils with a high susceptibility to structural damage and soil erosion throughout the year, including heavy textured, poorly structured soils,
Medium	**ALC and agricultural productivity:** Grades 2 and 3a agricultural land. Annual horticultural cropping (non-irrigated). Entry level Agri-environment scheme lands. **Soil Conditions:** **(i) Value for Agriculture** Soils with low wetness limitation affecting workability (wetness class II), where drought is not a limitation. **(ii) Vulnerability to damage** Soils with some seasonal susceptibility to structural damage and soil erosion.
Low	**ALC and agricultural productivity:** Grades 3b and lower agricultural land. Arable or grassland areas. **Soil Conditions:** **(i) Value for Agriculture** Soils with moderate wetness limitation affecting workability (wetness class III or IV); or **(ii) Vulnerability to damage** Soils with medium to course textures and some resistance to soil structural damage for most of the year.
Very low	**ALC and agricultural productivity:** Agricultural land of Grades 4 or 5 Arable or grassland areas. **Soil Conditions:** **(i) Value for Agriculture** Soils with high wetness limitation affecting workability (wetness class V or VI); Soils in which droughtiness is a limitation to crop growth; or **(ii) Vulnerability to damage** Coarse textured and stony soils with little potential for soil structural damage.

13.4.20 In addition to the receptors described in **Table 13.1**, agricultural stock (off-site grazing animals) and pets have been identified as possible receptors in relation to the very specific issue of potential (unrecorded) animal burial pits within the site and the risk of exposure to disease from these pits, if present and accidentally disturbed.

This is also addressed in **Volume 10, Chapter 12**, with regard to human receptors. Stock animals and pets are considered to be high value/sensitivity receptors.

ii. Impact Magnitude

13.4.21 The magnitude of impact is based on the consequences that the HPC development would have upon soils, land and agricultural receptors, and has been considered in terms of high, medium, low and very low (see **Table 13.2**). Where an impact could reasonably be placed within more than one magnitude rating, professional judgement has been used to determine which rating would be applicable. There is no published guidance on thresholds for assessing what scale of loss is a significant loss of agricultural land, but the presence of best and most versatile land (BMVL) is a factor in the consideration of the sustainability of development proposals as set out in Paragraph 28 of PPS7. PPS7 promotes the creation of a sustainable countryside framework, and places the loss of best and most versatile land within the context of meeting wider sustainability objectives. The assessment of magnitude of change provided in **Table 13.2** is based on (a) generic guidelines used throughout this EIA (**Volume 1, Chapter 7,**), (b) timescales of permanent or temporary (both long and short term) loss of agricultural land and (c) land area loss thresholds previously adopted by MAFF (Ref. 13.24) when considering proposals involving more than 20ha of BMVL, and also land not classified as BMVL, but still given over to agricultural use.

Table 13.2: Guidelines for the Assessment of Magnitude

Magnitude	Guidelines
High	Permanent or long–term (over ten years) loss of over 50ha of BMVL, or entire regional resource of BMVL (ALC Grades 1, 2, 3a). (50ha being the size of a moderate to large sized land holding according to Defra statistics for Somerset)*. Existing land use would not be able to continue.
Medium	Medium to long term (5-10 years) loss of 20 – 50ha of BMVL, or large proportion of local resource of BMVL. (20-50ha being the size of a moderate sized land holding according to Defra statistics for Somerset)*. Existing land use would be able to continue but noticeable changes (such as a measureable loss of yield, additional land management or increased fertilising would occur.
Low	Temporary (<5 years) loss of 10 – 20ha of BMVL, or large proportion of local resource of BMVL. (10-20ha being the size of a small to moderate sized land holding according to Defra statistics for Somerset)*. Existing land use would be able to continue but noticeable changes (such as the need for additional land management, increased fertilising, or reduced cropping choices) would occur.
Very low	Temporary short term (<two years) loss of <10ha of BMVL. 0-10ha being the size of a small sized land holding according to Defra statistics for Somerset)*. Short term adverse changes to the value of the receptor but recovery is expected in the short term (0 – one years), and there would be no impact on its integrity. No material change to existing land use. Loss or degradation of area of BMVL but a small proportion of local resources. No impact on overall agricultural land availability for wider area/region.

**Data taken from the Defra website (Ref. 13.21) at: http://www.defra.gov.uk/statistics/foodfarm/landuselivestock/junesurvey/junesurveyresults/*

13.4.22 Potential impacts have been considered in terms of whether they are: direct or indirect, permanent or temporary, adverse (negative) or beneficial (positive) and cumulative.

iii. Significance of Impacts

13.4.23 The significance of the impact is judged on the relationship of the magnitude of impact to the assessed receptor sensitivity and/or importance. The method for determining significance of the impacts, without mitigation, is outlined in **Volume 1, Chapter 7**. The assessment of impact significance is the most important step in the EIA process, since it is this which is used to determine whether mitigation is required and also to determine whether mitigation measures have reduced the impact to an acceptable residual level. Only impacts assessed as being moderate or major significance are considered to require mitigation.

iv. Residual impacts

13.4.24 The final step in the EIA process is the assessment of the residual impacts after the implementation (where necessary) of the proposed mitigation measures. In this assessment, residual impacts assessed as minor or negligible are considered to be acceptable for the project.

v. Cumulative Effects

13.4.25 **Volume 1, Chapter 7** of this ES refers to the methodology used to assess cumulative impacts. Additive and interactive effects between impacts generated within the site boundary and study area are considered within this chapter. Cumulative impacts that consider activities and impacts generated at distance from the site and study area are considered in **Volume 11** of this ES; this assesses the project-wide cumulative impacts and in-combination impacts with other proposed or reasonably foreseeable projects.

e) Limitations, Assumptions and Uncertainties

13.4.26 Agricultural Land Classification (ALC) and soil survey fieldwork was carried out across the site, but did not include the BDAE as it is classified as ‘made ground’ rather than agricultural land. However, there is grazing in the BDAE, including the area of made ground, as part of the management of the Hinkley Point County Wildlife Site (CWS) (see **Volume 2, Chapter 20**, Terrestrial Ecology and Ornithology) and hence this area of land is included in this assessment.

13.4.27 ALC and soil survey fieldwork was carried out on land within the HPC development site boundary. ALC grades and soil types within the study area but beyond the site boundary (**Figure 13.1**) have been interpreted from the following published sources:

- Soil Survey of England and Wales (1984) Soils and Their Use in South West England. SSEW Bulletin No 14, and associated Map Sheet No 5 (Ref. 13.15);
- Findlay, D.C. 1965. The Soils of the Mendip District of Somerset (Sheets 279 and 280). Memoir of the Soil Survey of Great Britain, Harpenden, and Map Sheet entitled: ‘Soil Survey of England and Wales, Weston-super-Mare, Sheet 279’. (Ref. 13.25) ;
- Groundsure Environmental Data Report 2008 (Ref. 13.26) ; and

- MAGIC (Multi-Agency Geographic Information for the Countryside) website (www.magic.defra.gov.uk)) (Ref. 13.16).

13.4.28 Defra has no records of animal burial pits within the site; however, this does not eliminate the possibility that unrecorded pits may be present.

13.5 Baseline Environmental Characteristics

a) Introduction

13.5.1 This section presents the baseline environmental characteristics for the site and the rest of the study area with specific reference to soil, land use and agriculture.

b) Study Area Description

13.5.2 **Figure 13.1** illustrates the study area which includes the HPC development site, comprising the three land parcels described in Section 13.4. Collectively, the three parcels of land are referred to hereafter as the development site. The areas of 11 off-site highway improvements schemes have also been considered in this assessment, but these are not included in Figure 13.1.

13.5.3 The development site comprises land required for the permanent HPC development, and also land required during the construction phase, to accommodate contractor compounds; the on-site accommodation campus; access and haulage roads, and storage areas for excavated materials.

13.5.4 The development site is generally open rolling countryside, primarily in agricultural use (mixed pasture and arable) with some areas of woodland/scrub. The site is bisected by Holford Stream (which flows from west to east) and its associated shallow valley.

13.5.5 Land immediately adjacent to and within 100m of the site is also primarily in agricultural use, comprising a mosaic of pasture, arable land and small tracts of woodland. Two small areas of Common Land adjacent to the site's eastern boundary, small areas of Shurton village to the south of the site, a short section of the C182 road and a small section of Hinkley Point A (HPA) to the north-east are also included within the study area.

13.5.6 The proximity of the site to Sites of Special Scientific Interest (SSSI), National Nature Reserve (NNR), Special Protection Area (SPA), Special Area for Conservation (SAC), a Ramsar Site and a locally designated County Wildlife Site (CWS) highlights the ecological interest and value of the area, to which soils and land use may have some relationship (see **Chapter 20**).

c) Soil Types

i. Soil Parent Materials

13.5.7 The development site lies in an area of weathered Blue Lias formation deposits comprising mudstones and limestones of Jurassic Age. These rocks are overlain by previously deposited fill material (in the BDAE) and the weathered products of in-situ rocks and transported materials. Transported materials include "head deposits" formed by the mass movements of soils down slope and periglacial disturbance, both of which result from the effect of freezing and thawing of the ground during the

Quaternary Ice Age. Other soil parent materials include marine estuarine deposits and fluvial glacial sands. The underlying geology of the site is described in detail in **Volume 2**, **Chapter 14**.

ii. Description of Soil Types

13.5.8 The more generalised distribution of soil types (Soil Survey of England and Wales, 1984) (Ref. 13.15) indicates that the majority of the study area consists of soils of the Evesham Association which are described as being slowly permeable, calcareous clayey brown earths.

13.5.9 Findlay (1965) (Ref 13.25), the primary source of information used in this section, provides more detailed descriptions and distributions of soils and maps them at the Soil Series level, compared to the more generalised Soil Association level and mapping which is provided in the SSEW Bulletin 14 (Ref. 13.15). The following soil descriptions are taken from both scales of mapping.

13.5.10 Five soil types (identified as Soil Series) are mapped for the area within the site (Refs. 13.15 and 13.25):

- **Evesham Series:** Slowly permeable, calcareous, clayey soils with some loamy soils over clayey subsoils. Some seasonal waterlogging. Developed over Jurassic and Cretaceous clay. Wetness Class II or III.
- **Worcester Series:** Reddish, slowly permeable clayey soils developed over Permo-Triassic Mercia mudstone and clay shales (previously described as Keuper Marls by Findlay (1965) (Ref 13.25). Some seasonal gleying. Wetness Class III.
- **Butleigh Series**: Calcareous, slowly permeable clay soils developed over fine-textured alluvium and colluvium derived from calcareous Lower Lias shales and clays. Wetness Class IV.
- **Compton Series**: Reddish brown clay soil developed over fine-textured alluvium and colluvium derived from Permo-Triassic Mercia mudstone and clay shales (described as Keuper Marls by Findlay 1965 (Ref 13.25)). Wetness Class IV.
- **Huntworth Series:** Reddish brown, freely draining and non-calcareous, sandy loam and sandy clay loam soils developed over Permo-Triassic Mercia mudstone and clay shales (described as Keuper Marls by Findlay 1965 (Ref 13.25)). Wetness Class I or II.

iii. Geographical Distribution of Soil Types

13.5.11 The geographical distribution of these soil types is provided in **Figure 13.2**.

13.5.12 The northern and southern parts of the site, including the BDAW and the BDAE, and the major part of the SCPA consist of soils of the Evesham Soil Series. These slowly permeable soils require artificial drainage to enable cultivation. They can be subject to seasonal waterlogging which can result in poaching if livestock are grazed on the land in early spring or late autumn.

13.5.13 The Holford Stream valley in the SCPA consists of alluvial and colluvial gley soils of the Butleigh Series. In this location, these soils have high groundwater levels, seasonal flood risk and, in places, are intensely gleyed. Cultivation is dependent on artificial drainage and soil damage and poaching can result from use of equipment or stocking in early spring or late autumn when the soil is wet.

13.5.14 There are two small areas of silty clay Worcester Soil Series in the western part of the site, picking out an area of easily weathered and eroded Mercia mudstones.

13.5.15 The northern part of Bum Brook valley in the southern part of the SCPA consists of re-deposited soils of the Compton Series which, in this location, are seasonally waterlogged and, in places, intensely gleyed, requiring artificial drainage to enable cultivation.

13.5.16 Huntworth soils only occur in the location of the proposed emergency access route, on the southern boundary of the site at Shurton village.

iv. Drainage, Moisture Status and Soil Wetness Class

13.5.17 The drainage and wetness characteristics of soils and their ability to retain soil moisture during the growing season are described in terms of their Wetness Class (WC). The range of WC grades used in soils in England and Wales is provided in **Appendix 13B**.

13.5.18 The Soil Survey of England and Wales describe soils of the Evesham 2 Association (described as Evesham Soil Series, Ref. 13.15) as:

> *"…slowly permeable soils which are subject to winter waterlogging. Evesham 2 soils are well-structured and respond well to artificial drainage (Wetness Class II or III). Evesham 2 topsoils are difficult to cultivate and can only be satisfactorily worked over a narrow range of moisture content, so timeliness is essential. There are few opportunities for landwork in spring, especially in wet years, and the soils are best cultivated in autumn and sown to winter crops. Winter cereals, particularly wheat, and grass are the main crops. Some oilseed rape is grown as a break crop. Grass yields are limited by droughtiness and the appreciable poaching risk reduces the safe grazing period".*

13.5.19 Described as WC II-III (see **Appendix 13B**), Evesham 2 soils can be waterlogged within 70cm of the surface for up to 180 days per year, thus limiting the season of soil workability.

13.5.20 The Soil Survey of England and Wales (Ref 13.15) describes the Worcester Association (described as the Worcester Soil Series by Findlay (1965) (Ref. 13.25)) as:

> *"….normally seasonally waterlogged (Wetness Class III) but on slopes greater than 11 degrees this may be reduced to Wetness Class II. The slowly permeable subsoils cause rapid winter run-off. These soils benefit from drainage measures but they compact easily so careful management is needed if improvements in soil water regime are to be maintained"*

13.5.21 The Butleigh Soil Series is described by Findlay (1965) (Ref. 13.25) as:

"…found on flat or gently sloping land which receives drainage waters from adjoining high ground in winter but is rarely flooded. The internal drainage is slow and a zone of permanent waterlogging may be present below 3ft (approx 900mm)".

13.5.22 The Compton Soil Series is described by Findlay (1965) (Ref. 13.25) as:

> *"…occurring at the foot of steep slopes where downwash rests on estuarine clay or peat at depths normally in excess of 3ft (approximately 900mm). Where peat is shallower, surface mineral soils become more intensely gleyed."*

13.5.23 The soil Wetness Classification was not in use at the time of the Findlay study (1965) (Ref. 13.25). However, the location of both Butleigh and Compton soils in the lower parts of the Holford Stream and Bum Brook valleys contributes to their seasonal wetness and both soils are gleyed in subsoil and often in topsoil horizons. Both poorly drained soils would be classified as WC IV under today's classification (**Appendix 13B**).

13.5.24 The Huntworth Soil Series is described by Findlay (1965) (Ref. 13.25) as:

> *"Gravelly deposits...are found around the Quantock Hills....and on the north side of the hills between Holford and Stogursey. (Huntworth soils are)...coarse textured…free draining and do not appear to include much clay.... The gravels occur on flat land or on gentler slopes at various levels between 50 and 150ft".*

13.5.25 As explained above, soil Wetness Classification was not in use at the time of the Findlay study (1965) (Ref. 13.25). The coarse texture and freely draining status of Huntworth soils would cause them to be classified as WC I or II under today's classification (**Appendix 13B**).

13.5.26 The four main soil types within the site (Evesham, Worcester, Butleigh and Compton) are vulnerable to damage at certain times of the year because they are workable only within a narrow moisture range, hence winter working under wet conditions is likely to cause compaction and damage to soil structure.

13.5.27 The distribution of Compton soils within the site is limited to the very southern boundary of the site. These soils north of Shurton have been identified as being 'teart' soils, showing higher than normal concentrations of molybdenum, which can lead to toxicity in cattle grazed on herbage from these soils. No local evidence of this effect has been identified for the study area.

d) Land Use

i. Land Use Description

13.5.28 The site is generally open countryside, primarily in agricultural use (mixed pasture and arable) with some areas of woodland. Adjacent land use to the south and west is also primarily agricultural. Within the BDAW, there are three derelict barn buildings, indicating the past agricultural use of the site (see **Volume 2**, **Chapter 23** on Historic Environment).

13.5.29 The topography of the site consists of undulating countryside, terminating at the Severn Estuary to the north at a natural cliff line which descends to a shingle beach and wave cut platform. The topography is generally typical of that in the wider locality, with the exception of the BDAE where the topography has been influenced by a number of man-made features.

13.5.30 Within the BDAW and the SCPA are a series of east-west trending ridges and depressions. The lowest terrain within the site is formed by an east-west trending linear depression which runs along the boundary between the BDAW and the SCPA. The base of the depression is occupied by Holford Stream. North of this depression, within the BDAW, the ground rises sharply towards the Green Lane ridge. An agricultural access track runs east to west along the ridge.

13.5.31 There are a series of agricultural drainage ditches present within the site, running along field boundaries. Two surface drainage features are present within and adjacent to the BDAW. Site reconnaissance has confirmed these water features serve as agricultural drainage ditches which are typically ephemeral (i.e. seasonally dry) (see **Chapter 16 of this volume**). Agricultural land drains are in place at two locations within the BDAW. The indicative locations of these are shown in **Appendix 13D**. There is no connectivity shown between these drains and land drains within adjoining agricultural land outside the site.

ii. Historic Land Use

13.5.32 A review of historical maps and plans included within the reports described above has identified that both the BDAW and SCPA have remained as greenfield agricultural land since the earliest available map was published in 1886. Agricultural buildings are likely to have been associated with this historic agricultural land use. Within the SCPA, Corner Farm was on-site from 1886 but had been removed by 2002. Within the BDAW, Benhole Farm was located on the north-western corner of this land parcel until around 1976 when it was demolished to leave a single remnant outbuilding which is still present on-site, along with two other derelict farm buildings.

13.5.33 The BDAE comprised greenfield, predominantly agricultural, land until 1957 - 1958 when sewage works, a hostel and a fabrication and construction area was constructed in the north eastern part of the area, during the construction of Hinkley Point A. Further development and changes of land use continued thereafter including construction of a small sewage works at the western boundary in 1968. Also, during the construction of the Hinkley Point B nuclear power station an accommodation/construction camp and fabrication area with associated electrical substations were developed on the southern section of the area, and surplus spoil from the construction was deposited in the centre of the area. A former licensed waste management facility (NDA temporary spoil storage area) was also present. Other non-agricultural land use included vehicle storage areas and the creation of a visitor's centre. As a result of these land use activities, this area is categorised as Non-Agricultural land. Infilled ponds potentially present within the BDAE and elsewhere across the site are discussed **Chapter 14 of this volume.**

13.5.34 The improved grassland areas within the BDAE area are grazed annually. Other areas are maintained in Good Agricultural and Environmental Condition (GAEC).

13.5.35 Land use surrounding the site has remained predominantly agricultural with the exception of the existing Hinkley Point Power Station Complex to the east.

e) Agricultural Land Classification (ALC)

13.5.36 In order to assess the impacts of the development on soils and land use, the baseline soil conditions and land use on and around the site have been assessed. The ALC was assessed through site survey (ALC Survey Reports by Reading Agricultural Consultants (RAC) Ltd. 2009 and 2010 (**Appendix 13A**).

13.5.37 The methodology for determining ALC, combines the results from the soil surveys (see **Appendix 13A**) with topographic data and long-term averaged climate data of the study area, obtained from the Meteorological Office (1989) (Ref. 13.23).

13.5.38 The 2010 ALC report (**Appendix 13A**) assesses both the potential of the land for agricultural use and its soil quality. In summary, most of the land forms an undulating plain with an overall fall to the north. There is a series of parallel east-west ridges with a south-facing scarp face forming the northern side of the Holford Stream valley. Soils in the northern part of the site have generally good drainage (wetness class WC I), with some areas of imperfect drainage (WC III) where there is underlying clay. Soils in the southern part of the site mainly lie on the valley interfluve and exhibit variable wetness characteristics ranging from moderately well to imperfectly drained (WC II-III). The valley bottom soils are affected by a high water table and act as a receiving site for local rainfall. These soils are poorly drained (WC IV). These WC findings differ from those described in the SSEW 1:250,000 mapping (Ref. 13.15) due to the much greater degree of detail provided by the ALC fieldwork.

13.5.39 Published broad scale mapping of agricultural land quality (ALC status), at a scale of 1:250,000, taken from the MAGIC website (Ref. 13.16), indicates the entire site and most of the surrounding land as being of Grade 3, but this is not subdivided into Grades 3a and 3b. This grade split is the divide between what Government policy defines as best and most versatile (Grades 1, 2 and 3a) and agricultural land of only moderate quality (Grade 3b). There is a small area of Grade 4 land to the south and east of the Hinkley Point B nuclear power station. Field survey results of ALC conditions (see **Appendix 13A**) indicate that the principal constraints to agriculture within the site are:

- seasonal soil wetness, from soil profile impermeability and the presence of heavy textured impermeable layers in soil profiles, exacerbated by the slightly longer than average field capacity period of 167 days in an average year, which combine to limit soil workability and the opportunity days for land works;
- superficial stoniness, often associated with shallow soil depth, which makes cultivation, seed-bed preparation and seed sowing difficult;
- locally steep gradient, often associated with an uneven land form in some fields and occasional rock outcrops, which hinder cultivation;
- cumulative wetness in the Holford Stream valley, which is a receiving site, causing prolonged wetness which seriously limits soil workability and the opportunity days for landworks; and
- exposure to strong winds, sometimes salt-laden, which may damage crops.

13.5.40 The distribution of surveyed ALC grades across the site is illustrated in **Figure 13.3**.

13.5.41 The range of arable cropping is considered to be restricted to autumn-sown cereal and oilseed rape crops, or grass. The steep south-facing scarp to the north of the

Holford Stream valley has gradients in excess of 7°, which limit the land quality to Subgrade 3b, and gradients in excess of 11°, but less than 18°, limit the land quality to Grade 4. The downgrading is based on the hazardous nature of operating agricultural equipment on steep slopes.

13.5.42 The areas occupied by the various ALC grades for the site are given in **Table 13.3** below (adapted from the RAC ALC Report 2010 (**Appendix 13A**)).

Table 13.3: Agricultural Land Classifications (ALC) for the Study Area

Grade	Description	Area (ha)	Area (% of agricultural land)
Subgrade 3a (Best and most versatile)	Good quality	19.8	14
Subgrade 3b	Moderate quality	102.6	73
Grade 4	Poor quality	18.8	13
Total Agricultural		141.2	100
Non-agricultural land		30.2	
Total Land		171.4	

Note: The total land excludes the foreshore over required for the construction of the seawall.

13.5.43 Approximately 73% of the surveyed land is classified as Moderate Quality Agricultural Land (ALC Subgrade 3b). 14% of the surveyed agricultural land on-site is ALC Subgrade 3a which falls within the category of BMVL (ALC Grades 1, 2, and 3a). This band of Subgrade 3a, good quality agricultural land, crosses the southern part of the BDAW. The remaining 13% is Poor Quality (ALC Grade 4) land.

13.5.44 In the wider context, **Figure 13.4** illustrates the distribution of ALC Grades across Somerset and **Table 13.4** provides approximate total areas of ALC Grades across Somerset, based on ALC data provided by Natural England from their Geographical Information System (GIS).

Table 13.4: Agricultural Land Classifications (ALC) for Somerset

ALC Grade	Approximate Area (ha)
Grade 1	9,342
Grade 2	33,365
Grade 3 (undifferentiated)	204,108
Grade 4	61,706
Grade 5	22,712
Non-Agricultural	6,572
Urban	6,653

f) Agricultural Activity and Crops

13.5.45 With the exception of the BDAE, historic and current land use within the site is primarily agricultural, comprising arable (including oil seed rape and wheat) or grazing use. Some areas of land are non-farmed woodland and scrub habitat. There are small areas of non-farmed grassland alongside ditches and along cliff tops. Hedgerows and fences form field boundaries.

13.5.46 Incidental field observations made during 2008 noted fields within the site planted with oil seed rape and wheat, with smaller areas used for hay production and grazing. Plates which illustrate the agricultural activity taking place across the site are provided in **Appendix 13E**.

i. Built Development Area West (BDAW)

13.5.47 Approximately a fifth of the BDAW, amounting to approximately 15ha, consists of permanent pasture and the rest (approximately 60ha) is arable, primarily cereals (wheat). There are three fields in this part of the site which are permanent grassland, with only the two inland fields being used for cattle grazing (see **Plates 13.E1** and **13.E3**, **Appendix 13E**). Permanent grassland in the field along the cliff top (**Plate 13.E2, Appendix 13E**) appears to have been re-sown with a grass and wildflower seed mixture approximating National Vegetation Classification (NVC) MG6c.

13.5.48 Between Green Lane and the topographic ridge which runs west to east through this part of the site, the arable fields were planted with oil seed rape in 2008 and wheat in 2009. The western area of this part of the site was planted with wheat in 2008 (**Plates 13.E4** and **13.E7, Appendix 13E**) and oil seed rape in 2009.

ii. Built Development Area East (BDAE)

13.5.49 The whole of the BDAE, excluding the existing car park, is included in the Hinkley Point CWS and consists of areas of pasture for cattle grazing, mixed deciduous woodland and overgrown, scrubby hedgerows.

iii. Southern Construction Phase Area (SCPA)

13.5.50 As for the BDAW, the SCPA, south of Green Lane, consists of a mosaic of land used for oil seed rape or wheat (approximately 40ha), with permanent grassland (approximately 15ha) in Holford Stream valley which is used for cattle grazing and grass conservation (hay or silage) (**Plates 13.E5** and **13.E6, Appendix 13E**).

iv. Land Use in Somerset

13.5.51 This section provides a comparison of the areas of agricultural land uses within the site with the areas of those land uses recorded across the whole of Somerset in the 2010 Defra census which was carried out in June, 2010 (Ref. 13.21).

13.5.52 The total area of permanent pasture within the site is approximately 30ha. The total area of permanent pasture in Somerset recorded in the 2010 Defra census was 153, 593ha. Permanent pasture within the development constitutes approximately 0.02% of the pasture land in Somerset.

13.5.53 The total area of arable land (primarily wheat or oil seed rape) within the site is approximately 100ha. The total area of wheat in Somerset recorded in the 2010 Defra census was 24,277ha. If it is assumed that all of the arable land within the site is wheat, it would constitute approximately 0.4% of the area of wheat in Somerset.

13.5.54 The total area of oil seed rape in Somerset recorded in the 2010 Defra census was 4,340ha. If it is assumed that all of the arable land within the site is oil seed rape, it would constitute approximately 2.3% of the area of oil seed rape in Somerset.

13.5.55 The total area of farm woodlands within the site is approximately 3.6ha. The total area of farm woodland in Somerset recorded in the 2010 Defra census was 7,994ha. The area of farm woodland within the site constitutes approximately 0.05% of the area of farm woodlands in Somerset.

g) Agri-environment Schemes

13.5.56 Land that is part of an agri-environment scheme is shown indicatively in **Figure 13.5**.

i. Built Development Area West

13.5.57 The majority of the land in the northern part of the BDAW, (approximately 37ha) is part of a Countryside Stewardship Agreement with the site freeholder. There is also a strip of land, consisting of four fields, running along the northern part of the Holford Stream valley which belongs to an existing Countryside Stewardship Agreement (approximately 17.9ha). There is a total of approximately 54.9ha of land within Countryside Stewardship Agreements in the BDAW. These agreements would end prior to any construction activities commencing.

ii. Built Development Area East

13.5.58 Land immediately west of HPA nuclear power station in the BDAE (approximately 13.8ha) is the subject of an entry level Environmental Stewardship Agreement (see **Figure 13.5)**.

13.5.59 This agreement would end prior to any construction activities commencing.

iii. Southern Construction Phase Area

13.5.60 All but one of the fields within the SCPA, which includes the southern part of Holford Stream valley (approximately 61.5ha), is the subject of an entry level Environmental Stewardship Agreement. This will end prior to commencement of any construction activities on site.

iv. Agri-Environment Schemes in Somerset.

13.5.61 According to Natural England, the total number of agreements and the total area of land in Countryside Stewardship Schemes or entry level Environmental Stewardship Schemes in Somerset (as July 2011) is as follows:

- Total Entry Level Environmental Stewardship Schemes – 1,128 agreements, amounting to 88,406.8ha of land.
- Total Countryside Stewardship Scheme – 211 agreements, amounting to 6,113.2ha of land.

13.5.62 The amount of land under Entry Level Environmental Stewardship Agreements within the site is approximately 0.09% of the land under such agreements in the whole of Somerset. The amount of land under Countryside Stewardship Agreements within the site is approximately 0.9% of the land under these types of agreements in the whole of Somerset.

h) Agricultural Field Drainage

13.5.63 Two areas within the site are known to have existing agricultural field drainage systems. These areas are illustrated in **Appendix 13D**. The date and type of drainage is unknown.

i) Common Land

13.5.64 There are two small areas of Common Land which lie adjacent to the SCPA (**Table 13.6**). Both of these fields are permanent pasture land. Both are excluded from the HPC site. Since they are within 100m of the site boundary, and hence within the study area for this chapter, they are included in this impact assessment.

j) Invasive and Alien Weed Species

13.5.65 Invasive weed species such as Japanese knotweed *Reynoutria japonica* and ragwort *Senecio jacobea* are not currently considered to be widespread or invasive within the site. The baseline habitat surveys for the site (see **Volume 2, Chapter 20** on Terrestrial Ecology and Ornithology) have not recorded any presence of Japanese knotweed for example and, although these surveys were not primarily concerned with identifying invasive species, the presence of such species would be recorded if observed in the course of survey.

k) Animal Health and Animal Burial Pits

13.5.66 The Animal Health Division of Defra has been consulted about the potential presence of any animal burial pits relating to foot and mouth or other disease outbreaks (**Appendix 13F**). No such pits are recorded within the site.

13.5.67 It should be noted that burial pits were not registered before 1972, and individual animals could still be buried without registration up to the early 1990s. However the potential for unrecorded burials being present within the site is unlikely.

l) Summary

13.5.68 With the exception of the BDAE, historic and current land use within the site is primarily agricultural, comprising arable (including oil seed rape and wheat) or grazing use. Some areas of land are non-farmed grassland, hedgerow, and woodland and scrub habitat.

13.5.69 The majority of the surveyed agricultural land within the site (86%) is classified as Moderate or Poor quality land. A smaller proportion (14%) of the land is classified as BMVL (ALC Grad 3a). Much of the land within the site is under agri-environment schemes.

13.5.70 Approximately two thirds of the land within the site is part of an agri-environment scheme which will end prior to commencement of any construction activities on site.

13.5.71 The value/importance of the agricultural land within the site is considered to be low/medium overall, due to the presence of agri-environment schemes, but with the agricultural land classification being predominantly Subgrade 3b.

13.5.72 The land immediately adjacent to and within 100m of the site is also predominantly agricultural, but also includes two small areas of Common Land, a very small part of the Hinkley Point A power station site, a small section of the C182 road and a small part of Shurton village.

m) Receptor Value and Sensitivity

13.5.73 The baseline section has identified six types of soil, land use and agriculture receptors which could potentially be impacted by the proposed development. This section summarises the value and sensitivity of these site-specific receptors.

13.5.74 The approach to determining the sensitivity or value of the soil, land use and agricultural receptors is described in Section 13.3. The sensitivity or value of soil, land use and agricultural receptors at the site is summarised here (**Table 13.5**) in order that impact magnitude and, hence, significance can be assessed in a consistent way.

Table 13.5: Summary of Receptor Sensitivity/Value

Receptor	Sensitivity/Value	Comment
Agricultural potential (via ALC) On-site and off-site land	Medium	Determined in relation to the potential of the land, in terms of its ALC, for productive farming activity.
Soil quality (i.e. vulnerability to damage) On-site and off-site soils	High	Determined in relation to identified soil type and wetness class and vulnerability to being damaged through physical disturbance during ground preparation activities. Soils on site are considered to be vulnerable to structural damage as a result of trafficking, stripping, and handling.
Agricultural crops Off-site crops and grassland	Medium	Determined in relation to the ALC grade of the land and the crops/grassland generally present.
Agricultural stock, and pets (dogs etc.) Off-site grazing animals	High	Determined in relation to the sensitivity of stock and (potentially) household pets to diseases from disturbed animal burial pits.
Agricultural field drainage and drainage ditches	High	Determined in relation to the need to maintain continuity and efficacy of drainage systems in adjacent (off-site) agricultural fields.
Common Land off-site*	Medium	Determined in relation to the ALC grade of the land and the grassland present.

** Value of Common Land in relation to amenity and recreation is assessed in Chapter 25*

13.6 Assessment of Impacts

a) Introduction

i. Development Description Relevant for Soil Impact Assessment

13.6.1 A description of the HPC development is provided in **Volume 2**, **Chapter 2**.

13.6.2 Earthworks are required to prepare the site for the construction of the proposed new power station and will primarily involve the creation of a series of level platforms for the built development and for construction activities (e.g. materials, plant and equipment lay down and contractor's compounds). A description of the site preparation works is provided in **Appendix 1** of **Annex 2.**

13.6.3 It is estimated that during the site preparation earthworks, which are required principally to form the construction and development platform, approximately 2.3 million m^3 of material (un-bulked) will be excavated, of which (according to current best estimates), approximately 234,000m^3 would be topsoil and an equivalent volume of subsoil. Volumes of excavated soils are slightly higher than the estimates presented in the Site Preparation Works Planning Application and supporting Environmental Statement submitted to WSC in November 2010. The soil volumes in this document are the result of more detailed site knowledge of soil depths and conditions while soil volumes provided in the ES for the Site Preparation Works were based on calculations to inform the overall bulk earthworks appraisal of materials cut and fill balancing.

13.6.4 The topsoil and subsoil volumes provided above represent the scenario in which subsoil and topsoil would not be stripped from beneath materials stockpiling areas in the SCPA or under the western bund. Volumes for this scenario have beens calculated to ensure that sufficient space is reserved for appropriate stockpiling of topsoil and subsoil materials which are destined for re-use in landscape restoration post-construction. A significant area of land would be required in order to stockpile excavated soil and rock materials and land south of Green Lane (the Southern Construction Phase Area (SCPA)) has been proposed for this purpose. This enables the earthworks balance to be maintained within the HPC development site and ensure that materials are retained on site. As part of the site preparation works, it is proposed that Holford Stream would be culverted and suitable fill material used to infill Holford Stream valley. The resulting platform would be used for materials stockpiling as illustrated in the phasing plans presented in the **Construction Method Statement** (see **Annex 2**).

13.6.5 The HPC development site is approximately 175ha, of which approximately 105ha would be required only temporarily during the construction and hence would be restored to agriculture, woodland or ecological habitat post-construction. Topsoil and subsoil stripped and stockpiled during site preparation works will be re-used in the early and final landscaping, details of which are presented in the **Landscape Restoration Plan (see Chapter 2 of this volume)**.

13.6.6 Key considerations relating to soil stripping and stockpiling are listed below (see **Appendix 1** of **Annex 2** of the ES**):**

- an assessment of the thickness of soils has been derived from extensive site investigation works and for the calculation of topsoil volumes to be stripped and stockpiled, an average depth of 250mm has been assumed;
- topsoil will be stripped and stockpiled separately from subsoil;
- subsoil, where it is assessed as being suitable quality for reuse in restoration post-construction, will stripped and stockpiled separately from unsuitable 'overburden'; and
- soils beneath materials stockpiles in the SCPA will not be stripped. Post construction, when the final topographic surfaces are prepared for landscape restoration, a rigorous programme of soil restoration will be implemented which

will include deep ripping of areas where overburden or subsoil is compacted, prior to soil profile reconstruction.

13.6.7 This impact assessment acknowledges that given the large volumes of soil materials that will be moved and stored during the construction phase of the development, a robust plan is required to manage and conserve these soil resources in a suitable condition for re-use in restoration of the non-developed parts of the site post-construction.

13.6.8 Accordingly, a **Soil Management Plan** (**SMP**) (see **Annex 3**) has been prepared for the HPC development to address both standard good working practices and site-specific mitigation measures.

Soil Stripping and Stockpiling

13.6.9 Stockpiling of stripped soil will take place in the SCPA, south of Green Lane; some soil being used to create a bund along the western. Stockpiling will be restricted to land to the north of the southern main construction fenceline. The volumes of topsoil and subsoil to be stripped and stockpiled are described above and in **Appendix 1** of **Annex 2** of the ES. Earthworks associated with the site preparation works are projected to commence in early in 2012, with soil stripping being undertaken during the earthworks.

13.6.10 Topsoils and subsoils will be segregated during stripping and stockpiling into the following three soil resources:

- topsoil (comprising agricultural grassland and woodland);
- subsoil (comprising agricultural, grassland and woodland); and
- alluvium (wet grassland topsoil and subsoil mixed, where available).

13.6.11 Land in the BDAE will be used for construction of HPC. Accordingly there will be no land in this part of the site to restore after construction. Soils stripped from the BDAE will be stored separately in the stockpile area reserved for overburden.

13.6.12 The plan to select the above three soil types for segregated stripping and storage is designed to ensure that sufficient appropriately stored soils is available for agricultural land and ecological habitat creation during land restoration after the construction of the HPC development has ended.

13.6.13 Since larger areas of semi-natural and calcareous grasslands, and woodland habitats are proposed post construction (as detailed in the **Landscape Restoration Plan**) than currently exist on site, nutrient-poor subsoils will also be used to create future topsoils for calcareous and neutral grasslands.

ii. Introduction to Impact Assessment

13.6.14 This chapter assesses those aspects of the HPC development which have the potential to cause adverse impacts upon soil, land use and agricultural receptors within the study area, including:

- temporary and permanent loss of agricultural land;

- damage to in-situ soils (impacts on soil quality and profiles) due to trafficking, handling and storage associated with vegetation removal, soil stripping and landscape restoration activities;
- damage to soils and agricultural land within the study area which are adjacent to the site, but are off-site, due to soil erosion, surface runoff or dust deposition;
- loss of land currently managed under Countryside Stewardship Agreements and Environmental Stewardship schemes;
- disruption of agricultural field drainage systems; and
- spreading of noxious weeds and/or diseases.

13.6.15 Potential soil, land use and agricultural receptors have been identified in accordance **Table 13.5** as follows:

- medium quality agricultural land both on and off-site;
- good quality soil both on and off-site;
- agricultural crops and pasture off site;
- common land adjacent to the site;
- agri-environment schemes;
- agricultural field drainage systems both onsite and adjacent to the site; and
- health of agricultural stock and domestic pets.

13.6.16 The proposed works and potential soil, land use and agricultural impacts are discussed below. As a precautionary approach to the impact assessment, where more than one receptor value or sensitivity is considered relevant, the higher or more sensitive score is used in the significance assessment to ensure that the 'worst case' is assessed.

13.6.17 Impacts are assessed in relation to the construction, operational and landscape restoration phases of the HPC development, identified soil, land use and agricultural receptors and relevant legislation and policy as described in section 13.2. Hence, for example, impacts affecting BMVL (Grades 1, 2 and 3a), soil quality, agri-environment schemes and animal health are considered in line with PPS7, the West Somerset Local Plan (2006) 'saved' Policy A/2, the Environmental Stewardship (England) Regulations (2005) and the Countryside Stewardship (Amendment) Regulations (2000). The potential for construction activities, particularly the ground preparation works, to cause a breach of the Wildlife and Countryside Act 1981 (as amended) in relation to the spread of noxious and invasive weeds is also assessed.

13.6.18 The following impact assessment has been undertaken assuming legislative compliance and the adoption of standard good working practices.

b) Off-site Highway Improvements

13.6.19 An assessment has been undertaken for all 11 proposed schemes in relation to soils and land use. None of the highway improvements would result in the loss of any agricultural land, however a number of the highway improvements have the potential for loss of a very small area of urban green space and urban trees. These are as follows:

- Wylds Road/The Drove: Two very small areas of green space with trees would be lost – one area of trees screening a warehouse and one screening a car park.
- Bristol Road/Wylds Road: It is possible that two very small areas of urban trees would be lost – one screening a car park and one screening a car park and series of warehouses.
- Huntworth Roundabout: A very small area of existing roadside verge with semi-mature trees would be lost as a result of proposed road widening. This amounts to an extremely small part of an existing block of roadside woodland.

13.6.20 The implications of these changes in land use are considered in terms of (a) ecology and (b) recreation and amenity in **Volume 2**, **Chapters 20** and **25** respectively.

13.6.21 As the highway improvements do not affect either agricultural land or agricultural soils, they are scoped out of further assessment in this chapter.

c) Construction Impacts

13.6.22 Activities during the construction phase with the potential to cause adverse impacts on soils and land use primarily occur during the early site preparation works and include: the vehicle and plant activities associated with removal of trees and hedgerows, and erection of perimeter fencing; and soil stripping and soil stockpiling. Other activities, during the construction phase include bulk earthworks, deeper excavations, construction of haul roads, site compounds, site access road and roundabouts, sea wall and main HPC construction; these will take place after vegetation clearance and topsoil stripping. Therefore, there would be no adverse impacts on soils and land use related to these activities in addition to those arising during the early site preparation works.

i. Temporary and Permanent Loss of Agricultural Land within the Site

13.6.23 Land take during construction will involve both permanent and temporary loss of agricultural land and changes in cropping and farming activity.

13.6.24 The majority of construction related land use impacts will involve direct land take and loss of agricultural land within the site. The majority of the changes to current land use and agricultural activity within the site arising as a result of construction are likely to be permanent or at least long-term over the lifetime of the facility, as a large proportion of the area will be occupied by the permanent HPC development. Some land take impact will be medium term during the construction period, with land required on a temporary basis to accommodate the construction activities and then restored post-construction. Of the total site area (approximately 175ha), 67.5ha of land will be permanently lost as a result of the development. Post-construction, approximately 105ha of land will be restored (as described in the **Landscape Restoration Plan**) to arable agricultural land, grassland, woodland and scrub, hedgerow and wetland habitats.

13.6.25 Vegetation clearance and ground preparation works will result in the loss of and changes to existing agricultural land use. The impact will be site-specific, adverse, largely long-term or permanent, and direct. The spatial extent is likely to cover all, or a significant proportion of, the site. The likelihood of this occurring is certain.

13.6.26 Soil (topsoil and subsoil) stripping and storage will cause a loss of soils and loss of land with potential for agricultural use. The stripping of topsoil directly affects some land areas defined as BMVL (Grade 3a) within the BDAW and is a material consideration of the sustainability of development proposals (paragraph 28 of PPS 7) (Ref. 13.6). This is in line with the Government's expectation that a "high level of protection" is to be afforded to all natural resources (guidance contained in PPS1 (2005) (Ref. 13.27) on sustainable development). The HPC development directly or indirectly affects 19.8ha of land defined as best and most versatile land (Grade 3a) (**Table 13.3**), based on ALC survey **Appendix 13A**). The 19.8ha of Grade 3a land equates to 14% of the total area of surveyed agricultural land affected within the site.

13.6.27 Of the 19.8ha of BMVL, only 9.7ha would be permanently lost as part of the footprint of HPC development. The remaining 10.1ha would be taken out of agricultural use temporarily during the construction phase and restored to agricultural land of the same ALC Grade post-construction.

13.6.28 ALC data made available from Natural England does not differentiate between Grades 3a and 3b, hence the total area of Grade 3a land across Somerset cannot be determined. However, from **Table 13.3** and **Table 13.4**, and **Figure 13.4**, it can be seen that the amount of Grade 3a and Grade 3b land directly impacted by the development, both temporarily and permanently (122.4ha), is an extremely small proportion of the overall available Grade 3 (undifferentiated) agricultural land in Somerset – that is as a worst-case less than 0.06% of Grade 3 land in Somerset. However, it should be noted that PPS7 promotes the creation of a sustainable countryside framework, and places less emphasis on the loss of BMVL than the preceding PPG7.

13.6.29 Using the criteria set out in Section 13.3, the agricultural land quality within the site is assessed as medium value/sensitivity due to its grade and extent (**Table 13.5**). The impact of direct land take and removal/storage of soils on agricultural land use and quality is certain to occur, and will be medium/long-term to permanent in duration. The magnitude of impact is assessed as low given the overall area of BMVL affected within the site, and as a proportion of Grade 3 (undifferentiated) land across Somerset as a whole (**Table 13.3** and **Table 13.4** and **Figure 13.4**).

13.6.30 Given that the sensitivity/importance of the receptor is medium, and the magnitude of change is low, the significance of unmitigated land take impact on agricultural soils within the site is assessed as **minor adverse**.

13.6.31 There will be no soil stripping or stockpiling of soil beyond the development site boundary, hence there will be no impact (direct off-site) on agricultural land quality.

ii. Damage to Soil Quality within the Site due to Vegetation Removal

13.6.32 Vehicle and plant trafficking associated with the removal of trees and hedgerows and the erection of perimeter fencing has the potential to damage topsoils through compaction and puddling/smearing if the activities take place when the soil is wet. The heavy clay soils and soil profiles within the site are considered to be a receptor of high sensitivity (**Table 13.5**) because their structure is particularly vulnerable to damage when the soils are wet. Since the vegetation clearance activities will take place around field boundaries, areas of woodland and the entire perimeter of the site, there is potential for soils and soil profiles across the site to be impacted. The impact will be adverse, direct and limited to areas within the site. The likelihood of the impact occurring is considered to be likely. Since trafficking in relation to vegetation clearance activities could occur across the whole site, the magnitude of the impact is assessed as being medium. The significance of the impact is therefore assessed as being **major adverse** without mitigation measures in place.

iii. Damage to Soil Quality and Profiles within the Site due to Soil Stripping

13.6.33 Soil stripping will impact upon soils and soil profiles which are, as indicated above, a receptor of high sensitivity (**Table 13.5**). The impact will arise from damage to soil structure, integrity and profiles during stripping and storage. Since the *in situ* soils are predominantly heavy clays with relatively poor structure, adverse impacts such as soil compaction, loss of soil structure and creation of impermeable soil conditions could occur as soils are excavated, handled and stored for later re-use. As described above, soils of the Evesham 2 Association are vulnerable to damage at certain times of the year because they are workable only within a narrow moisture range.

13.6.34 The impact on soil quality and soil profiles will be limited to land within the site and will be adverse and direct due to the scale of soil stripping, movement and storage that will be required. The spatial extent of the impact is likely to cover all, or a significant proportion of the BDAE and BDAW and will include much of the SCPA where stockpiling will take place. There will be no soil strip or stockpiling or other soil disturbance outside the site, and, hence, there will be no (direct off-site) impact from these activities on soil quality.

13.6.35 The impact on soil quality and soil profiles on site will be site specific, adverse and direct due to the scale of soil stripping, movement and length of storage time that will be required. The spatial extent of the impact is likely to cover all, or a significant proportion of, the site at various times during the construction phase, and will include parts of the SCPA where temporary stockpiling and potentially permanent placement of spoil will occur. These works will disturb soil profiles and, without suitable site specific mitigation, may adversely affect soil quality and its future value as both topsoil and subsoil for re-use. The impact would be both permanent (i.e. topsoil will be removed from areas of the site used for buildings, hardstanding and certain permanent works such as roads) and temporary (i.e. some topsoil will be replaced and re-used over time). The probability of this impact occurring is certain.

13.6.36 The magnitude of impact is assessed as medium given the extent of soils affected. The significance of impact is therefore assessed as **major adverse** without mitigation measures in place via a **SMP**, but this would be at a local geographic scale, i.e. the impact would be on soils within the development site itself.

13.6.37 There will be no vegetation removal, soil stripping or stockpiling or other soil disturbance outside the site, and hence there will be no off-site impacts on soil quality as a result of these ground preparation activities.

iv. Disturbance to Agricultural Crops and Grazed Grassland Off-site, including Common Land

13.6.38 All plants, trees, crops and other vegetation within areas which may be directly affected by the construction works will be removed during the early vegetation clearance activities. As a result there will not be any plants, trees, crops and other vegetation present on the areas directly impacted by the main construction phase.

However, plants, trees, crops and other vegetation will be retained where practicable within areas which are not directly affected by the construction activities.

13.6.39 Farming activity (including crops and other vegetation, and livestock) and Common Land beyond the boundaries of the site could potentially be indirectly affected by disturbance during ground preparation activities, which have the potential to cause dust generation/deposition during earthworks and soil erosion, surface run-off and sediment deposition. Dust can be generated from machinery movements on exposed, dry soils, soil stockpiles and excavation activities. If dust becomes airborne it could be transported and then deposited on nearby agricultural land and potentially taint or adversely affect stock pasture or crops. It should be noted that, due to the relatively short distance that dust will travel before it is deposited, this impact is only a risk to land immediately adjacent to active working locations within the site. These issues are discussed in greater detail in **Chapter 12** of this volume on Air Quality. Such impacts are considered to be unlikely and would be highly localised and restricted to agricultural land and Common Land immediately adjacent to construction areas. Any impacts would also be short-term and reversible.

13.6.40 The proposed site drainage works include the re-routing of existing surface drainage systems, installation of a temporary de-watering system and installation of a deep underground drainage system. Surface water from the working areas will be captured and discharged as part of the temporary drainage of the construction site. During the re-grading of land and bulk earthworks activities there is potential for localised changes to surface water runoff. Within the site, there will be no direct impact on soils and land use as a result of the drainage works, over and above that identified for vegetation and topsoil removal. Temporary construction phase drainage facilities will help to maintain soil contained in stockpiles in a viable condition for re-use.

13.6.41 Off-site farming activity (including crops and other vegetation, and livestock) and Common Land adjacent to the boundaries of the site could potentially be indirectly affected by localised changes to surface run-off (e.g. from terraced areas, haul roads and soils/materials stockpiles). Such impacts would be of very low magnitude and unlikely, since a temporary surface water drainage system, and a **Water Management Plan**, will be put in place (see **Chapter 16** of this volume on Surface Water). If any impact did occur, it would be highly localised and restricted to land immediately adjacent to working areas. These indirect impacts would also be short term and reversible. The value/sensitivity of the receptor (trees, crops and stock off-site) is considered to be a localised receptor of medium sensitivity and hence impact significance is assessed as being **minor adverse** in relation to land off-site adjacent to the site.

v. Disturbance to Adjoining Land from Invasive and Noxious Weed Species

13.6.42 The areas of bare ground created during construction works provide opportunities for colonisation by a variety of plant species, including potentially noxious and invasive weeds. If left uncontrolled, these could potentially spread beyond the site onto adjacent land areas, and cause an offence under the Wildlife and Countryside Act 1981 (Ref. 13.2) (see Section 13.3). It is both a legal requirement and standard construction good practice to implement prevention and control measures to avoid the establishment and spread of invasive and noxious weed species and hence these measures would be implemented as a matter of course. Accordingly, the likelihood of such an impact is unlikely, and due to the pattern of weed dispersal, would affect only very small area of land in close proximity to the site. Such an impact is readily reversible and short-term.

13.6.43 As a result, the potential magnitude of impact of weed colonisation of or spread from stripped areas is assessed as low, affecting the ALC or agricultural land quality of adjacent land. The value and sensitivity of adjacent off-site agricultural land is assessed as medium. The significance of impact on agricultural land quality or potential is therefore assessed, pre-mitigation, as **minor adverse** given the lack of evidence of any existing weed problem within the site.

13.6.44 The movement of plant and machinery on and off-site has the potential to spread or introduce noxious weeds or invasive alien plant species, if carried on tyre treads for example. However, site surveys to date have identified little or no occurrence of invasive weeds, and therefore it is considered unlikely to occur unless through the accidental transport of weed species in association with vehicles and equipment. This impact on agricultural land quality would be applicable only to off-site land adjoining the site (land within the site itself would no longer part of agricultural production) and is assessed as low, but possible without appropriate preventative or control measures in place. The impact significance is assessed as **minor**.

vi. Loss of Land in Agri-environment Schemes

13.6.45 The HPC development will affect land currently managed under agri-environment schemes (comprising Entry Level Environmental Stewardship and Countryside Stewardship Agreements). Land within the site has been acquired for the HPC development and schemes within the site will cease prior to commencement of the HPC construction phase.

13.6.46 This change is not assessed as an impact in this chapter according to the methodology described in Section 13.3, because the land required for the HPC development will already have been taken out of agricultural production prior to the start of the works. The impact on farm economics through loss of grant is assessed in **Chapter 9** of this volume of the ES. Ecological/biodiversity issues associated with changes to agri-environment schemes are addressed in **Chapter 20** of this volume of the ES

vii. Disturbance to Agricultural Field Drainage due to Soil Stripping and Earthworks

13.6.47 During soil stripping and earthworks activities, existing agricultural field drainage systems or drainage ditches within the proposed development area would be disrupted or lost either temporarily, or within the permanent area of construction, permanently. The temporary drainage system for the HPC development will ensure that there is no flooding or waterlogging on site. However, disruption of any agricultural drainage systems which are contiguous with field drainage systems off-site could result in temporary flooding or at least waterlogging of adjacent (off-site) agricultural land. This impact would be direct, localised and reversible, through reinstatement of artificial drainage. The magnitude of the impact is assessed to be low on an agricultural field drainage receptor of high value (**Table 13.5**). The significance of damage to agricultural field drainage systems is assessed as being **moderate adverse** without mitigation measures in place.

viii. Animal Health from Exposed Animal Burial Sites

13.6.48 No records of animal burials are recorded within the site and the potential impact magnitude is assessed as very low. The likelihood of encountering or accidentally disturbing unrecorded old burial pits is considered to be unlikely. The potential impacts on humans should previously unrecorded burial pits be discovered are addressed in **Volume 2, Chapter 14**. With regard to non-human receptors (including livestock, pets and working dogs), the value/sensitivity is considered to be high. Livestock and other animals would not be present within construction working areas, but may be present on public paths and on adjacent farmland, hence there is the possibility (albeit unlikely) of exposure to disease from burial pits should an unrecorded pit be accidentally disturbed during works. The significance of impact is therefore assessed as **minor adverse**.

d) Cumulative Construction Impacts

13.6.49 There will be no site-specific cumulative construction impacts on soil, land use and agricultural receptors.

e) Operational Impacts

13.6.50 HPC will be operational for 60 years. In the early post-construction phase, land restoration will take place on the non-developed footprint. This section addresses the activities during the restoration works which have the potential to cause adverse impacts on soils and land use including: the vehicle and plant activities associated with removal of stored soils from stockpiles and re-placement ahead of land restoration.

13.6.51 On completion of the construction of HPC, the land outside of the permanent development site would be restored as proposed in the **Landscape Restoration Plan**. This would involve the re-use of stored topsoil, subsoil and possibly ‘overburden’ as part of the restoration of land to agricultural use and ecological habitat creation. It is intended that areas of arable agricultural land, calcareous grassland, neutral grassland, scrub, woodland, wetland and hedgerow habitat will be created. Subsoil and topsoil will be replaced in sequence (i.e. subsoil before topsoil) to re-establish natural soil profiles. This will generally involve similar machinery and plant to the earthworks component of the construction phase.

i. Damage to Soil Quality and Soil Profiles within the Site

13.6.52 On-site impacts due to landscape restoration will arise due to the handling and removal of soils from stockpiles, soil transport, deposition and grading on previously stripped areas. Without mitigation in place, the structure and integrity of stored soil and its future value as both reinstated topsoil and subsoil may be adversely impacted due to this handling and movement. Impacts will also arise as a result of tracking of machinery over stockpiles and re-deposited soils, causing localised compaction. The magnitude of impact is assessed as low because soils are being replaced on-site from temporary and artificially created stockpiles and have therefore already experienced a degree of disruption to natural profiles and structure. For the purposes of this assessment the value/sensitivity of the soils is considered to remain as high, despite having been stripped and stored, to reflect the relative sensitivity and vulnerability of these soils to handling and movement. The significance of impact is therefore assessed as **moderate adverse** without mitigation.

ii. Disturbance to Agricultural Land, Crops and Grazed Grassland Off-site, including Common Land

13.6.53 Farming activity (including crops and other vegetation, and livestock), Common Land and soils beyond the boundaries of the site could potentially be indirectly affected by disturbance during restoration works in a similar way to that previously described for the construction phase, with the potential for dust generation/deposition during earthworks and soil erosion, surface run-off and sediment deposition. The impacts would also be short term and reversible. The value/sensitivity of the agricultural receptor plants, including crops and grazed grassland and Common Land off-site is considered to be medium. Indirect dust deposition and runoff impacts are considered to be very low magnitude adverse impacts on a localised receptor and are assessed as being of **minor** significance in relation to land or soils adjacent to the site.

iii. Changes to Off-site Agricultural Field Drainage Systems

13.6.54 Soil handling and restoration of soils and final landscaping works could result in impacts on the field drainage of adjacent (off-site) agricultural land. This impact would be localised and reversible, through reinstatement of artificial or field drainage systems and connections. The magnitude impact assessed to be low on a receptor of high value/sensitivity, and the impact significance is assessed as being **moderate adverse**.

f) Cumulative Operational Impacts

13.6.55 There will be no site-specific cumulative impacts during the landscape restoration and operational phase on soil, land use and agricultural receptors.

13.7 Mitigation of Impacts

a) Introduction

13.7.1 This section describes the proposed mitigation measures to manage and reduce, wherever possible, any impacts on the soil resources and current land uses on-site during the construction operation and post-construction land restoration of the HPC development.

13.7.2 For the purpose of this assessment, mitigation measures have been proposed where there is an adverse impact of greater than minor significance and the impact magnitude, spatial scope and temporal nature make it appropriate to do so.

b) Mitigation of Impacts during Ground Preparation Activities

13.7.3 To protect the physical condition of and reduce disturbance to on-site soils during vegetation removal and fencing activities, an access plan showing permitted routes and working areas will be clearly delimited. This will ensure that compaction by vehicles and equipment of *in-situ* soils is reduced as far as practicable.

13.7.4 The proposed mitigation in relation to impacts on soils, land use and agriculture during the HPC development (particularly in relation to vegetation clearance and soil stripping and stockpiling activities) includes development of a **Soil Management Plan** (**SMP**) (see **Annex 3**). The measures therein and the implementation of the **SMP** are site-specific and area designed to conserve surface soils, both topsoil and subsoil, in a viable condition suitable for re-use during landscape restoration for the creation of a variety of semi-natural habitats and agricultural land uses.

13.7.5 As part of general good working practice, procedures will be implemented as part of the **SMP** for the HPC development to ensure appropriate biosecurity (disease and pest control) and weed control to protect both on-site soils and adjacent land holdings. Standard procedures will be developed in line with Environment Agency guidance to control the spread of invasive/alien plants or disease for example the inspection and cleaning of vehicle and plant wheels and tread, and inspection of any planting material brought in for landscape restoration. In addition, the design includes a wide buffer zone created by a soil bund on the western part of the site (**Chapter 22** of this volume of the ES) which will provide a physical barrier to the dispersal of weeds between the site and adjacent agricultural land to the west.

13.7.6 The restoration of land within the site has been designed for the sustainable re-use of soil. Stripped and stored soil materials will not be wasted and different soil materials will be used to fulfil different functions in landscape restoration.

13.7.7 Measures to manage and treat site runoff, and prevent erosion and dust generation will also be set in place through a series of specific control measures in the **Water Management Plan** (**WMP**) and **Air Quality Management Plan** (AQMP). These are more fully described in **Chapter 16** on Surface Water, and **Chapter 12** on Air Quality.

13.7.8 An outline of the measures that would protect land drainage and underpin the mitigation provided by the **SMP** is set out below.

i. Mitigation for Disrupted or Damaged Agricultural Field Drainage

13.7.9 Ahead of ground preparation works and soil stripping, inspections will be made of agricultural field drainage systems, both on site and adjacent to the site boundary. Inspections will assess whether any connections to adjacent drainage systems exist. If so, plans will be put in place to reconnect and subsequently reinstate (as practical and appropriate) adjacent drainage systems so as to prevent any damage or flooding to off-site receptors from the development's landscape restoration works.

13.7.10 Measures to manage and treat site drainage and run-off and prevent erosion are set out in the **WMP**. This will include any necessary measures to maintain agricultural field drainage function on adjoining land if affected by changes within the HPC development site.

ii. Soil Quality Protection Measures

13.7.11 A number of site-specific measures are required to protect soil quality during soil stripping, handling, transporting, storing, and restoration, including re-use of soils, so as to maintain as far as practicable, soil viability and biological activity.

13.7.12 A **SMP** has been prepared to manage impacts on soil quality as a result of carrying out construction activities on the development site. It includes a number of measures that are set out below:

- measures of *in situ* soil protection ahead of and during soil stripping;
- measures for segregation and separate storage of different soil types, separately from other excavated materials;

- methods of topsoil stockpiling;
- quality control and auditing measures;
- criteria for cessation of works; and
- use of Tool Box Talks.

13.7.13 The detailed implementation of these measures would be developed before, and as, the construction works proceed.

13.7.14 The **SMP** follows Defra's Code of Practice on Sustainable Soils (2009) (Ref. 13.28) and complies with the MAFF Good Practice Guide for Handling Soils by Machine (2000) (Ref. 13.29). The term Soil Management Plan is synonymous with the term 'Soil Resource Plan' which is described in the Defra Code of Practice.

Measures of In-Situ Soil Protection Ahead of During Soil Stripping

13.7.15 Designated routes of access and egress will be put in place during vegetation removal and fencing activities. This will prevent and reduce to an absolute minimum the amount of vehicle and plant trafficking across areas of topsoil ahead of stripping.

13.7.16 Before any soil stripping activities take place, a soil stripping phasing plan will be prepared by the earthworks contractor. The plan will provide timescales and sequencing of topsoil and subsoil stripping for a series of coded compartments and will permit identification and tracking of topsoil and subsoil resources from stripping, through handling and transport to stockpiling and to landscape restoration. It will also ensure that (a) topsoil is stripped ahead of subsoil, (b) soils are stripped in each part of the site ahead of bulk earthworks activities, and (c) access routes and working areas are clearly delimited to ensure that soil compaction on areas not directly involved in the works is avoided. This will minimise the total area impacted and will, as far as possible, protect soil structure so that stripped soils can be used in later landscape restoration.

Measures for Segregation and Separate Storage of Different Soil Types

13.7.17 The soil survey and Site Investigation trial pit logs (see **Volume 2, Chapter 14**) indicate that topsoil depths vary across the different parts of the site. To ensure that the correct depths of topsoils and subsoils are stripped and stockpiled according to the conditions laid out below, guidance for soil stripping would be provided for each section of the site and will be supervised by the EDF Energy Site Environmental Engineer. The sources of all soil stockpiled will be logged as part of the **SMP** auditing process.

13.7.18 There will be separate stockpiling for each of the three soil resources described in Section 13.6. Documentation and control measures will be set in place to prevent accidental mixing and to ensure that soils are segregated according to source location and eventual planned re-use, as required in the **Landscape Restoration Plan**.

Methods of Soil Stockpiling

13.7.19 The viability of soil re-use after storage depends on how appropriately the soil has been stored. Topsoil and subsoil stripping methodologies will be based upon that recommended by Defra (2009) (Ref 13.28). Antecedent weather conditions are critical for this and soil stripping and handling will not take place if there are heavy rainfall conditions which exceed those agreed for cessation of works (see below). Accordingly the **SMP** provides guidance on soil storage, including regular monitoring of stockpile conditions.

13.7.20 Key issues for soil handling and storage are soil moisture and soil consistency (plastic or non-plastic). These characteristics are used to determine appropriate size and height of stockpiles and their method of formation. During the soil stripping activities, this will be determined *in-situ* at the weekly work planning stage, in relation to each geographical part of the site and reviewed daily with adjustments provided by the EDF Energy Site Environmental Engineer.

13.7.21 There will be two principal methods for forming soil stockpiles, based on the soil moisture and consistency of stripped soil:

- **Method 1** will be applied to soil that is in a dry and non-plastic state when stripped. The aim would be to create a large core of dry soil, and to restrict the amount of water that can get into the stockpile during the storage period. Dry soil that is stored in this manner can remain so for a period of years and it is re-useable within days of re-spreading.
- **Method 2** will be applied if the programme or prevailing weather conditions result in soil having to be stockpiled when wet and/or plastic in consistency. This method minimises the amount of compaction, while at the same time maximising the surface area, through the use of windrows, to enable the soil to dry out further. It also allows the soil to be heaped up into a ‘Method 1’ type stockpile, once it has dried out.

13.7.22 Good methods of topsoil stockpiling are required to prevent loss of soil structure and the development of anaerobic conditions. Particular care is required to maintain their viability for future use in restoration. Space has been designated to (a) allow segregation of three different soil materials, (b) allow for sufficient and appropriate soil stockpiling and, should this be necessary, (c) include areas for drying very wet topsoils in windrows before stockpiling to minimise damage to soil structure and viability.

13.7.23 In relation to stockpiling, the Defra (2009) Code of Practice acknowledges that:

13.7.24 “*Stockpile heights of 3-4m are commonly used for topsoil that can be stripped and stockpiled in a dry state but heights may need to be greater where space is limited.*”

13.7.25 Because of limitations on space within the HPC development site it may be necessary for soil stockpile heights in the SCPA to exceed 4m but heights will be minimised as far as is reasonably practicable. The methodology outlined above for soil stockpiling will ensure that an additional height of 1m, for example, would be no more detrimental to soil structure than stockpiling to 4m. Should stockpiling to 5m, for example, be required, a preliminary assessment of visual impact has indicated that there would be no change to views of the site from Shurton.

13.7.26 The general principles in relation to stockpile location and stability are as follows:

- stockpiles will not be positioned within the root or crown spread of trees, or adjacent to ditches, watercourses or existing or future excavations;

- topsoil and subsoil stockpiles will be seeded with a neutral grassland seed mix to maintain slope stability and to prevent erosion or dust generation;
- grass seeded and maintained stockpiles will have a maximum side slope of 1 in 2 (25°); and
- topsoil and subsoil stockpiles will be managed and inspected throughout their lifetime to ensure maintenance of stockpile stability and integrity.

Quality Control and Auditing Measures

13.7.27 The **SMP** will describe the management and documentation for the topsoil stripping and stockpiling process. There will be an associated written procedure and paper trail for each stripped earthworks area/soil type and associated stockpile which would address:

- soil type, depth stripped and source area identifier/location code;
- stockpile location, identifier code and stockpile height;
- stripping and handling method employed (noting any special conditions or measures used in stripping or stockpiling, such as preliminary windrowing to dry the soil or under-drainage); and
- planned and actual restoration or re-use, including proposed location identifier code.

13.7.28 Locations and quality of *in-situ* soils (both topsoils and subsoils), methods of stripping, stockpiling and spreading, location, size and content of stockpiles together with schedules of volumes of each material, expected after-use of each material and identification of the person responsible for supervising soil management during the works will form part of the audit process). It will also include drawings showing areas to be protected from soil stripping activities and showing locations of haul roads, compounds etc.

13.7.29 Stripped and stored topsoil and subsoil will be categorised according to the three separate soil types described in Section 13.6.

13.7.30 In addition, subsoil (described as 'overburden') will be excavated and stockpiled separately. Some of this subsoil material is likely to be required for the recreation of the subsurface parts of soil profiles in certain parts of the site where deeper soil is required. Topsoil and subsoil from the BDAE will be excavated and stockpiled separately.

13.7.31 The **SMP** includes measures to be implemented in the post-construction land restoration phase to ensure soil quality and integrity is maintained during the process of handling and transporting soils and their replacement across the previously stripped areas. This would include matching documented stockpiles to appropriate areas of restoration, defined movement routes for vehicles and machinery to minimise tracking over replaced soils and specific measures for grading and restoration of soils across the site.

Criteria for Cessation of Works

13.7.32 To ensure that soil structure (both topsoil and subsoil) is protected, appropriate weather and soil moisture criteria will be used to provide thresholds beyond which soil stripping, handling and stockpiling activities would cease. These criteria would be agreed with relevant stakeholders by the contractor in advance of any site operations.

Use of Tool Box Talks

13.7.33 Regular Tool Box talks will be used to ensure all site staff are aware of the **SMP** and applicable procures. The Tool Box Talks would be based on guidance provided by Defra:(http://www.defra.gov.uk/environment/quality/land/soil/builtenviron/documents/toolbox-talks.pdf).

c) Mitigation of Impacts during Later Phases of Construction

13.7.34 Once the vegetation clearance and soil stripping activities have been completed across the site, it is not anticipated that further bulk earthworks, terracing, haul road construction, site compound and sea wall construction, drainage, deep excavation or construction of HPC could have any effects on stockpiled soils. Mitigation for stored soils during these activities will include regular inspections of stockpile conditions to check that surfaces are appropriately shedding water, that no soil erosion has occurred and that soils are being maintained in a suitable condition.

13.7.35 Once the soil stripping has been completed across the site, a programme of topographic shaping and landscape planting will take place south of the line of latitude 144750. As part of the topographic re-shaping activities, subsoil and topsoil material from the stockpiles in the SCPA will be moved south of latitude 144750 and used to create the necessary planting conditions for the semi-natural grasslands, scrub and native woodland which will be created in this area.

d) Mitigation of Impacts during Land Restoration of the Non-Developed Footprint

13.7.36 The proposed **Landscape Restoration Plan** will be implemented when the construction phase of works for the HPC development has been completed. This will include the re-use of stockpiled soils and subsoils to create suitable conditions for agricultural land, woodland, calcareous and neutral grassland, scrub, hedgerows and wetland habitats. Good practice regarding soil restoration requires that soils should be returned as closely as possible to their original state after disturbance. Appropriate restoration techniques and the use of well-managed and viable soil materials will mean that site restoration planting establishes more quickly and is sustained.

13.7.37 The origin of stripped soils will be tracked and documented in the **SMP** as part of stripping, handling and stockpiling activities, such that they can be returned to their original locations during the restoration programme. Several areas of agricultural land will be reinstated in the north-west and west of the site (see Landscape Restoration Strategy, **Appendix 13G**). Within these areas the reinstated ALC grades would be the same as those existing prior to the commencement of ground preparation and soil stripping activities.

13.7.38 Excavated subsoil material will be re-used where it is of suitable quality. The methodology for moving soils from stockpiles and re-using topsoil, subsoils and other suitable materials across the site would be set out in the **SMP**.

13.7.39 **Table 13.6** below provides an indication of how soil would be restored in each of the proposed restored land use types in the **Landscape Restoration Strategy**.

Table 13.6: Soil Types and Indicative Depths to be used in the Landscape Restoration Strategy

Restored Land Use	Proposed Restored Topsoil Soil Type and Depth (cm)	Proposed Restored Subsoil Soil Type and Depth (cm)
Agricultural land	20-25 (stockpiled topsoil)	25-35 (stockpiled subsoil and/or ripped subsoil)
Woodland	20-25 (stockpiled topsoil)	25-35 (stockpiled subsoil and/or ripped subsoil)
Calcareous grassland (low nutrient conditions required)	20-25 (stockpiled subsoil)	10-20 (stockpiled topsoil)
Neutral grassland (low nutrient conditions required)	20-25 (stockpiled subsoil)	10-20 (stockpiled topsoil)
Wet meadow	20-25 (stockpiled valley alluvium, where available)	10-20 (stockpiled valley alluvium, where available and/or ripped subsoil)

i. Restoration of Different Land Types

13.7.40 Restoration of agricultural land uses, both arable and grassland, will be achieved using topsoil and subsoil stripped from agricultural and grassland areas of the site prior to construction and replaced to achieve the same soil profile depths and the same ALC Grade as prior to construction.

13.7.41 Creation of woodland, scrub and hedgerows will be achieved in the same manner, using stored topsoil and subsoil as indicated in **Table 13.6** above.

13.7.42 Successful creation of neutral and calcareous grassland habitats requires nutrient poor topsoil conditions to prevent weed competition. This will be achieved by creating the soil profile in these locations using topsoil first and placing stockpiled subsoil on top to create the seedbed.

13.7.43 The creation of wetland grassland will be achieved using stockpiled mixed (alluvial) topsoil and subsoil where available, stripped from areas of wet meadow grasslands in the Holford Stream valley section of the SCPA during the construction phase.

ii. Restoration of Land where Soil is not Stripped

13.7.44 Since areas beneath stockpiles in the SCPA would not have topsoil and subsoil stripped ahead of stockpiling, these areas will be inspected after stockpile removal and any necessary topographic regrading works, to determine what post-removal *in situ* treatment is required to reinstate appropriate soil conditions for agriculture, woodland or ecological habitat creation. Measures available for overburden on subsoil restoration, depending on their state, include:

- removal of any rock, overburden or aggregate residue from stockpiling;
- deep ripping to loosen soil, alleviate compaction and aerate the soil;
- cross ripping to ensure adequate coverage and connectivity between lines of ripping; and
- artificial drainage, should it be necessary to replace any agricultural field drainage and to connect with any adjacent drainage ditches or field drainage systems.

13.7.45 Best results from deep ripping are obtained during dry soil conditions. Accordingly, the ripping activities which precede restoration works will take place during dry Summer months to ensure that restoration is successful.

13.7.46 During the restoration works mitigation is required to reduce damage to soils due to the handling and removal of topsoils from stockpiles, soil transport, deposition, placement and grading on treated and ripped soil areas. Mitigation measures during this phase of work would closely follow those to be used during the initial topsoil and subsoil strip and stockpiling, including the implementation of the **SMP**.

13.7.47 Measures to manage and treat site run-off, and prevent erosion and dust generation during restoration works will also be set in place through a series of specific control measures described in **Chapters 12, 14 and 16** of this volume of the ES and the relevant SSMPs for the restoration works. Procedures will be implemented as part of the **SMP** for the restoration works to ensure appropriate biosecurity (disease and pest control) and weed control to protect both on-site soils and adjacent land holdings during restoration.

13.7.48 Despite deep ripping of *in situ* overburden and/or subsoil prior to site restoration and implementation of methods stated in the **SMP** to ensure correct handing and placement of topsoils, there will remain the potential for soils to be in poorer condition once restored compared to the condition of agricultural soils prior to construction. To ensure that the original soil conditions are correctly achieved, the site will be sown with a hay seed mix and both soil and herbage will be monitored over three growing season to ensure that specified soil and herbage criteria are achieved and that the initial agricultural soil conditions are correctly restored. The monitoring scheme and acceptability criteria are specified in the **SMP**. Should either restored subsoil or topsoil conditions fail to meet acceptability criteria during these three growing seasons, a suitably qualified agronomist will advise on appropriate remedial treatment and further monitoring will be prescribed, until required soil criteria are met and soil conditions are signed off.

iii. Methods and Timescales of Soil Restoration

13.7.49 During land and soil restoration works mitigation is required to ensure that there is minimal damage to soils due to the handling and removal of soils from stockpiles, soil transport, deposition and grading on previously stripped areas. Mitigation measures during this phase of work would closely follow those to be used during the initial topsoil strip and stockpiling, including the implementation of a **SMP**.

13.7.50 The primary objective of agricultural soil restoration is to restore to the same ALC grade in all parts of the site designated for restoration to agricultural land.

13.7.51 The primary objective of soil restoration for ecological areas is to create soil profile conditions suitable for the establishment and long-term sustenance of a functional semi-natural habitat for the following land uses: woodland, wet meadow grassland, calcareous grassland and neutral grassland, as indicated in the **Landscape Restoration Strategy**.

13.7.52 For each restored land use compartment, prescriptions for topsoil and subsoil replacement will be provided in the **SMP**. The soil restoration process will involve a number of stages and activities to recreate the soil profile in each restored compartment of the site. Since the soil types present within the site are heavy clays, soil handling and placement during restoration should be carried out while the soil and weather is dry. These activities will be scheduled to take place during summer and early autumn conditions.

13.7.53 As for the construction works, measures to manage and treat site runoff, and prevent erosion and dust generation during restoration works would also be set in place through implementation of a series of control measures which are described in the **WMP** and **AQMP**.

iv. Soil Monitoring

13.7.54 The SMP includes a soil monitoring programme. The programme of soil monitoring will include the following:

- **Baseline Soil Characterisation**. Testing of soil physical and chemical characteristics on in situ soils ahead of construction commencing to provide a baseline against which restored soil conditions post-construction can be compared.
- **Soil Moisture Testing**. At various stages throughout soil stripping and soil stockpiling, soil moisture testing will be used to inform the methods of stockpiling used.
- **Soil Stockpile Testing**. Testing of soil physical and chemical characteristics in topsoil and subsoil stockpiles immediately before their deployment for restoration activities, to ensure, after prolonged stockpiling, they are still fit for purpose.
- **Testing of in situ Soil Conditions after Restoration**. Testing of soil physical and chemical characteristics on *in situ* restored to determine whether set acceptability criteria have been achieved. Acceptability criteria are based on soil conditions prior to construction.

13.7.55 After restoration, should soil acceptability criteria not be met, methods will be provided in the **SMP** for treating a range of soil physical and chemical conditions, including alleviation of soil compaction, aeration, nutrient additions through fertilizing or nutrient depletion to achieve conditions for ecological habitat creation.

13.7.56 Sufficient time has been allocated for the restoration phase of work to permit *in situ* monitoring of soil conditions within restored areas over a minimum of three growing seasons post-restoration (i.e. during the landscape planting establishment phase). This is considered to be sufficient to ensure that appropriate soil conditions have been achieved and soil restoration criteria have been met.

13.7.57 Procedures would be implemented as part of the **SMP** for the restoration works to ensure appropriate biosecurity (disease and pest control) and weed control to protect both on-site soils and adjacent land holdings during the restoration phase of works.

13.8 Residual Impacts

a) Construction Impacts

13.8.1 Residual impacts, after mitigation measures have been taken into account, relating to soil, land use and agriculture during the construction phase of the HPC development, are summarised in **Table 13.7**. No mitigation is considered to be required for impacts that were assessed as negligible or of minor significance in Section 13.6. In relation to such impacts, where relevant, **Table 13.7** refers to standard good practice measures that would be set in place for the HPC development.

13.8.2 Residual impacts during the construction phase of the HPC development are predicted to be of no greater significance than minor adverse with mitigation measures in place. The identified mitigation mainly relates to potential impacts on soils during soil stripping, movement and storage. Mitigation in relation to these activities, as described in the **SMP**, is considered sufficient to reduce assessed significance from major adverse to minor adverse. The **SMP** as part of the **EMMP** for the HPC development will be a crucial element in ensuring that any residual impacts during vegetation clearance and soil stripping and stockpiling are reduced to an acceptable level.

13.8.3 Plans will be put in place to ensure that connectivity to adjacent drainage systems are appropriately treated so that there would be no on-site or off-site waterlogging or flooding. The design of the proposed development includes provision for temporary (construction phase) drainage management facilities. These will include provision to maintain the field drainage of adjoining land to ensure they are not adversely affected. Together, these measures are sufficient to ensure that there will be no significant residual impacts on field drainage conditions either within or outside the development during the construction phase.

b) Operational Impacts

13.8.4 Residual impacts, after mitigation measures have been taken into account, relating to soil, land use and agriculture during the operational phase of the HPC development, are summarised in **Table 13.7**. No mitigation is considered to be required for impacts that were assessed as negligible or of minor significance in Section 13.6. In relation to such impacts, where relevant, **Table 13.7** refers to standard good practice measures that will be set in place as part of the **EMMP** for the HPC development.

13.8.5 Residual impacts during the operational phase of the HPC development are predicted to be of no greater significance than minor adverse with mitigation measures in place. The identified mitigation mainly relates to potential impacts on soils and agricultural land adjacent to the site. Standard good practice measures are assessed to be sufficient to ensure that there will be no significant residual impacts on soils and land use during the operation of the HPC development.

c) Restoration Impacts

13.8.6 Residual impacts, after mitigation measures have been taken into account, relating to soil, land use and agriculture during the post-construction land restoration works associated with the HPC development, are summarised in **Table 13.7**. No mitigation is considered to be required for impacts that were assessed as negligible or of minor significance in Section 13.6. In relation to such impacts, where relevant, **Table 13.7** refers to standard good practice measures that would be set in place for the HPC development.

13.8.7 Residual impacts during the post-construction restoration phase of the HPC development are predicted to be of no greater significance than minor adverse with mitigation measures in place. The identified mitigation mainly relates to potential impacts on soils during their movement and handling from stockpiles and their replacement during restoration. Mitigation in relation to these activities, as laid out in the **SMP**, is considered sufficient to reduce assessed significance from moderate adverse to minor adverse. The **SMP** for the HPC development will be a crucial element in ensuring that any residual impacts during restoration activities are reduced to an acceptable level.

13.8.8 Post-operation, as part of the restoration of the site to agriculture, field drains will be reinstated within the restored land area as required to ensure adequate land drainage. These will connect with field drains present on adjoining land as necessary to maintain a properly functioning system. As a result of these design features and mitigation measures, there will be no significant residual impacts on field drainage condition within the site or in agricultural fields adjacent to it during the restoration phase.

d) Cumulative Restoration Impacts

13.8.9 Cumulative site-specific impacts have been considered in relation to the effects of restoration activities on soils and land use receptors. As no additional land take is required for the restoration process, and the long-term outcome is considered to be positive in that it will restore land over time to at least the same ALC Grade of agricultural land as prior to construction, no adverse cumulative impacts on soil, land use and agriculture are predicted to occur.

13.9 Summary of Impacts

13.9.1 A summary of identified residual impacts and mitigation measures is provided in **Table 13.7.** This addresses the construction, operation and restoration phases.

Table 13.7: Summary of Impacts

Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Construction							
Soil quality and profiles – within site	Vegetation removal.	Medium	Site Specific Direct Adverse Temporary	High	Major	Designated routes of access Soil Management Plan.	Minor
Soil quality and profiles – within site.	Ground preparation including topsoil stripping and stockpiling.	Medium	Site Specific Direct Adverse Temporary	High	Major	Designated routes of access Soil Management Plan. Reuse and restoration of soils in line with Landscape Restoration Strategy.	Minor
Temporary or permanent loss of agricultural land quality (ALC Grade and agricultural land use potential)	Vegetation removal and ground preparation including topsoil stripping and stockpiling.	Low	Site Specific Direct Adverse Temporary	Medium	Minor	None proposed.	Minor
Agricultural crops and grazed grassland and Common Land off-site	Indirect disturbance/dust/run-off impact on adjoining land.	Very low	Indirect Adverse Temporary	Medium	Minor	No specific mitigation required. As part of standard good working practice – controls on working.	Minor
Agricultural land – on and off-site	Accidental introduction or spread of noxious or invasive weeds and diseases.	Low	Direct & Indirect Adverse Temporary	Medium	Minor	No specific mitigation required. As part of standard good working practice – implement MAFF procedures for the control of soil transfer.	Minor

Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Construction							
Field drainage	Disruption to or loss of drainage infrastructure and any connections to adjacent agricultural drainage systems	Low	Site Specific Direct Adverse Temporary	High	Moderate	Mitigation measures to protect adjacent agricultural field drainage systems will be included in the SMP	Minor
Animal health – off-site	Disturbance of old animal burial pits	Very low	Site Specific Direct Adverse Temporary	High	Minor	No specific mitigation required. As standard good practice, include contingency measure to contact Defra Animal Health Division if previously undiscovered pit encountered.	Minor
Operation – Restoration of the Non-developed Footprint							
Soil quality and profiles	Earthworks – topsoil restoration.	Low	Site Specific Direct Adverse Temporary	High	Moderate	Soil Management Plan.	Minor
Agricultural land, crops and grazed grassland and Common Land off-site	Indirect disturbance/dust/run-off impact on adjoining land.	Very low	Indirect Adverse Temporary	Medium	Minor	No specific mitigation required. Soil Management Plan.	Minor
Field Drainage	Disruption to drainage infrastructure and connection to off-site agricultural drainage systems	Low	Site Specific Direct Adverse Temporary	High	Moderate	Mitigation measures to protect adjacent agricultural field drainage systems will be included in the SMP	Minor

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CHAPTER 14: GEOLOGY AND LAND CONTAMINATION

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14. GEOLOGY AND LAND CONTAMINATION

14.1 Introduction

14.1.1 This chapter of the Environmental Statement (ES) provides an assessment of the potential impacts in relation to geology and land contamination during the construction, operation and the restoration of the Hinkley Point C (HPC) development and associated off-site highway improvements.

14.2 Scope and Objectives of Assessment

14.2.1 The scope of this assessment has been determined through a formal Environmental Impact Assessment (EIA) scoping process undertaken with the Infrastructure Planning Commission (IPC). It has also been informed by consultation with statutory consultees including the Environment Agency, Sedgemoor District Council (SDC), West Somerset Council (WSC) and Somerset County Council (SCC), as the relevant authorities, and also by comments received from non-statutory consultees including local residents and members of the general public in response to EDF Energy's Stage 1, Stage 2, and Stage 2 Update consultations (see the **Consultation Report**).

14.2.2 The assessment of geological and land contamination impacts on sensitive receptors arising from the proposed development has been undertaken adopting the methodologies described in Section 14.4. The existing baseline conditions, against which the likely environmental effects of the development are assessed, have been determined through a review of desk based and intrusive site investigation reports. These are described in Section 14.5, which also identifies the receptors of relevance to the assessment. The study area for this assessment, as illustrated in **Figure 14.1**, focuses on the HPC Development Site and also includes the associated off-site highway improvements.

14.2.3 Within this chapter, the assessment of land contamination includes both chemical and radiological contamination. In the context of land contamination, the scope of the assessment has been broadened to include the potential for 'contaminated land' and 'land affected by contamination' within the understanding and definition of these terms in the UK (i.e. in line with the definitions contained with Part 2A of the Environmental Protection Act 1990 (Ref. 14.1) and Planning Policy Statement 23 (Ref. 14.2)). The assessment includes the potential for groundwater contamination with respect to the presence of contaminated soils and assesses the potential risk/impacts using the 'source-pathway-receptor' approach.

14.2.4 Impacts associated with geology and land contamination are assessed in Section 14.6 of this chapter. Many environmental aspects are interrelated; as such impacts from land contamination have the potential to impact a number of other environmental components (e.g. land contamination may impact upon groundwater, surface waters and/or ecology). For the purpose of this chapter, the impact assessment related to land contamination is considered with respect to the following receptors: on-site and off-site human health, on-site and off-site terrestrial ecology (including plants, trees, and other vegetation but excluding crops), on-site and off-site crops and livestock, the on-site and off-site built environment, the on-site and off-site soil[1] environment and on-site and off-site controlled waters. Impacts to controlled waters are only considered with respect to assessment of impact to on-site groundwater and surface water from actual or potential soil contamination. Possible further indirect impacts from potential contaminated groundwater and/or surface water to other receptors are discussed in **Chapter 15** and **Chapter 16** of this volume, respectively. Potential impacts to ecological receptors including trees, and other vegetation are discussed in **Chapter 20** of this volume. Potential impacts to soils and crops are considered in **Chapter 13** of this volume.

Appropriate mitigation measures aimed at preventing, reducing or off-setting any potential adverse impacts on geology and land contamination that are identified to be of significance are presented in Section 14.7. The assessment of residual impacts following implementation of the mitigation measures is presented in Section 14.8. The assessment of cumulative impacts of HPC with other elements of the HPC Project, and other proposed and reasonably foreseeable projects are considered in **Volume 11** of this ES.

14.2.5 The objectives of the geology and land contamination assessment are to:

- identify the geology and land contamination characteristics within the study area which may be affected by, or be relevant to, HPC;
- characterise the baseline conditions for geology and land contamination within the study area;
- assess the impacts of HPC on geology and land contamination within the study area;
- recommend mitigation measures, if considered necessary, to reduce the potential adverse impacts on geology and land contamination; and
- assess the residual impacts on geology and land contamination.

14.3 Legislation, Policy and Guidance

14.3.1 This section identifies and describes legislation, policy and guidance of relevance to the assessment of potential geology, land contamination and groundwater impacts associated with the construction, operation and restoration phases of the proposed development.

14.3.2 As stated in **Volume 1**, **Chapter 4** of this ES, the Overarching National Policy Statement (NPS) for Energy (NPS EN-1) when combined with the NPS for Nuclear Power Generation (NPS EN-6) provides the primary basis for decisions by the IPC on applications for nuclear power generation developments that fall within the scope of the NPSs.

14.3.3 Notwithstanding this, the IPC may consider other matters that are both important and relevant to its decision-making. This could include Planning Policy Statements (PPSs), Planning Policy Guidance Notes (PPGs), regional and local policy

[1] The risks posed by actual and potential land contamination to the on or off site soil environment has mainly been assessed in terms of potential impact to soil quality through possible ecotoxicological effects (i.e. toxicological risk to ecological receptors and ecosystems). In terms of soils, this is predominantly intended to mean soil flora and fauna (e.g. invertebrates), however it may also include higher animals (mammals, avian receptors).

documents, although, if there is a conflict between these and the NPS, the NPS prevails for the purposes of IPC decision making.

14.3.4 Further, the Planning Act 2008 provides that the IPC must, in making its decision on an application, have regard to any Local Impact Report (LIR) prepared by relevant local authorities. It is anticipated that the LIRs will rely in part on PPSs, PPGs, regional and local policy to provide a context for their assessment. On this basis, regard has been given to these documents (where relevant to the technical assessment) since they are likely to inform the LIRs prepared by the relevant local authorities.

a) International

14.3.5 There is no European Union (EU) legislation which is directly relevant to the subjects of geology and land contamination apart from the Environmental Liability Directive (2004/35/EC) (Ref. 14.3). There are various pieces of EU Legislation (see below) which are indirectly relevant. Details of the indirectly relevant EU legislation are contained within other chapters (i.e. **Chapter 15** and **Chapter 16** of this volume) and although not repeated here the relevant EU legislation is listed below for completeness:

- The Water Framework Directive (2000/60/E) (Ref. 14.4).
- Groundwater Directive (80/68/EEC) (Ref. 14.5).

i. Environmental Liability Directive (Ref. 14.3)

14.3.6 The Environmental Liability Directive is based on the "polluter pays" principle and requires EU member states to impose obligations and liabilities on operators whose activities cause or threaten environmental damage. Environmental damage specifically includes land contamination where there is a significant risk of adverse effects to human health.

14.3.7 The Environmental Liability Directive requires an operator to take preventative, as well as remedial, measures. It applies both to damage that has occurred and where there is an imminent risk of it occurring, but does not apply to damage that occurred prior to 30 April 2007. The Environmental Liability Directive is implemented in England by the Environmental Damage (Prevention and Remediation) Regulations 2009 (SI 2009/153) (Ref. 14.6).

b) National Legislation

i. Geology

The Wildlife and Countryside Act 1981 (Ref. 14.7)

14.3.8 The Wildlife and Countryside Act (1981) covers the protection of wildlife, the countryside, National Parks and the designation of protected areas, and Public Rights of Way (PRoW). It provides the designation of Sites of Special Scientific Interest (SSSI), which are areas of special scientific interest due to their flora, fauna, or geological or geophysical features, as well as National Nature Reserves (NNR) or Marine Nature Reserves (MNR).

14.3.9 SSSIs have specific guidelines to protect the area of special interest from damage or deterioration. Consultation with the appropriate conservation agencies must be made prior to any development or activities which could impact these sites. They are subject to legal protection and are managed to conserve their habitats or to provide special opportunities for scientific study.

The Countryside and Rights of Way Act 2000 (Ref. 14.8)

14.3.10 The Countryside and Rights of Way Act (CRoW) (2000) puts responsibility onto relevant authorities to "*take reasonable steps to further the conservation and enhancement of … geological and physiographical features by reason of which the site is a SSSI*".

ii. Land Contamination

14.3.11 There are several items of legislation and/or guidance that aim to deal with the prevention of land and groundwater contamination and others which aim to address and remediate contamination once it has occurred. As with European legislation, several of these regulations are more indirectly relevant to the management and prevention of land contamination. Examples of indirectly relevant regulations are listed here for reference but are not discussed in detail within this chapter:

- Water Resources Act 1991 (SI 57) (as partly amended by the Water Act 2003) and associated Anti-pollution Works Regulations 1999 (SI 1999/1006) (Ref. 14.9).
- Control of Pollution (Oil Storage) (England) Regulations 2001 (SI 2001/2954) (Ref. 14.10).
- Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (SI 2003/3242) (Ref. 14.11).
- Nuclear Installations Act 1965 (Ref. 14.12).

Environmental Protection Act 1990 Part 2A (Ref. 14.1)

14.3.12 The key piece of legislation which is directly relevant to contaminated land in the UK is Part 2A of the Environmental Protection Act (EPA) 1990 and associated Contaminated Land Regulations (England) 2006 (SI 2006/1380) (Ref. 14.18). The Environment Act 1995 added Part 2A to the Environment Protection Act 1990 and Part 2A came into force in 2000. This contains the primary legislation with respect to identification, assessment and where necessary determining liability for the remediation of contaminated land and groundwater in England and Wales. Part 2A (as it is more commonly known) created a statutory definition of 'Contaminated Land' as follows:

> "*any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that;*
>
> *a) significant harm is being caused or there is the significant possibility of such harm being caused, or*
>
> *b) pollution of controlled waters is being, or is likely to be caused."*

14.3.13 Section 86 of the Water Act 2003 (Ref.14.9) sets out an amendment to this definition by introducing the thresholds of "significant pollution of controlled waters" and "significant possibility of significant pollution of controlled waters". However, this section is not yet in force and the Government has not announced an anticipated commencement date.

14.3.14 Tables A and B of the statutory guidance provided in Defra circular 01/2006 (Ref. 14.13) define statutory receptors under Part 2A, which include;

- human beings;
- various ecological systems and designated ecological sites;
- property including crops, produce, livestock and wild animals which are the subject for shooting or fishing rights; and
- buildings.

14.3.15 The Radioactive Contaminated Land (Modification of Enactments) (England) Regulations 2006 (SI 2006/1379) (Ref.14.14) extended Part 2A to include some, but not all, land contaminated by radioactive substances. The Regulations only apply to radioactivity arising from historical practice or works activity not naturally occurring (e.g. radon is a naturally occurring radionuclide). The Regulations reserve to the Health and Safety Executive (HSE) the power to deal with radioactive contaminated land on a site licensed under the Nuclear Installations Act 1965 (Ref. 14.12). The Radioactive Contaminated Land (Modification of Enactments) (England) (Amendment) Regulations 2007 (SI 2007/3245) (Ref.14.15) add the category of radioactive contaminated land caused by off-site nuclear occurrences. Radioactive Contaminated Land (Modification of Enactments) (England) (Amendment) Regulations 2010 (SI 2010/2147) (Ref.14.16) extended Part 2A again to include radon and radionuclides present as a result of radioactive decay, where they are the result of the after-effects of a radiological emergency or a past activity. The application of Part 2A to radioactive contamination differs in some respects from its application to non-radioactive contamination. In particular, in relation to radioactive contamination, the definition of 'Contaminated Land' is modified such that it only covers harm to human health and not pollution of controlled waters, and there is no requirement for such harm to be 'significant' as for non-radioactive contamination.

14.3.16 The assessment and determination of contaminated land is based around the ‘source-pathway-receptor’ approach, whereby, linkage(s) (known as a ‘pollutant linkage’ in Part 2A) must be shown to exist between the source of contamination and a receptor (target). A pathway could be any feature which connects a source to a target, for example, it could be a drain, service trench or permeable ground.

14.3.17 Part 4 A.37 of Defra statutory guidance circular 01/2006 (Ref. 14.13) states that land should not be designated as contaminated land where:

- a substance is already present in controlled waters;
- entry into controlled waters of that substance from the land has ceased; and
- it is not likely that further entry would take place.

14.3.18 Part 2A imposes liability for the clean-up of contaminated land in the first instance, on those who caused or knowingly permitted the contaminating substances to be present in, on or under the land (by applying the "polluter pays" principle). If no such person can be found, liability passes to the current owners and occupiers of the site (regardless of whether they were aware of the contamination). Currently, the

Secretary of State is liable for the remediation of radioactive contaminated land caused by nuclear occurrences.

14.3.19 Further to the legislation described above, a consultation report was issued by Defra in 2010 (Ref. 14.17), which stated proposals for updating and revising the Statutory Guidance (Ref. 14.13). The consultation also includes proposed minor amendments to the Contaminated Land (England) Regulations 2006 (Ref. 14.18). The proposed updates and revisions provide guidance on how the Local Authority should go about deciding whether significant pollution of controlled waters is being caused, or whether there is a significant possibility of such pollution being caused. The consultation period for the consultation report was held between December 2010 and March 2011.

Environmental Damage (Prevention and Remediation) Regulations 2009 (Ref. 14.6)

14.3.20 The Environmental Damage (Prevention and Remediation) Regulations 2009 (Ref 14.6) implement the provisions of the Environmental Liability Directive (Ref 14.3) in England. The Regulations follow the provisions of the Directive closely and accordingly impose obligations and liability on operators for environmental damage caused or threatened by their activities, specifically including damage to land by contamination by substances, preparations, organisms or micro-organisms that results in a significant risk of adverse effects on human health. The Regulations only apply to damage that takes place after the Regulations come into force on 1 March 2009.

14.3.21 If an operator of an activity causes an imminent threat of environmental damage the operator must immediately take all practicable steps to prevent the damage and provide all relevant details to the enforcing authority. Where environmental damage has been caused, the authority must require the operator to undertake remedial works, subject to certain exemptions. In relation to land, the remediation must ensure, as a minimum, that the contaminants are removed, controlled, contained or diminished so that the land, taking account of its lawful current use or any planning permission in existence at the time of the damage, no longer poses any significant risk of adverse effects on human health.

The Environmental Permitting (England and Wales) Regulations 2010 (Ref. 14.19)

14.3.22 The Environmental Permitting (England and Wales) Regulations 2010 superseded the Environmental Permitting (England and Wales) Regulations 2007 (SI 2007/3538) which were intended to create a single permitting and compliance scheme for sites and processes previously regulated under the Integrated Pollution Prevention and Control (IPPC), Pollution, Prevention and Control (PPC), Waste Management Licensing (WML) and Landfill Regulations. Under the 2010 Regulations an Environmental Permit is required for specified processes and activities including (for example) energy, metals, mineral, chemicals and waste management activities. Some waste management operations are excluded from environmental permitting because they are regulated under other regimes or because they are lower risk activities which can be undertaken under a registered/approved exemption.

14.3.23 The 2010 Regulations aim to ensure a high level of environmental protection by preventing, or where this is not practicable, reducing emissions to air, land and/or water from regulated processes. The permits must include conditions to ensure that no significant pollution is caused and that all necessary measures are taken to prevent pollution. These measures include the use of conditions prescribing Best Available Techniques (BAT) to prevent or reduce emissions. In determining BAT, the regulator must have regard to any statutory BAT guidance, e.g. sector and process guidance notes and/or EU BREF guidance notes.

14.3.24 Permits also must include conditions to ensure:

- protection of soil and groundwater;
- suitable emissions monitoring and environmental monitoring is in place;
- the application of measures to prevent accidents and accidental releases; and
- when activities cease on-site, the site is returned to a satisfactory condition and any residual pollution risk removed.

Environment Agency Pollution Prevention Guidelines (Ref. 14.20)

14.3.25 A number of Pollution Prevention Guidelines (PPG) have been produced by the Environment Agency (EA) covering a range of subject areas. They aim to provide practical advice to industry and the public on legal responsibilities, and good environmental practice and management to prevent pollution of surface water, groundwater and land from activities such as storage of oils and fuels, refuelling activities, construction and demolition, fire water management and vehicle washing.

Environment Agency CLR 11, Model Procedures for the Management of Land Contamination (Ref. 14.21)

14.3.26 CLR 11 provides the technical framework for applying a risk management process when dealing with land impacted by contamination. The technical approach presented in the Model Procedures is designed to be applicable to a range of non-regulatory and regulatory contexts. These include:

- development or redevelopment of land under the planning regime;
- regulatory intervention under Part 2A of the Environment Protection Act 1990;
- voluntary investigation and remediation; and
- managing the potential liabilities of those responsible for individual sites or a portfolio of sites.

UK Best Practice Guidance

14.3.27 In addition to the above legislation and policies, there is a large amount of UK best practice guidance documentation which is relevant to geology and land contamination. Some of the key pieces of guidance are listed below (the list provided below is indicative only, i.e. not exhaustive):

- BS10175:2001 Investigation of Potentially Contaminated Sites – Code of Practice (Ref. 14.22). This guidance was re-issued in March 2011; however the 2001 version of the guidance was current and applicable at the time of the intrusive investigations used to inform this ES chapter (July 2008, August to December 2008, and November 2009 to August 2010).

- BS5930:1999 + A2:2010 Code of practice for site investigations (Ref. 14.23).
- EN ISO 14688-2002-1: Geotechnical investigation and testing – Identification and classification of soil – Part 1: Identification and description (Ref. 14.24).
- BS EN ISO 10381-2:2002 Soil Quality - Sampling – Part 2: Guidance on sampling techniques) (Ref. 14.25).
- Department of the Environment. Prioritisation and categorisation procedure for sites that may be contaminated. Contaminated Land Report 6 (Ref. 14.26).
- Environment Agency. Human health toxicological assessment of contaminants in soil. (Science Report SC050021/SR2) (Ref. 14.27).
- Environment Agency. An ecological risk assessment (ERA) framework for contaminants in soil (Ref. 14.28).

c) National Planning Policy

i. Planning Policy Statement 1: Delivering Sustainable Development (PPS1) (2005) (Ref. 14.29)

14.3.28 PPS1 was published in 2005 and sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system.

14.3.29 Paragraph 5 states that planning should facilitate and promote sustainable and inclusive patterns of urban and rural development by, amongst other things: protecting and enhancing the natural and historic environment, the quality and character of the countryside, and existing communities.

ii. Planning Policy Statement 9: Biodiversity and Geological Conservation (PPS9) (2005) (Ref. 14.30)

14.3.30 PPS9 was published in 2005 and sets out planning policies on the protection of biodiversity and geological conservation through the planning system. The broad aim of the policies is to ensure that planning, construction, development and regeneration should have minimal impacts on biodiversity and enhance it wherever possible.

14.3.31 Key objectives of PPS9 (page 2 of the policy) include:

> *"To promote sustainable development by ensuring that biological and geological diversity are conserved and enhanced as an integral part of social, environmental and economic development, so that policies and decisions about the development and use of land integrate biodiversity and geological diversity with other considerations.*
>
> *To conserve, enhance and restore the diversity of England's wildlife and geology by sustaining and where possible improving the quality and extent of natural habitat and geological and geomorphological sites; the natural physical processes on which they depend; and the populations of naturally occurring species which they support."*

iii. Planning Policy Statement 23: Planning and Pollution Control (PPS23) (2004) (Ref. 14.2)

14.3.32 PPS23 is intended to complement the pollution control framework under the Pollution Prevention and Control Act 1999 and the Pollution Prevention and Control Regulations 2000. The policy sets out the importance of the planning system in determining the location of development which may give rise to pollution, either directly or indirectly. The policy also seeks to ensure that other uses and developments are not, as far as possible, affected by major existing or potential sources of pollution.

14.3.33 Paragraph 23 of PPS23 states that, in considering individual planning applications, the potential for contamination to be present must be considered in relation to the existing use and circumstances of the land, the proposed new use and the possibility of encountering contamination during development. Local Planning Authorities (LPAs) should satisfy themselves that the potential for contamination and any risks arising are properly assessed and that the development incorporates any necessary remediation and subsequent management measures to deal with unacceptable risks.

14.3.34 Paragraph 24 of PPS23 states that LPAs should pay particular attention to development proposals for sites where there is a reason to suspect contamination. If the potential for contamination is confirmed, further studies to assess the risks and identify and appraise the options for remediation should be undertaken. Paragraph 25 of PPS23 advises that the remediation of land affected by contamination through the granting of planning permission (with the attachment of the necessary conditions) should secure the removal of unacceptable risk and make the site suitable for its new use.

14.3.35 PPS23 also states that, amongst other things, the following matters may be material in the consideration of individual planning applications where pollution considerations arise:

> *"…the need to ensure that land, after development, is not capable of being determined as contaminated land under Part 2A of the EPA 1990 and that all unacceptable risks have been addressed; and*
>
> *…the possible adverse impacts on water quality and the impact of any possible discharge of effluent or leachates which may pose a threat to surface or underground water resources directly or indirectly through surrounding soils."* (page 12 of the policy)

iv. Consultation Paper on a New Planning Policy Statement – Planning for a Natural and Healthy Environment (2010) (Ref. 14.31)

14.3.36 In its final form, it is intended that this PPS will replace PPS9. The draft PPS contains policies to maintain and enhance, restore or add to biodiversity and geodiversity through the planning system. It includes policies to promote opportunities for the incorporation of beneficial biodiversity and geological features within the design of development, and to maintain networks of natural habitats by avoiding their fragmentation and isolation.

14.3.37 A key objective of this PPS is to bring together related policies on the natural environment and on open space and green spaces in rural and urban areas to ensure that the planning system delivers healthy sustainable communities which adapt to and are resilient to climate change and gives the appropriate level of protection to the natural environment (page 10 of the policy).

d) Regional Planning Policy

14.3.38 The Government's revocation of regional strategies was quashed in the High Court on 10 November 2010. However, on that same date the Government reiterated in a letter to Chief Planners its intention to revoke regional strategies through the Localism Bill. This letter was also challenged but, on 7 February 2011, the High Court held that the Government's advice to local authorities that the proposed revocation of regional strategies was to be regarded as a material consideration in their planning development control decisions should stand. The decision of the High Court was upheld by the Court of Appeal on 27 May 2011. Therefore, the regional strategies remain in place but in the case of development control decisions it is for planning decision makers to decide on the weight to attach to the strategies (see **Volume 1**, **Chapter 4** of this ES for a full summary of the position regarding the status of regional planning policy).

i. Regional Planning Guidance 10 for the South West 2001-2016 (RPG10) (2001) (Ref. 14.32)

14.3.39 RPG 10 sets out the broad development strategy for the period to 2016 and beyond. Policy EN1 (Landscape and Biodiversity) seeks the protection and enhancement of the region's internationally and nationally important landscape areas and nature conservation sites. The protection and, where possible, enhancement of the landscape and biodiversity should be planned into new development.

14.3.40 Policy RE1 (Water Resources and Water Quality) states that to achieve the long-term sustainable use of water, water resources need to be used more efficiently. The policy also states that local authorities, the Environment Agency, water companies and other agencies should seek to, amongst other things, protect groundwater resources.

ii. The Draft Revised Regional Spatial Strategy (RSS) for the South West Incorporating the Secretary of State's Proposed Changes 2008-2026 (July 2008) (Ref. 14.33)

14.3.41 Chapter 7 of the RSS deals with Enhancing Distinctive and Cultural Life. Policy ENV1 states:

> *"The quality, character, diversity and local distinctiveness of the natural and historic environment in the South West will be protected and enhanced, and developments which support their positive management will be encouraged. Where development and changes in land use are planned which would affect these assets, Local Authorities will first seek to avoid loss of or damage to the assets, then mitigate any unavoidable damage, and compensate for loss or damage through offsetting actions. Priority will be given to preserving and enhancing sites of international or national landscape, nature conservation, geological, archaeological or historic importance. Tools such as characterisation and surveys will be used to enhance local sites, features and distinctiveness through development,*

including the setting of settlements and buildings within the landscape and contributing to the regeneration and restoration of the area."

14.3.42 Policy RE6 (Water Resources) states that the region's network of ground, surface and coastal waters and associated ecosystems will be protected and enhanced. It also advises that surface and groundwater pollution risks must be minimised so that environmental quality standards are achieved and where possible exceeded.

iii. Somerset & Exmoor National Park Joint Structure Plan Review 1991-2011 (2000) (Policies 'saved' from 27 September 2007) (Ref. 14.34)

14.3.43 The Somerset & Exmoor National Park Joint Structure Plan was adopted in 2000 with relevant policies saved from 27 September 2007. All policies have been saved with the exception of Policy 53 which is unrelated to geology, land contamination or groundwater impacts. The Plan provides a strategic base for all land use planning within the plan area for the period up to 2011.

14.3.44 Policy 1 (Nature Conservation) states that the biodiversity of Somerset and the Exmoor National Park should be maintained and enhanced. The greatest protection will be afforded to nature conservation sites of international and national importance. In addition, Local Plans should include policies to maintain and enhance sites and features of local nature conservation importance including landscape features which provide wildlife corridors, links or stepping stones between habitats.

14.3.45 Policy 15 (Coastal Development) states that provision for any development along the coast, including the Exmoor Heritage Coast, should be made within towns, rural centres and villages. Where development requires an undeveloped coastal location it should respect the natural beauty, biodiversity and geology of the coast and be essential in that location. New coastal developments should minimise the risk of flooding, erosion and landslip.

14.3.46 Policy 59 (Safeguarding Water Resources) states that protection will be afforded to all surface, underground and marine water resources from development which could harm their quality or quantity.

e) Local Planning Policy

i. West Somerset Local Plan (2006) (Policies 'saved' from 17 April 2009) (Ref. 14.35)

14.3.47 The West Somerset Local Plan forms part of the development plan for West Somerset. The Local Plan was adopted in April 2006 (with relevant policies saved from 17 April 2009).

14.3.48 The Proposals Map indicates that the HPC development site itself is not subject to any specific geology, or land contamination or groundwater designations. The foreshore, which lies just outside of the northern red line boundary of the site, is designated a SSSI (Policy NC/1) and National Nature Reserve (Policy NC/1). The SSSI designation also abuts the eastern boundary of the HPC development site. The Proposals Map also shows the Special Protection Area (SPA) and Ramsar designations which affect the foreshore ('unsaved' Policy NC/2).

14.3.49 The following saved policies are considered to be potentially relevant:

- Policy NC/1 (Sites of Special Scientific Interest) states that development proposals which may, directly or indirectly, adversely affect SSSIs will not be permitted unless: there are no alternative means of meeting the development need, and the reasons for the development clearly outweigh the value of the site and the national policy to safeguard the nature conservation value of the national network of such sites.
- Policy NC/1 also states that, where the site is a National Nature Reserve (NNR) or a site identified under the Nature Conservation Review or Geological Conservation Review, particular regard will be paid to the site's national importance. Where development is permitted, the use of conditions or planning obligations to ensure the protection and enhancement of the site's nature conservation interest will be considered.
- Policy NC/3 (Sites of Local Nature Conservation and Geological Interest) states that planning permission will not be granted for development which has a significant adverse effect on local nature conservation/geological interests or integrity of landscape features, unless the importance of the development outweighs the value of the substantive interests present.
- Policy PC/4 (Contaminated Land) states that all development proposals on or in proximity to land known to be, or which may be, contaminated will include measures designed to prevent an acceptable risk to public health and the environment.
- Policy CO/1 (The Coastal Zone) states that development proposals in any part of the Coastal Zone, including those areas of existing developed coast, will only be permitted where: the development and its associated activities are unlikely to have an adverse effect, either directly or indirectly, on heritage features, landscape character areas, nature conservation interests, including sub-tidal and marine habitats, and residential amenities; the development is unlikely to have an adverse effect on the character of the coast and maintains and where possible, enhances, improves or upgrades the environment particularly in derelict and/or despoiled coastal areas; the development requires a coastal location.

ii. West Somerset District Local Development Framework (LDF) Core Strategy (Options Paper) (January 2010) (Ref. 14.36)

14.3.50 The Core Strategy is at a preliminary stage of preparation and the Options Paper does not include any specific policies relating to geology and land contamination impacts which are of relevance to the HPC development site.

iii. Supplementary Planning Guidance

14.3.51 WSC and SDC have jointly prepared draft supplementary planning guidance in relation to the Hinkley Point C Project. Public consultation on the Consultation Draft version of the Hinkley Point C Project Joint SPD (the draft HPC SPD) (Ref. 14.37) commenced on 1 March 2011 and concluded on 12 April 2011. EDF Energy has submitted representations which object to the draft HPC SPD. See **Volume 1,**, **Chapter 4** for a full summary of the position regarding the status of the draft HPC SPD.

14.3.52 The draft HPC SPD does not set out specific guidance in relation to geology and land contamination impacts at the HPC development site.

14.3.53 Further planning policy context is provided in the Legislative Planning Policy Context chapter (**Volume 1**, **Chapter 4**) and the Introduction chapter (**Chapter 1** of this volume).

14.4 Methodology

14.4.1 The baseline environmental studies, surveys and impact assessment for geology and land contamination have been conducted in accordance with relevant best practice and standard methodologies as detailed under Section b) (Baseline Assessment) below:

a) Study Area

14.4.2 The baseline assessment of land contamination and geology is concerned with the establishment of current conditions within the HPC Development Site, which is divided into three separate areas of land:

- Built Development Area West (BDAW) - this area of land lies approximately 400m to the west of the existing Hinkley Point Power Station Complex and forms the western part of the HPC development site. The area currently comprises agricultural land and woodlands with associated derelict farm buildings.
- Built Development Area East (BDAE) - this area is located immediately adjacent and to the west of Hinkley Point A (HPA) and forms the eastern part of the HPC development site. The area is currently operational land and lies within the Nuclear Licensed Site area.
- Southern Construction Phase Area (SCPA) - this area is located to the south of the Built Development Areas East and West and extends to the southern boundary of the HPC development site.

14.4.3 The subsequent impact assessment relating to land contamination includes potential impacts to human health and other receptors (i.e., ecology, crops and livestock, built environment, soil environment and controlled waters) from soil contamination within the HPC development site and any potential impacts to off-site receptors up to a distance of approximately 500 metres from the HPC development site boundary, including ecology, crops/livestock and soil in adjacent fields, local residents of Shurton and Knighton and people using the public footpaths. A distance of 500m was selected as this was considered to be the maximum distance over which contamination could feasibly migrate to or from the site under extreme circumstances.

14.4.4 The extent of the geological impact assessment includes consideration of the geological conditions and exposed cliff and the foreshore geomorphology within the HPC development site.

14.4.5 The study area for the assessment also includes the ten locations constituting the off-site highway improvement works.

14.4.6 The study area as described above is illustrated in **Figure 14.1**. A detailed description of the proposed HPC development site is provided in **Volume 1**, **Chapter 2** of this ES.

b) Baseline Assessment

14.4.7 The baseline assessment for geology and land contamination is based upon:

- review of desk based information;
- design and undertaking of intrusive investigations and surveys;
- reporting and risk assessment; and
- consultation with appropriate Statutory Bodies (including the Environment Agency, Natural England, Somerset County Council, West Somerset Council and West Somerset District Council).

14.4.8 The approach and methodologies used within the assessment are in accordance with the phasing and guidance contained within CLR 11: Model Procedures for the Management of Land Contamination (Ref. 14.21) and BS10175:2001 Investigation of Potentially Contaminated Sites – Code of Practice (Ref. 14.22) (this guidance was superseded in March 2011, however, the earlier version of the guidance was current and applicable at the time of the intrusive investigations and assessments). CLR 11 details the UK's technical framework for structured decision making about land contamination. Other key guidance documents and standards relating to investigations of contaminated land have also been considered and details presented in the relevant section (Section 14.3) of this chapter.

14.4.9 Preliminary assessments of the HPC development site were undertaken (Phase 1 desk-studies) using desk based information which was reviewed in order to identify potential salient features and identify potential hazards and risks. As part of the desk based assessment a 1km search area was applied to the area boundary to identify environmental setting information. It should be noted that the baseline general environmental context search area of 1km is larger than the 500m radius that has been used for the purpose of impact assessment. This included an assessment of geological, hydrogeological and hydrological conditions and the identification of potential salient features, through the review of the environmental data report (GroundSure report Ref.14.38), current and historical maps, plans and photographs and, where available, review and synthesis of existing reports. The sources reviewed as part of the desk based assessment included the following (this list is indicative and not exhaustive):

- GroundSure. Environmental Data Report, Geology and Ground Stability Report and Historical Map Pack. 2008. (Ref. 14.38).
- Ordnance Survey. Explorer Map 1:25,000 scale Quantock Hills & Bridgwater Sheet 140. 2005. (Ref. 14.39).
- British Geological Survey (BGS). 1:50,000 BGS Sheet 279; Weston-Super-Mare. 1980. (Ref. 14.40).
- Geological Survey of Great Britain. 1:10,560 Somerset Sheets: ST4 NE, ST24 NW and ST25 SW. 1980. (Ref. 14.41).
- Whittaker, A and Green, G.W. Geology of the Country Around Weston-Super-Mare: Memoir for 1:50000 Geological Sheet 279, New Series, with parts of sheets 263 and 295. Institute of Geological Sciences. London. 1983. (Ref. 14.42).

- Environment Agency. Policy and Practice for the Protection of Groundwater, Groundwater Vulnerability of the Somerset Coast, Sheet 42. Scale 1:100,000. EA. 1996 (Ref. 14.43).
- Environment Agency. Superficial and Bedrock Aquifer Designation Maps. 2011. (Ref. 14.44).
- Rendel Palmer and Tritton. Hinkley Point 'C' Power Station Pre-Application Studies, Volume 2 Geotechnical Report. 1986. (Ref. 14.45).
- Allot Atkins Mouchel. Hinkley Point 'C' Power Station Geotechnical Studies, Geotechnical Summary Report – Chapter 7. Report Ref: HPC 1101/57. 1988. (Ref. 14.46).
- Aspinwall & Company. Analysis of Groundwater Conditions at Hinkley Power Station. Report Ref: NU5101B for Nuclear Electric. 1996. (Ref. 14.47).
- Serco Assurance. Baseline Survey of an Area of Land to be Leased from British Energy at Hinkley Point. Report Re: SA/Env/0878/Issue 01. 2006. (Ref. 14.48).
- Serco Technical & Assurance Services. Pre-Closure Contamination Survey (C Station Land), Hinkley Point A. Report Ref: TAS/002838/001 Issue 01. December 2008. (Ref. 14.49).

14.4.10 Baseline non-intrusive radiological surveys have been undertaken across the different areas of land within the HPC development site. Measurements were taken using a Mini 6-80/MC7, a low-background Geiger-Muller detector designed for environmental gamma dose rate measurement using the methods outlined in the Environment Agency Guidance TGNM5 – Monitoring (Ref. 14.50).

14.4.11 To complement the gamma dose rate measurements, a walkover survey was completed using a Thermo G2 probe and an Electra ratemeter, which is a sodium iodide scintillation detector designed for the detection of gamma radiation. Survey locations were randomly selected to afford good coverage of the different areas of land within the HPC Development Site, a number of targeted survey points were also selected to cover areas of interest on the BDAE identified in the desk based assessment.

14.4.12 The field readings were compared to background concentrations taken at a cemetery site near Bridgwater using both the G2/Electra and the Mini 6-80/MC71. Measurements were taken over undisturbed ground within the cemetery where no grave digging had occurred. Following the review of desk based information and baseline surveys the findings were used to design and undertake intrusive investigations at the HPC Development Site to collect site-specific data (Phase 2 investigations). The intrusive investigations were undertaken as part of wider geological and geotechnical on-shore investigations (two on-shore campaigns have been undertaken with the first campaign in 2008-2009 and the second campaign in 2009-2010) and comprised the excavation of a series of exploratory holes (including boreholes, trial pits, hand pits and windowless sampling holes) to establish ground conditions and collect representative soil samples. Selected soil samples collected during the investigations were subject to chemical analysis for a range of radiochemical and non-radiological contaminants, which included selected samples for leachate and Waste Acceptance Criteria (WAC) analysis.

14.4.13 Following the preliminary assessments, surveys and the completion of intrusive investigations and associated risk/data assessments, the baseline land contamination characteristics have been determined through the development and subsequent validation of a Conceptual Site Model (CSM). A CSM has been produced to identify potential risks posed to human health and other receptors as a result of soil contamination which may be present within the HPC development site.

i. Development of Conceptual Site Model

14.4.14 A CSM is developed as an initial step in the process of assessing the risks related to contaminated land and groundwater. A CSM is defined within the British Standard BS 10175 – Investigation of Potentially Contaminated Sites – Code of Practice (2011) (Ref. 14.51) as follows (note that whilst the intrusive investigations were undertaken in accordance with the 2001 version of this guidance (Ref. 12.22), the 2011 guidance has been considered to be appropriate for the development and refinement of the conceptual model presented herein):

> *"Characteristics of a site that are relevant to the occurrence and potential effects of ground contamination that describe the nature and sources of contamination; the ground, groundwater, surface water, ground gases and volatile organic compounds (VOCs) that could be present; the environmental setting; potential migration pathways; and potential receptors."*

14.4.15 The CSM provides a three-dimensional picture of a site, presenting and illustrating the potential pollutant linkages that may exist at the site. A pollutant linkage may exist where a source of contamination is present that may interact with a receptor (target) via a pathway. The contaminant source, pathway and receptor are defined as follows:

- CONTAMINANT SOURCE – Location or feature from which contamination is, or was, derived.
- PATHWAY – Mechanism or route by which a contaminant could come into contact with, or otherwise affect, a receptor.
- RECEPTOR – Entity that could be adversely affected by a contaminant(s) (examples of receptors include persons, other living organisms, ecological systems, controlled waters, atmosphere, structures and utilities).

14.4.16 The CSM evolves through the various phases of an investigation as more detailed information becomes available, allowing potential pollutant linkages to be validated or discounted. The baseline CSM for land contamination is presented in Section 14.5 b) **Figure 14.17** and **Appendix 14G**.

c) Assessment Criteria

14.4.17 The non-radiochemical data collected during the intrusive investigations have been used to conduct a generic Tier 1 risk assessment, where observed concentrations of contaminants in soil have been compared against relevant Tier 1 Soil Screening Values (SSVs) comprising applicable Soil Guideline Values (SGVs) or other Generic Assessment (or screening) Criteria (GAC) as appropriate. GACs have been developed in order to assess the potential risk to different receptors including human health, the built environment and the soil environment including potential phytotoxic and ecological (i.e. ecotoxicological) risk. A summary of the sources of the SSVs and GACs is summarised in **Table 14.1**, and details of the adopted approaches are provided below.

Table 14.1: Generic Environmental Assessment Criteria

Environmental Media	Generic Screening Criteria
Soil	**Human Health Risk** • Derived Soil Screening Values (SSV) using the Environment Agency's Contaminated Land Exposure Assessment (CLEA) model (v1.06), which has adopted all the same standard parameters the Environment Agency used to derive standard UK Soil Guideline Values (SGV) for commercial and industrial end use, with the exception of soil organic matter which has been set to 1%, to reflect the site specific soil conditions. Note that assessment criteria for a residential without consumption of home grown vegetables receptor have been used as the basis for SGV, GAC and SSVs for the Southern Construction Phase (SCPA) area. This is because the development proposals show that a significant part of this area will be used for temporary contractors accommodation. • Defra/EA 2002. Research and Development Publication SGV 10. Soil Guideline Values for Lead Contamination. (Ref. 14.55). • Hazardous Waste (England and Wales) Regulations 2005/Chemical (Hazard Information and Packaging Supply) Regulations 2002. (Ref. 14.56). • BS3882:2007 Specification for topsoil requirements for use. (Ref. 14.57). **Phytotoxic Risk** • Sludge (Use in Agriculture) Regulations 1989 – Statutory Instrument 1989 No. 1263 (Ref. 14.58). • Former Inter Departmental Committee for the Redevelopment of Contaminated Land (UK) (ICRCL) 59/83 (N.B. Paper withdrawn by Defra in 2004). (Ref. 14.59). **Built Environment Risk** • Water Regulations Advisory Service (WRAS) Guidance Note 9-04-02 2002. The Selection of Materials for Water Supply Pipes to be Laid in Contaminated Land. (Ref. 14.60). • Wessex Water Soil Survey Guidance. (Ref. 14.61). • BRE Special Digest 1 (3rd Edition) (2005) Concrete in Aggressive Ground. (Ref. 14.62). **Ecological Risk** • UK and international ecological/ecotoxicological Soil Screening Values. Environment Agency 'An ecological risk assessment (ERA) framework for land contamination,' October 2008.(Ref. 14.28 & Ref. 14.55). • UK Soil and Herbage Pollutant Survey (UKSHS) Report No. 7, Environmental Concentrations of Heavy Metals in UK Soil and Herbage (Ref. 14.69) and Report No 9 Environmental Concentrations of Polycyclic Aromatic Hydrocarbons in UK Soil and Herbage (Ref. 14.70).
Groundwater	• River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010. (Ref. 14.75). • UK/EC/WHO Drinking Water Standards (Ref. 14.73) and Freshwater and Saline Environmental Quality Standards (Ref. 14.74).
Ground Gas	• Construction Industry Research and Information Association (CIRIA) 665.

Environmental Media	Generic Screening Criteria
	Assessing risks posed by hazardous ground gases to buildings. (Ref. 14.76). • Health and Safety Executive. EH40/2005 Workplace Exposure Limits (as consolidated with amendments 2007). HSE Books. 2007 (Ref. 14.77)

i. Approach to Human Health Risk Assessment

14.4.18 In October 2009 the Environment Agency released a new version of the CLEA Model (version 1.06).

14.4.19 The Environment Agency intend to publish revised SGVs and toxicological (TOX) reports for a list of priority substances identified by the SGV taskforce which includes many of the most commonly occurring contaminants. At the time of this data assessment, the Environment Agency had published SGV reports and associated TOX reports for eleven substances; arsenic, nickel, mercury, selenium, cadmium, phenol, 'dioxins, furans and dioxin-like PCBs', benzene, xylenes, toluene and ethyl benzene.

14.4.20 The published SGVs are based on a sandy loam soil type with a Soil Organic Matter (SOM) of 6%. In order to ensure that the Tier 1 SSVs are conservative and more site-specific, a series of internally-derived human health SSVs were generated using the CLEA model (v 1.06). For the BDAE and BDAW, SSVs have been generated using identical input parameters and assumptions to those adopted by the Environment Agency in the published SGVs for commercial and industrial end use (which is appropriate given the proposed development of the site for a new power station), with the exception that the SOM has been reduced from 6% to 1% (a more conservative SOM). A non-standard land use is proposed for the SCPA, i.e. to include a workers accommodation campus, therefore as a conservative approach SSVs have been generated using identical input parameters and assumptions for the residential without the consumption of homegrown vegetables land use, with the exception that the SOM has also been reduced to 1%. Note that it is recognised that the standard input parameters used in the derivation of residential without the consumption of homegrown vegetables land use SGVs/GACs and SSVs do not match the receptor types, exposure frequencies and durations of the proposed temporary contractors accommodation land use. However, as the input parameters for residential without the consumption of homegrown vegetables land use are more health protective than would be used for a temporary contractors accommodation land use, this approach is considered appropriate for a generic quantitative risk assessment.

14.4.21 The Land Quality Management Ltd (LQM) and Chartered Institute of Environmental Health (CIEH) (Ref. 14.52) and Contaminated Land: Applications in Real Environments (CL:AIRE) (Ref. 14.53) have generated Generic Assessment Criteria (GAC) for a number of metals and organic contaminants, including the 16 Environmental Protection Agency (EPA) priority Polycylic Aromatic Hydrocarbons (PAHs), Total Petroleum Hydrocarbons (TPH) and several Semi-Volatile Organic Compounds (SVOCs) and Volatile Organic Compounds (VOCs) . LQM/CIEH used the CLEA model v1.04 to derive their GACs, with CL:AIRE utilising the current CLEA model v1.06. The Tier 1 values derived internally by EDF Energy for the purpose of assessing these substances were generated using the CLEA model (v 1.06) and the same input criteria and assumptions as the LQM/CIEH and CL:AIRE input parameters.

14.4.22 In addition to the CLEA SGV, LQM/CIEH and CL:AIRE contaminants, an extensive literature review was carried out by EDF Energy in order to derive suitable assessment criteria for cyanide. As a result of the review, the use of the health criteria values provided by the Environment Agency within their document – Environment Agency TOX Report 5 (March 2002) (Ref. 14.54), were adopted as these provide a conservative approach for assessing the risks posed by cyanide at the HPC development site.

14.4.23 For the purpose of the human health risk assessment, EDF Energy internally-derived Tier 1 SSVs were used for all metals (with the exception of lead), PAHs and speciated TPHs. In the absence of published Tier 1 SSVs for the remaining contaminants the following alternative sources were used for the purpose of the human health risk assessment:

- for lead the 2002 Environment Agency SGV (Ref. 14.55) has been used in the absence of a published UK alternative (the SGV has been withdrawn, however the toxicology report and methodology are still valid);
- for Total/Sum TPH the Hazardous Waste (England and Wales) Regulations 2005 (Ref. 14.56), inert waste threshold has been applied;
- for pH the value within the BS3882:2007 Specification for Topsoil and Requirements for Use (Ref. 14.57), has been applied; and
- for asbestos the significance threshold is the presence or absence of detectable fibres in soil.

ii. Approach to Phytotoxic Risk Assessment

14.4.24 Certain soil contaminants may pose a risk to plant establishment and growth (phytotoxicity). As there are no published UK screening values for assessing phytotoxic risk, in order to undertake a Tier 1 assessment of risks to plants the thresholds recommended in the Sludge (Use in Agriculture) Regulations 1989 – Statutory Instrument 1989 No. 1263 (Ref. 14.58) for the potentially phytotoxic contaminants copper, nickel and zinc were used. Water soluble boron is also a potential phytotoxic contaminant and in the absence of any other available guidelines the value provided by the former ICRCL Guidance Note 59/83 (Ref. 14.59) (paper withdrawn by Defra in 2004) was used.

14.4.25 To assess the potential risk of pH effects on plants the pH value presented within the BS3882:2007 Specification for Topsoil and Requirements for Use (Ref. 14.57) was adopted as the Tier 1 assessment criteria.

iii. Approach to Built Environment Risk Assessment

14.4.26 Contamination may pose risks to the built environment (e.g. buried water pipes and concrete). The thresholds used within this assessment for potable water supply pipes have been taken from the Water Regulations Advisory Scheme (WRAS) Guidance Note 9-04-03 (Ref. 14.60), and the Wessex Water Soil Survey Guidance (WWSSG) (Ref. 14.61). The Building Research Establishment (BRE) Special Digest 1:2005, Concrete in Aggressive Ground (Ref. 14.62) were used to assess potential chemical attack to buried concrete structures. The above guidance documents were used in order to undertake a Tier 1 assessment of the risk to built environment receptors. Note that the WRAS Guidance Note (Ref. 14.60) has recently been withdrawn and WRAS intends to prepare and publish a replacement Guidance Note making reference to UK Water Industry Research Ltd (UKWIR) guidance (Ref.14.63) which was issued in March 2011.

14.4.27 It is not considered that potential changes to risk thresholds which may result from the updated Guidance Note would change the built environment impact assessment ratings or overall conclusions and recommendations presented within this chapter.

14.4.28 The comparison of the analytical results with the thresholds specified in the above guidance enabled an initial assessment of the risk posed by the HPC development site soils to buried water services and concrete. In terms of assessing the potential for soil to attack/degrade buried concrete, this assessment provides an initial screening analysis on the basis of the total observed sulphate concentrations and pH conditions.

iv. Approach to Ecological Risk Assessment

14.4.29 Criteria for assessing the risk from contaminated soils to ecological systems are currently not well developed in the UK. In October 2008 the Environment Agency published an ecological risk assessment (ERA) framework for contaminated soils (Ref. 14.28) in collaboration with Defra, Natural England, Welsh Assembly Government, the Countryside Council for Wales, local authorities and industry. Guidance document ERA2b (Ref. 14.64) contains guidance on the use of ecological/ecotoxicological Soil Screening Values (SSVs). Table 17 of the ERA2b document provides proposed SSVs for selected contaminants. For those contaminants not covered by the Environment Agency document (Ref. 14.28), the guidance (Ref. 14.64) suggests using alternative sources, of which the following were used in this assessment: US EPA Eco SSLs (Ref. 14.65), Canadian Soil Quality Guidelines (Ref. 14.66), Oak Ridge National Laboratory Screening Benchmarks (Ref. 14.67) and/or Dutch RIVM Serious Risk Concentrations for Ecosystems (SRCeco) (Ref. 14.68).

14.4.30 The proposed SSVs given in the Environment Agency Guidance document (Ref. 14.64) and the other sources have been used as an initial (Stage 1) screening tool to assess whether or not the concentrations of soil contaminants may pose a risk to ecology and ecosystems. The risks posed by contaminants in soil are chiefly determined on the basis of soil environment specific receptors (i.e. invertebrates), however may also include higher animals (i.e. mammals, avian receptors).

14.4.31 These ecological risk SSVs are very conservative, i.e. highly precautionary. There are no statutory designated ecosystems within the HPC development site. However, there are designated sites in adjacent areas (e.g. the Severn Estuary and a SSSI to the south-east).

14.4.32 A staged approach to the assessment of ecological risk has been adopted, whereby observed contaminant concentrations were initially compared with the ecological SSVs described above. Where concentrations exceeded the relevant SSVs a further Stage 2 assessment was carried out where contaminant concentrations were compared to the background concentrations recorded in rural soils in England as published by the Environment Agency in the UK Soil and Herbage Pollutant Survey Reports (Ref. 14.69 and Ref. 14.70).

14.4.33 For soils on the BDAE and SCPA only, a Stage 3 assessment was undertaken where contaminants were recorded at concentrations exceeding the rural England background concentration range for soils. Under the Stage 3 assessment contaminants were compared with site-specific concentration ranges, i.e. the range of concentrations recorded within soils on the BDAW, which are considered to be representative of local background concentrations (as detailed in Section 14.5 b) ii). A Stage 3 assessment for the BDAW area was not undertaken, primarily as this was not required (i.e. because there were no exceedences of Stage 2 screening criteria) but also because the BDAW data was the source of the Stage 3 local background screening concentrations.

Statistical Assessment

14.4.34 Where appropriate, the soil analytical results were subject to statistical tests, using the statistical approach recommended by CL:AIRE/CIEH Guidance on Comparing Soil Contamination Data with a Critical Concentration (Ref. 14.71). The guidance takes two different approaches to statistical analysis of the data based on the aims and context of the investigation. The statistical analysis (using the ESI Statistical analysis tool (Ref. 14.72)) of the contamination data is based on the planning scenario adopted in the current guidance. The 95th Upper Confidence Level (UCL) of the true population mean for each contaminant has been compared to the Critical Concentration (Tier 1 SSVs) to determine whether the site soils contain a potential source of contaminants which may pose an unacceptable risk. For the purpose of the statistical analysis the data are divided into 'populations' (in statistical terms), based on the material characteristics (i.e. Made Ground or natural ground), and where relevant, by geographical area.

v. Approach to Controlled Water Risk Assessment

14.4.35 To assess the risks to groundwater and surface waters, soil leachate concentrations have been compared to appropriate Drinking Water Standards (DWS) (Ref. 14.73) and Environmental Quality Standards (EQS) (Ref. 14.74 and 14.75) for freshwater and coastal and other non-freshwater surface waters. In accordance with the requirements of the Water Framework Directive (WFD) (Ref. 14.4), the published Tier 1 screening values taken from the document, The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010 (Ref. 14.75) have been used where available. All EQS values have been revised in line with the WFD (where applicable).

vi. Ground Gas Risk Assessment

14.4.36 A programme of ground gas monitoring has been undertaken at the HPC development site in accordance with the requirements set out in the guidance document Construction Industry Research and Information Association (CIRIA) 665 Assessing risk posed by hazardous ground gases to buildings (2007) (Ref. 14.76), which is the main UK guidance document for ground gas monitoring and risk assessment. A programme of monitoring has been undertaken on the BDAW in 2009 and on the BDAE and SCPA in 2010, subsequent to the first and second on-shore investigations respectively.

14.4.37 The data collected during the monitoring programme has been used to undertake a Ground Gas Risk Assessment (GGRA) in accordance with the methodology detailed within the guidance document CIRIA C665 (Ref. 14.76). The GGRA is a Tier 1 generic quantitative risk assessment relating to certain high risk gases to human health and buildings. The gas risk assessment methodology is based on the calculation of a Gas Screening Value (GSV) for each of the key parameters (methane and carbon dioxide) which is then compared to the threshold values provided in Table 8.5 of CIRIA C665 (Ref. 14.76). These threshold values determine the gas Characterisation Situation (CS) and the level of risk posed by any exceedence of acceptable ground gas conditions, based on the flow rates and gas concentrations recorded. A gas CS is then described that corresponds to a defined level of protection required to mitigate the risk (Table 8.6 of CIRIA 665, Ref. 14.76).

14.4.38 Hydrogen sulphide and carbon monoxide concentrations recorded during the monitoring programme have been compared to the Health and Safety Executive Workplace Exposure Limits provided in the EH40 guidance document (2007) (Ref. 14.77). An initial screening value of 10ppm for VOCs has been adopted based on the range of concentrations for individual VOC compounds (typical range 1–100ppm) within the EH40 guidance document (2007) (Ref. 14.77).

vii. Approach to Radiochemical Data Assessment

14.4.39 There are no soil guideline values which have been specifically derived to assess contamination with respect to radioactivity. However, the Environmental Permitting (England and Wales) Regulations 2010 (EPR 2010) (Ref. 14.19) provide activity concentration limits for specified naturally occurring radioelements in soil materials. In order to provide a preliminary assessment of the data, threshold values for specified radionuclides were derived from these EPR2010 limits.

14.4.40 For the purposes of the assessment of radiochemical data, threshold values for individual isotopes of the EPR2010-specified elements included in the analysis suite were derived by dividing the elemental limit for each isotope by the number of radioactive isotopes of the element present in the three natural radioactive decay series (uranium-238, thorium-232 and uranium-235). **Table 14.2** presents the derived threshold values for isotopes of the EPR2010 specified elements adopted for the assessment of data.

Table 14.2: Derived Threshold Values for Isotopes of the EPR2010 Specified Elements in Solids

Determinand	Other isotopes in the natural decay series	Total number of isotopes of the determinand in the natural decay series	EPR2010 specified elemental limit for the determinand /Bq g^{-1}	Derived threshold value for the determinand /Bq g^{-1}
Actinium-228⁺	Actinium-227#	2	0.37	0.19
Lead-210*	Lead -211# Lead -212⁺ Lead -214*	4	0.74	0.19
Lead-212⁺	Lead -210* Lead -211#	4	0.74	0.19

Determinand	Other isotopes in the natural decay series	Total number of isotopes of the determinand in the natural decay series	EPR2010 specified elemental limit for the determinand /Bq g^{-1}	Derived threshold value for the determinand /Bq g^{-1}
	Lead -214*			
Lead-214*	Lead -210* Lead -211# Lead -212+	4	0.74	0.19
Protactinium-234m*	Protactinium -234* Protactinium -231#	3	0.37	0.12
Radium-226*	Radium -228+ Radium -224+ Radium -223#	4	0.37	0.093
Thorium-234*	Thorium-232+ Thorium -231# Thorium -230* Thorium -228+ Thorium -227#	6	2.59	0.43
Uranium-235#	Uranium-238* Uranium-234*	3	11.1	3.7

* Present in the uranium-238 natural decay series.
# Present in the uranium-235 natural decay series.
+ Present in the thorium-232 natural decay series

14.4.41 A number of exemption orders have been made under radioactive substances regulations that specify the conditions under which materials or wastes defined as radioactive under EPR2010 are exempt from some or all of its provisions. There are two key exemption orders that are relevant to radioactively contaminated land:

- Statutory Instrument 1986, No. 1002 and amended 1992, No. 647. The Radioactive Substances (Substances of Low Activity) Exemption Order (the SoLA Exemption Order) (Ref. 14.78); and
- Statutory Instrument 1962, No. 2648. The Radioactive Substances (Phosphatic Substances, Rare Earths etc.) Exemption Order (the PSRE Exemption Order) (Ref. 14.79).

14.4.42 The SoLA Exemption Order (Ref. 14.78) exempts solid materials from the provisions of EPR2010 provided that they are substantially insoluble in water and have an activity concentration that is below 0.4Bq g^{-1}. The SoLA Exemption Order is applicable to both natural and anthropogenic radionuclides and the 0.4Bq g^{-1} limit specified is considered to be additional to the background levels of radionuclides (both natural and anthropogenic).

14.4.43 The PSRE Exemption Order (Ref. 14.79) states that material that is radioactive solely because of the presence of one or more of the EPR2010 specified elements (actinium, lead, polonium, protactinium, radium, radon, thorium and uranium) and is substantially insoluble in water, is unconditionally exempted from the provisions of

EPR2010 provided that the activity concentration of each of the specified elements present does not exceed 14.8Bq g^{-1}.

14.4.44 Comparison of results obtained with the threshold values derived from EPR2010 and with the relevant Exemption Order limits provides a preliminary quantitative assessment that determines whether or not the soil could be subject to radioactive substances regulation.

14.4.45 The data derived from the analysis of site soils has also been compared with adopted background values derived from a number of sources. Background data for the HPC development site adopted for the purpose of the following data assessment are taken from a number of sources. Environmental monitoring data acquired from near to the HPC development site have been used preferentially where available, otherwise data relating more generally to the United Kingdom have been used.

14.4.46 Background data adopted for the assessment are taken from the following sources:

- Radioactivity in Food and Environment (RIFE) reports 13 (Ref. 14.80) and 14 (Ref. 14.81). These reports include radionuclide data for anthropogenic radionuclides and carbon-14 in soil samples collected from an unspecified location near the HPC development site in 2007 and 2008;
- DoE/HMIP/RR/93/063 (1993) (Ref. 14.82). This report, commissioned by Her Majesty's Inspectorate of Pollution (HMIP), includes data for naturally occurring radionuclides in soils from various locations in the United Kingdom; and
- UNSCEAR (2000) (Ref. 14.83). This report provides data for radium-226 in soil from the United Kingdom.

14.4.47 The adopted background data are summarised in **Table 14.3**. Values in parentheses indicate calculated mean values and other values are taken directly from the data sources.

Table 14.3: Adopted Radiological Background Values

Determinand	Background Value/Bq g^{-1}
Carbon-14*	0.010 - 0.012 (0.011)
Cobalt-60*	< 0.00023 - < 0.00041 (< 0.00032)
Zirconium-95*	< 0.00090 - < 0.0035 (< 0.0022)
Niobium-95*	< 0.0010 - < 0.0072 (< 0.0041)
Ruthenium-106*	< 0.0025 - < 0.0049 (< 0.0037)
Antimony-125*	< 0.00069 - < 0.0012 (< 0.0009)
Caesium-134*	< 0.00034 - < 0.00064 (< 0.00049)
Caesium-137*	0.0052 - 0.0068 (0.0060)
Cerium-144*	< 0.0020 - < 0.0038 (< 0.0029)
Europium-154*	< 0.00071 - < 0.0013 (< 0.0010)
Europium-155*	< 0.00094 - < 0.0018 (< 0.0014)
Americium-241*	< 0.00097 - < 0.0026 (< 0.0018)
Potassium-40#	0 - 3.2

Determinand	Background Value/Bq g^{-1}
Lead-210#	0.041
Radium-226+	0.037

Values in parentheses are mean values.
*Data from RIFE reports 13 (Ref. 14.80) and 14 (Ref. 14.81).
Data from DoE/HMIP/RR/93/063 (1993) (Ref. 14.82).
+ Data from UNSCEAR (2000) (Ref. 14.83).

14.4.48 In accordance with the methodology outlined above, surveys specifically carried out for the ES include:

i. Built Development Area West

- AMEC. Phase 1 Desk Study and Preliminary Non-Radiological Site Investigation for the Built Development Area West, BPE. Report Ref: 15011/TR/00022. 31 March 2010. (Ref. 14.84).
- AMEC. Baseline Radiological Survey. Report Ref: 15118/TR/00003, BPE. 7 November 2008. (Ref. 14.85).
- AMEC. Phase 2 Supplementary Investigation of Potential Radiological Contamination, BPE. Report Ref: 15011/TR/00091. 28 September 2011. (Ref. 14.86).
- AMEC. Final Ground Gas Assessment for Built Development Area West, BPE. Report Ref: 15011/TR/00123. 9 September 2010. (Ref. 14.87).
- Structural Soils Ltd. Factual Report on Ground Investigation: On Shore Investigations for Hinkley Site, Report Ref: 721763. August 2009. (Ref. 14.88).
- EDF. Onshore geological, geotechnical and hydrogeological interpretive report. Report Ref: EDTGG09014A. 14 October 2009. (Ref. 14.89).

ii. Built Development Area East and Southern Construction Phase Area

- AMEC. Desk Based Assessment and Synthesis Report for the Built Development Area East and Southern Construction Phase Area. Report Ref: 15011/TR/00121. 4 November 2010. (Ref. 14.90).
- AMEC. Radiological Survey Report for Hinkley Point. Report Ref: 15011/TR/00144, BPE. 23 July 2010. (Ref. 14.91).
- AMEC. Phase 2 Contamination Assessment (Non Radiological) of the Built Development Area East and Southern Construction Phase Area, BPE. Report Ref: 15011/TR/00151. 3 November 2010. (Ref. 14.92).
- AMEC. Phase 2 Contamination Assessment (Radiological) of the Built Development Area East and Southern Construction Phase Area, NNB BPE. Report Ref: 15011/TR/00150. October 2011. (Ref. 14.93).
- AMEC. Ground Gas Risk Assessment for the Built Development Area East and Southern Construction Phase Area, NNB BPE. Report Ref: 15011/TR/00166 October 2011. (Ref. 14.94).
- Structural Soils Limited. Final Factual Report on Second Campaign On-Shore Investigations at Hinkley Site. Report Ref: 723335. February 2011 (Ref. 14.95).

iii. Cliff and Foreshore Geology

- AMEC. Geological Survey and Mapping, BPE. Report Ref; 15122/TR/0011. 23 June 2009 (Ref. 14.96).

d) Consultation

14.4.49 Consultation was undertaken throughout the EIA process and further information may be found in the **Consultation Report**. **Table 14.4** summarises the consultation meetings/correspondence with key stakeholders. The scope of work described in this Chapter reflects their comments and advice, as appropriate.

Table 14.4: Key Consultation Meetings for Geology and Land Contamination

Date	Consultee	Type/Purpose of Consultation
09/12/2008	Natural England	Scoping meeting relating to foreshore and cliff geomorphology and geological issues. The purpose of the meeting was to discuss and clarify with Natural England aspects relating to the foreshore and cliff geomorphology and geological issues. Matters discussed included: • Bridgwater Bay National Nature Reserve (NNR) and possible geological designations or interest in the NNR; • clarifying the extent of the Blue Anchor to Lilstock Site of Special Scientific Interest (SSSI), requirements relating to fossil finds; • replication of cliff exposures would reduce Natural England's concerns if a similar quality of exposure could be found elsewhere that was publicly accessible; and • aims and objectives of the proposed geological mapping survey.
		Natural England confirmed that geomorphological designations do not extend to the east of the SSSI boundary and they did not require demonstration that such features are present. Photographing what was present by way of geomorphological features on the foreshore of the study area would be sufficient, i.e. no need to survey and map the geomorphological features (unlike the geological exposures in the cliff face). Natural England stated during consultation that the identification of a replicate, accessible section of units elsewhere within the 'Blue Anchor to Lilstock SSSI' is likely to be acceptable as an offset to the loss of the units exposed within the cliff and rock pavement at Hinkley Point. As a result of consultation, Natural England stated that 'it must be demonstrated that the same geological sequence that is observable and accessible at Hinkley Point is replicated elsewhere along the coastal section, which extends up to a distance of approximately 10km to the west, and that the replicated site is equally accessible to the public.'
09/01/2009	Natural England	Geology and geomorphology site walkover meeting with representatives from Natural England. During the meeting the work for the first section of geological surveying was discussed. The exposures within the stretch of cliff along the study area contain good examples of the interbedded limestones and mudstones of the Blue Lias formation, but in places the extent of the exposure is small (e.g. only 2m high cliffs). All observed that the cliff units at the study area are, in fact,

Date	Consultee	Type/Purpose of Consultation
		replicated in the foreshore. It was agreed that the geological mapping would continue for about 10km to the west of the study area (i.e. beyond the Lilstock section). Good exposures are documented further to the west and these might provide good examples of replicate sites. The outcome of the walkover meeting was that the geological mapping would continue as planned.
09/12/2008	Local Authorities (Sedgemoor and West Somerset)	Scoping consultation meeting. During the meeting a brief summary of the Phase 1 and Phase 2 contaminated land investigations on the Built Development Area West conducted to that point and their findings was presented to the Local Authorities along with the proposals for gas and groundwater monitoring.
01/10/2009	Local Authorities (Sedgemoor and West Somerset)	Presentation/Consultation meeting. The purpose of the meeting was to provide a more up to date and detailed presentation of the Phase 1 and Phase 2 investigations and gas and groundwater monitoring which had been completed at that time on the Built Development Area West and to discuss the future proposed investigations on the Built Development Area East and Southern Construction Phase Area and proposed assessment methodologies.
12/12/2008	Environment Agency	Copy of draft Outline Surface Water, Marine Water, Groundwater and Gas Monitoring Plan sent to Environment Agency for comment.
15/12/2008	Environment Agency	Scoping consultation meeting. During the meeting a brief summary of the Phase 1 and Phase 2 contaminated land investigations on the Built Development Area West conducted to date and their findings were presented to the Environment Agency along with the proposals for gas and groundwater monitoring. Environment Agency explained that as far as they were aware there is no real contaminative history on the Built Development Area West.
28/07/2009	Environment Agency	Presentation/Meeting. The purpose of the meeting was to provide a more up to date and detailed presentation of the Phase 1 and Phase 2 investigations and gas and groundwater monitoring which had been completed at that time on the Built Development Area West and to discuss the future proposed investigations on the Built Development Area East and the Southern Construction Phase Area and proposed assessment methodologies.
27/07/2010	Environment Agency	Presentation/Meeting. The purpose of the meeting was to provide an up to date presentation of the Phase 1 and Phase 2 investigations and gas and groundwater monitoring which had been completed at that time on the site. Also, included discussions on proposed groundwater ConSim modelling.
24/06/2009	Hinkley Point New Build – Water Liaison	During the meeting a brief summary of the Phase 1 and Phase 2 contaminated land investigations and monitoring conducted to date on the Built Development Area West and findings were presented. Discussed Phase 1 desk based assessment report for the

Date	Consultee	Type/Purpose of Consultation
		complementary lands (Built Development Area East and Southern Construction Phase Area) and Phase 2 investigation for these areas planned for August/September 2009.
28/07/2009	Hinkley Point New Build – Water Liaison	Environment Agency stated that all Strategic Siting Assessment (SSA) land would have to be investigated. Environment Agency stated they would like to see Phase 1 and 2 detailed data.
02/09/2009	Hinkley Point New Build – Water Liaison	Meeting to present plans for the second on-shore geophysics, geological and geotechnical works to start in September 2009 for the land to East and South of the SSA boundary (i.e. Built Development Area East and Southern Construction Phase Area).
06/01/2010	Hinkley Point New Build – Water Liaison	Environment Agency stated they would like to see Phase 1 and 2 detailed data.
28/07/2009	Marine Authorities Liaison Group (MALG)	Meeting/presentation at which Phase 1 and Phase 2 non-radiochemical results and findings were discussed and proposals for further site investigation initiated.

e) Assessment Methodology

14.4.50 **Volume 1**, **Chapter 7** of this ES describes the assessment methodology for this EIA. In addition the following specific methodology was applied for the determination of receptor value and sensitivity (see **Table 14.5**) and of impact magnitude (see **Table 14.6**) for geology and land contamination.

i. Value and Sensitivity

14.4.51 Receptors relevant to geology and land contamination that may be impacted by the HPC development were assigned a level of importance in accordance with the methodology described in **Volume 1**, **Chapter 7** of this ES and the guideline definitions of value and sensitivity specific to geology and land contamination shown in **Table 14.5**.

14.4.52 Where a receptor could reasonably be placed within more than one value and sensitivity rating, conservative professional judgment has been used to determine which rating would be applicable.

Table 14.5: Guidelines for the Assessment of Value and Sensitivity

Value and Sensitivity	Guidelines
High	**Geology** Geology has an international or national designation (e.g. Blue Anchor to Lilstock SSSI which extends along approx. 40m of the frontage of the site) and/or has very low capacity to accommodate any change. **Land Contamination** Receptor of high sensitivity and high intrinsic value (e.g. humans, or habitats and ecology within area designated for conservation importance, groundwater abstraction).
Medium	**Geology** Geology has a local or regional designation (e.g. Local Geological Site or the exposed foreshore geomorphology and cliff along the frontage of the site) and/or has low capacity to accommodate any change.

Value and Sensitivity	Guidelines
	Land Contamination Receptor of medium sensitivity and value, i.e. possesses key distinctive characteristics (e.g. important buildings to be constructed on-site).
Low	**Geology** Geology not designated but possesses key characteristics which may be locally important and/or has a high capacity to accommodate change. **Land Contamination** Receptor of low sensitivity and value, i.e. possesses some distinctive characteristics (e.g. groundwater with no significant local use at or adjacent to the site in or down gradient of the likely area of influence).
Very Low	**Geology** Geology not designated and is non distinctive and/or is likely to tolerate the proposed change. **Land Contamination** Receptor of low sensitivity and value, i.e. possesses no distinctive characteristics (e.g. subsoil used for engineering fills).

14.4.53 The potential sensitivity of a receptor can be reduced following the application of standard good practice/control measures, as detailed in Section 14.6. For example, workers on-site may be exposed to (and subsequently impacted by) airborne contaminated dust if released from contaminated materials. However, if respiratory protection is worn, exposure is minimised and the sensitivity of the worker reduced as a result. In effect, if the pathway is not apparent or is managed, then value and sensitivity should be reduced.

ii. Magnitude

14.4.54 The magnitude of impact has been based on the consequences that the proposed development would have upon geology and land contamination receptors, and has been considered in terms of high, medium, low or very low magnitude (see **Table 14.6**). Potential impacts were considered in terms of whether they are permanent or temporary, adverse (negative) or beneficial (positive) and/or cumulative.

14.4.55 A permanent impact is considered irreversible and, consequently, often represents an impact of high magnitude. The sources of impact may arise during construction and/or operation.

14.4.56 Where impact magnitude could reasonably be placed within more than one severity rating, conservative professional judgement has been used to determine which rating would be applicable.

Table 14.6: Guidelines for the Assessment of Magnitude

Magnitude of Impact	Guidelines
High	**Geology** Very significant permanent change to solid geology over the whole site so that it is unrecognisable when compared to the baseline conditions down to substantial depths below the ground surface. **Land Contamination**

Magnitude of Impact	Guidelines
	Soil contamination is considered to pose a high risk to potential receptors with one or more pollutant linkage certain to be present. Site certain to be deemed as Part 2A and/or considered unsuitable for use.
Medium	**Geology** Significant permanent changes to solid geology over the majority of the site so that it is unrecognisable when compared to the baseline conditions down to substantial depths. **Land Contamination** Soil contamination is considered to pose a moderate risk to potential receptors with one or more pollutant linkages likely to be present. Site likely to be deemed as Part 2A and/or considered unsuitable for use.
Low	**Geology** Noticeable but not significant changes to the near surface geology (weathered material) covering a part of the site or a number of isolated locations. **Land Contamination** Soil contamination is considered to pose a low risk to potential receptors with one or more pollutant linkages possibly present. Site possibly deemed as Part 2A and/or considered unsuitable for use.
Very low	**Geology** Noticeable but insignificant changes to the near surface geology (weathered material only) at a small number of isolated locations across the site. **Land Contamination** Soil contamination is considered to pose a very low risk to potential receptors with one or more pollutant linkages unlikely to be present. Site unlikely to be deemed as Part 2A and/or considered unsuitable for use.

iii. Significance of Impacts

14.4.57 The significance of the impact is judged on the relationship of the magnitude of impact to the assessed sensitivity and/or importance of the resource. The methodology to assess the predicted significance of impacts, without mitigation, is outlined in **Volume 1, Chapter 7** of this ES.

14.4.58 The following impact assessment assumes that standard good practice working methods have been implemented on site and compliance with all rules and regulations governing the site. It should be noted that compliance with rules and regulations and standard good construction practices are not considered as formal mitigation (i.e. specific additional mitigation to reduce assessed moderate or major adverse impacts) within this ES.

iv. Cumulative Effects

14.4.59 **Volume 1, Chapter 7** of this ES sets out the methodology used to assess cumulative impacts. Additive and interactive effects between site-specific impacts are considered within this chapter. The assessment of cumulative impacts with other elements of the HPC Project and other proposed and reasonably forseeable projects are considered in **Volume 11** of this ES.

f) Limitations, Assumptions and Uncertainties

14.4.60 Intrusive investigations (i.e. boreholes, trial pits, hand pits and windowless sampling holes), carried out in line with accepted best practice and guidance, were undertaken on the proposed HPC development site to collect site-specific data and to establish robust baseline conditions.

14.4.61 Laboratory analysis was carried out by suitably accredited laboratories which have certified standards of quality control and assurance. The radiochemical analysis was undertaken by a United Kingdom Accreditation Service (UKAS) accredited testing laboratory and with the exception of carbon-14 testing, all tests employed for the work are UKAS accredited. The non-radiochemical analysis was undertaken by a MCERTS (Environment Agency Accreditation system) and UKAS accredited laboratory. However, there are some parameters within the testing suite for which accreditation is not available. The chemical analytical data, provided within the relevant site investigation reports present details of the accreditation status for each of the analytical parameters. All sampling and analysis has been carried out in accordance with appropriate UK best practice and guidance including appropriate quality assurance methods. As such, the analysis undertaken is considered to be reliable and representative of the baseline conditions.

14.4.62 The approach and methodology adopted for this chapter are considered to be both transparent and consistent with relevant guidance. The assessments made represent best professional judgement at the time of writing against the criteria specified.

14.4.63 Prior to site preparation and the main construction works a series of enabling works will be completed as described in **Volume 1, Chapter 6** of this ES. The effective completion of those enabling works is assumed as the baseline for the impact assessment presented in this Chapter. Note that this is different to the current baseline as described in Section 14.5.

14.5 Baseline Environmental Characteristics

a) Introduction

14.5.1 This section of the chapter describes the baseline geological and land contamination characteristics for the proposed HPC development site.

b) Study Area Description

14.5.2 The baseline assessment of land contamination is concerned with the establishment of current conditions within the HPC development site as illustrated in **Figure 14.1**. For the purposes of establishing the wider environmental context, a search radius of 1km has been used. Note that for the purpose of impact assessment, a smaller radius of 500m has been adopted as a realistic distance over which contamination may migrate or travel off-site from potential on-site sources and vice versa under exceptional circumstances.

14.5.3 Eleven off-site highway improvement schemes will also be included in the HPC Project DCO application. They are described in the **Volume 1, Chapter 2** of this ES. The schemes concern land that is presently within the highway, on highway land (such as verges), limited areas of hard surfacing and urban greenspace.

14.5.4 Due to the very minor extent (area and depth) of groundworks required for the delivery of these schemes and the fact that best practice environmental construction control measures will be adopted throughout, it is considered that no impacts associated with existing or future potential land contamination will occur as a result of the highway improvements. Therefore, all eleven schemes are scoped out of the baseline and hence further assessment within this chapter.

14.5.5 The topography of the HPC development site comprises undulating countryside, terminating at Bridgwater Bay to the north at a natural cliff line which descends to a wave-cut platform. The topography of the HPC development site is typical of that in the wider locality, with the exception of the BDAE where the topography has been influenced by a number of man-made features.

14.5.6 Across the built development areas, (i.e. that to be occupied by the built development and the main construction area) ground elevations range from approximately 10m above ordnance datum (AOD) to 35m AOD and across the SCPA ground elevations range from approximately 5m AOD to 28m AOD.

14.5.7 There are a series of man-made topographical features present within the HPC development site, the majority of which are located within the BDAE and which include: a double humped mound; the former Hinkley Point Power Station Visitor Centre (now the British Energy Nuclear New Build Induction Centre); an overflow car park and a helicopter landing pad in the north-eastern corner of the BDAE. There is also surface evidence (in the form of a degraded concrete slab) in the vicinity of the former sewage works which was located adjacent to the boundary between the BDAE and BDAW. As described in **Volume 1, Chapter 6** of this ES, a number of these features have been subject to alterations by way of remediation/removal works, or construction and installation of new features in the Spring and Summer 2011 as part of the enabling works.

14.5.8 Within the BDAW, there are three derelict barn buildings. One is located close to Wick Moor Drove, and the others are located towards the centre of the BDAW. The archaeological significance of these structures is considered within **Chapter 23** of this volume (Historic Environment).

14.5.9 Other man-made topographical features which characterise the HPC development site include a series of hedgerows which demark field boundaries. There are also isolated blocks of woodland present within the northern part of the HPC development site. Two of these blocks are located towards the centre of the BDAW (Newclose Covert and Haysgrove Brake); a further two along the boundary between the BDAW and the BDAE (Whitewall Brake and Seaberton Brake); one extending northwards from the southern boundary of the BDAE (Govetts Copse); and one towards the centre of the SCPA (Bishops Wood).

14.5.10 A number of minor surface watercourses are present within the HPC development site. Holford Stream runs west to east within the northern part of the SCPA. This watercourse flows under Wick Moor Drove and drains into Wick Moor to the east. There are also a series of agricultural drainage ditches present on-site, running along field boundaries. Two drainage ditches are present on the BDAW, one running west to east along a field boundary in the northern part of this land parcel before turning northwards towards the coastline (Hinkley Point C Drainage Ditch). The other drains run west to east at the base of the depression along the boundary of the BDAW and the SCPA. Site reconnaissance has confirmed these drainage ditches to be ephemeral (i.e. seasonally dry) water features (see Surface Water Monitoring Report (Ref. 14.97).

i. Geology

Made Ground

14.5.11 Intrusive investigations undertaken in the BDAW (Ref. 14.84, 14.86) confirmed the absence of any Made Ground (with ground conditions largely comprising topsoil over natural deposits), with the exception of localised deposits associated with the historical farm buildings (Benhole Farm) in the north-western part of the BDAW.

14.5.12 During the Phase 2 supplementary investigation (Ref. 14.86) one location (TRE21, see **Figure 14.5**) in the area of the former Benhole Farm footprint recorded Made Ground deposits comprising slightly gravely cobbly sandy clay with occasional gravel, bricks, glass and clay tile, to a depth of 0.33m. Further investigations targeting this area of Made Ground, conducted as part of the second on-shore investigation, identified Made Ground deposits at three locations (TE82, TE83 and TE84, see **Figure 14.5**) in this area, comprising typically soft dark brown slightly gravelly clay with rare fragments of red brick and mortar to depths of between 0.25m and 0.4m below ground level (bgl). The Made Ground was underlain in TE83 and TE84 by a layer of limestone gravel and cobbles extended to depths ranging from 0.3m to 0.4m bgl.

14.5.13 The investigations conducted as part of the Preliminary Phase 2 Contamination Assessment of the BDAE (Ref. 14.92) identified varying depths of Made Ground across this area, ranging from absent to proven depths of 9.0m within the mounds. Made Ground deposits were found to typically comprise either reworked natural soils (weathered Blue Lias Formation deposits comprising mudstone and limestone), or demolition and construction materials.

14.5.14 The Groundsure Geology and Ground Stability reports (Ref. 14.90) indicated the absence of any known Made Ground deposits on the SCPA, which is consistent with the recorded agricultural land use in this area. During the intrusive investigations undertaken as part of the Phase 2 investigation (Ref. 14.92) Made Ground was found in one location within the SCPA (WS75), which extended to a depth of 0.79m bgl. This was described as stiff dark brown/black gravelly clay, with the gravel comprising fragments of tile, occasional brick, coal and mixed lithology stone, organic rich material and a very low content of glass fragments to 0.59m bgl. This was underlain from 0.59m to 0.79m bgl by mid grey pliable gravelly clay.

Superficial Geology

14.5.15 The majority of the HPC development site is not overlain by significant drift deposits. From intrusive investigations (Ref. 14.86, 14.88), the drift deposits within the BDAW have been confirmed to depths of between 0.26m and 5.5m bgl. These deposits are classified typically as slightly gravelly locally sandy silty clay to a sandy silt/clay. Investigations within the BDAE (Ref. 14.92, 14.95) identified superficial drift deposits to depths of between 0.3m and 4.0m bgl, typically comprising slightly sandy slightly gravely clay.

14.5.16 Also, within the BDAE apparent sediment deposits, believed to be associated with former infilled ponds, were encountered at two isolated locations at depths of between 2.3m and 5.0m bgl.

14.5.17 Superficial deposits were found in a number of locations within the SCPA during intrusive investigations (Ref. 14.92, 14.95), extending to depths of between 0.21m and 4.64m bgl. Superficial deposits mainly comprised topsoil and gravelly clay. Horizons of peat and alluvium were encountered in WS79 and WS713 (both located within the northern part of the SCPA), extending to 3.60m and 4.64m bgl respectively. This correlates with a linear expanse of alluvial deposits (shown by published mapping sources) which is orientated approximately east-west along the boundary between the BDAW and the SCPA. This area of alluvium correlates with the alignment of a fault and the Holford Stream Valley.

14.5.18 Published data sources and earlier investigation reports (Ref. 14.90) indicate that there are certain areas where the drift geology differs from the general classification described above. These include:

- An expanse of alluvial deposits is associated with Bum Brook, which runs along the southern boundary of the HPC development site.
- Undifferentiated Tidal Flat Deposits are shown within three areas outside the HPC development site: the coastal area to the north-west; to the north-east (north-west of the existing Hinkley Point Power Station Complex); and on a large expanse to the east of the HPC development site in Bridgwater Bay.
- Tidal Flat Deposits are located to the east of the HPC development site within North Moor and Wick Moor.
- Drift deposits identified during the studies (Ref. 14.90) undertaken for the former proposed Central Electricity Generating Board (CEGB) Hinkley Point C PWR included head deposits around 1m in thickness, and estuarine alluvium up to 5m thick, comprising soft to firm organic clays. To the east of Hinkley Point B (HPB), fluvioglacial sands between 2.4m and 5.2m thick were found beneath the alluvium (Aspinwall & Company 1996) (Ref. 14.47) as well as a series of peaty deposits.

Solid Geology

14.5.19 The HPC development site is located within the Bristol Channel Basin which is a west-northwest to east-southeast trending basin approximately 30km wide and 150km long and contains a depth of approximately 3,000m of both Tertiary and Mesozoic sediments.

14.5.20 The solid geology in the locality of the HPC development site predominantly comprises the Blue Lias of the Lias Group (Lower Jurassic) and the Triassic Penarth and Mercia Mudstone Groups. The local area geology (which includes the HPC development site) is shown within **Figure 14.2** which is based in the electronic 1:50,000 British Geological Survey map (Sheet 279, 1980).

14.5.21 The BGS Sheet ST24NW (1:10,560 scale) shows the HPC development site to be located on the northern flank of an anticline with a crest orientation running generally east to west. Strata are seen to generally dip gently (10˚) in a direction ranging north-west through north-east. A major north-east to south-west trending faulted zone crosses the footprint of the existing Hinkley Point Power Station Complex, with part of this structure utilised as the cooling water outfall of the existing Hinkley Point Power Station Complex. To the north-west of this fault zone, Whittaker and Green (1983) (Ref. 14.42), as reported in the AMEC Geological Survey and Mapping report (Ref. 14.96), recorded that contours on the base of the Blue Lias bed 147 are parallel to the outcropping strata on the foreshore with a dip between 5˚ and 10˚ to north, north-east.

14.5.22 Fault zone drag is noted in the BGS Memoir (Ref. 14.42) to have resulted in the slight deflection of these strata towards an east-west trend. To the south-east of the fault zone the strata are noted to be folded into a slightly asymmetrical anticline, which plunges to 70˚. The fault zone is indicated in the Memoir to be poorly exposed on the foreshore, masked by the outflow channel. The net throw of the fault is recorded as approximately 4.5m at the foreshore with the downthrow to the south-east. The Memoir further asserts that the net throw on the fault increases to 10.6m further inland (NGR 2128 4624).

14.5.23 The AMEC Phase 1 Desk Study (Ref. 14.84) and Desk Based Assessment (Ref. 14.90) indicated (prior to the undertaking of any confirmatory intrusive investigations) that:

- The SCPA, according to the desk based sources of information, is underlain by the Penarth Group Langport Member, Blue Lias and Charmouth Mudstone Formations with the exception of a small area in the western section of the SCPA. This area is underlain by an inlier of the Mercia Mudstone and Blue Anchor Formations and corresponds with a topographic low to the immediate west of the SCPA.
- To the immediate north of the SCPA an uplifted linear exposure trends east-west and comprises mudstones, siltstones and nodular gypsum of the Triassic Mercia Mudstone Group and mudstones and limestones of the Penarth Group. This area corresponds with the linear depression in the local topography.
- The BDAE is underlain by the Penarth Group Langport Member, Blue Lias and Charmouth Mudstone Formations.

14.5.24 Intrusive investigations undertaken as part of the first on-shore investigation, conducted on behalf of EDF Energy by Structural Soils Ltd., in 2008 (Ref. 14.88), of the BDAW and the subsequent EDF Energy interpretative report (Ref. 14.89) have confirmed and characterised the sequence of geological strata present within this part of the HPC development site. The proven geological sequence comprises a basement of the Mercia Mudstone Group overlain by the Penarth Group, which is in turn overlain by Blue Lias. These deposits subcrop on the site and are covered by a thin veneer of superficial drift which is of variable thickness as detailed above. Cross sections illustrating the geological sequence identified on the BDAW are presented in **Appendix 14A**.

14.5.25 The solid geology of the BDAW area dips to the north by a relatively uniform 7° to 9°. Upthrown strata of the Mercia Mudstone Group outcrop in the southernmost part of the BDAW, in the fields to the south of the main east-west track (Green Lane) which crosses this part of the HPC development site. Penarth Group strata outcrop north of this on the east-west ridge of high ground, forming a steeper rock scarp outcrop succeeded northwards by the Blue Lias Formation which forms the geology all the way to the coastline. The mean dip direction of Blue Lias strata in BDAW (northern part) identified during AMEC mapping is 10˚. Slight deviations to this dip direction may occur due to the influence of small scale faults exhibiting drag/folding.

14.5.26 Previous investigations on the BDAE undertaken by Rendell Palmer and Tritton 1986 (Ref. 14.45) and subsequent cross sections presented within the Allot Atkins Mouchel report (Ref. 14.46) (copies of the relevant cross sections 'D-D', 'E-E' and 'F-F' are presented within **Appendix 14B**) indicate the geology of the BDAE to be similar to that underlying the BDAW, comprising varying thicknesses of Made Ground and natural soils overlying Blue Lias rocks (subcropping in a north to south direction, controlled by the northerly dip of the strata). Underlying the Blue Lias are rocks of the Lilstock and Westbury Formations of the Penarth Group which in turn overlie the Blue Anchor Formation of the Mercia Mudstone Group.

14.5.27 Intrusive investigations (Ref. 14.92, 14.95) undertaken as part of the second on-shore investigation on the BDAE (conducted on behalf of EDF Energy by Structural Soils Ltd.) have confirmed the presence of Blue Lias deposits, at depths starting from 0.1m bgl to 9.0m bgl. The deposits comprise an interbedded sequence of mudstone and limestone units. The upper mudstone units were frequently noted to have been significantly weathered to clay like deposits. Underlying the Blue Lias the top of the Penarth Group has been confirmed at depths of 9.0m and 11.1m bgl towards the southern boundary of the BDAE. This increases to confirmed depths of 68.6m and 71.8m bgl towards the coast. The top of the Mercia Mudstone Group was confirmed at depths of 80.2m and 83.9m bgl near the coast, decreasing to 23.45m bgl further inland.

14.5.28 Intrusive investigations undertaken as part of the second on-shore investigation on the SCPA (Ref. 14.92) have confirmed the presence of mudstone and limestone of the Blue Lias at contact depths ranging from surface to 1.04m bgl. Also, at three locations in the northern section of the SCPA superficial and alluvial deposits were underlain by the Mercia Mudstone Group, at contact depths ranging from 3.6m to 4.64m bgl, which is consistent with the linear expanse of alluvium identified from the desk based assessment.

14.5.29 The AMEC Geological Survey and Mapping report (Ref. 14.96) identifies the foreshore cliffs adjoining the HPC development site as comprising the Blue Lias Formation.

14.5.30 The Charmouth Mudstone Formation (referred to above) was not identified in the cliff sections or by Structural Soils Ltd., during the on-shore investigations of the BDAW, BDAE or SCPA. This formation is younger than the Blue Lias with the lower boundary taken as the top of the Blue Lias Formation (i.e. next formation within the regional stratigraphic sequence).

Stratigraphy and Lithology

14.5.31 A summary of the lithostratigraphical sequence identified within the HPC development site is provided in **Table 14.7**.

Table 14.7: Lithostratigraphical Sequence for the Post-Varsican Rocks of the East Bristol Channel Basin Identified within the HPC development site

Group and Formation			'up-to' thickness (m)	Lithology
Lower Lias	Blue Lias Fm		140	Alternation of shale/mudstone/limestone/mudstone sequences.
Penarth Group	Lilstock Fm	Langport Mb	2	Pale grey limestones with interbedded grey to bluish grey mudstones.
		Cotham Mb	2	Pale grey to greenish grey calcareous mudstones, limestones, siltstones and sandstones.
	Westbury Fm		14	Very dark shaley mudstones and dark grey argillaceous limestones
Mercia Mudstone Group	Blue Anchor Fm		38	Thin dark grey mudstone beds and green to greenish grey mudstone and siltstone beds. Some are dolomitic in part.
	Undifferentiated		484	Upper units are reddish brown mudstones and siltstones (occasionally greenish grey) with halite, gypsum and anhydrite as minor components. Nodules of gypsum and/or anhydrite. Halite as thin fracture infilling.

Table modified from Whittaker, A and Green, G. W. 1983 (Ref. 14.42).
Fm = Formation, Mb = Member

14.5.32 *Lower Lias, Blue Lias:* The Blue Lias comprises very weak to medium strong, thinly laminated to thinly bedded calcareous mudstone, alternating with weak, thinly laminated fissile mudstone and medium strong to strong thinly bedded argillaceous limestone.

14.5.33 *Penarth Group, Lilstock Formation (subdivided into Langport Member and Cotham Member):* The Cotham Member of the Lilstock Formation comprises weak to medium strong, thinly to thickly laminated, green-grey calcareous mudstone with some strong thinly bedded limestone beds, whilst the Langport Member comprises medium strong to strong, thinly bedded argillaceous and micritic limestone.

14.5.34 *Penarth Group, Westbury Formation:* The Westbury Formation mainly comprises very weak to weak, thinly laminated, fissile, dark grey-black calcareous mudstone and siltstone with limestone bands.

14.5.35 *Mercia Mudstone Group, Blue Anchor Formation:* The Blue Anchor Formation comprises mainly grey-green mudstone and siltstone. The siltstone is generally weak to strong thinly laminated to medium bedded, light grey-green with some nodules of gypsum and/or anhydrite and halite as thin fracture infilling. The mudstone is generally weak to strong thinly laminated to thinly bedded, grey (locally dark grey), sometimes calcareous, with some gypsum and anhydrite inclusions as veins or possibly of depositional origin. The Blue Anchor Formation also includes some dolomitic bands.

14.5.36 *Mercia Mudstone Group (Undifferentiated):* The undifferentiated component of the Triassic Mercia Mudstone Group comprises mainly reddish brown mudstones and siltstones. The mudstones are generally weak to strong thinly laminated to thinly bedded, red-brown with some grey colour. The siltstones are generally weak to strong thickly laminated to medium bedded, reddish brown, occasionally green-grey, with localised nodules of gypsum and/or anhydrite and halite as thin fracture infilling.

Designated Geological & Geomorphological Sites

14.5.37 The eastern extent of the 'Blue Anchor to Lilstock' Site of Special Scientific Interest (SSSI) extends into the western part of the BDAW frontage by approximately 40m (based on co-ordinates provided within English Nature 'Geological site documentation/management brief, Blue Anchor to Lilstock Coast', 1993 (Ref. 14.98)). The SSSI designation is for the outstanding series of cliff stratigraphy which comprises interbedded limestones, shale and mudstones of the Blue Lias units. Within the SSSI the exposed stratigraphic units are considered to be amongst the best examples of the Blue Lias outcrop in Europe. Furthermore, the SSSI also has a geomorphological designation for the exposed rock pavement on the foreshore. The location of the SSSI is presented in **Figure 14.3**. Natural England is the principal organisation with responsibility for the designation and management of the 'Blue Anchor to Lilstock' SSSI and Natural England have indicated that they consider the cliff exposure and foreshore geomorphology to be of significant value. The cliff exposure and foreshore along the majority of the frontage of the HPC development site (extending up to the existing seawall to the east of the HPC development site) are not designated but are considered by Natural England to include cliff stratigraphy of significant value and interest.

14.5.38 Consultation has taken place between Natural England and EDF Energy (detailed in **Table 14.4**) with the aim of identifying all potential issues associated with foreshore construction proposals. Of concern to Natural England is the possible loss of exposed Blue Lias units (**Plate 14.1**), together with the loss of the exposed rock pavement features (**Plate 14.2**) along the entire cliff section present within the HPC development site.

Plate 14.1: Looking East from HPC development site Boundary towards the Existing Power Station Complex

14.5.39 Natural England stated during consultation that the identification of a replicate, accessible section of units elsewhere within the ‘Blue Anchor to Lilstock’ SSSI is likely to be acceptable replication that will offset any loss of the units exposed within the cliff and rock pavement at Hinkley Point. Natural England required evidence to demonstrate that the same geological sequence that is observable and accessible at Hinkley Point is replicated elsewhere along the coastal section which extends up to a distance of approximately 10km to the west.

14.5.40 In response to the requirements of Natural England, a geological survey and mapping study (Ref. 14.96) was undertaken with the aim of identifying appropriate candidate sites within the ‘Blue Anchor to Lilstock’ SSSI at which the Hinkley Point Blue Lias units and rock pavement features are replicated and which are equally observable and accessible.

Plate 14.2: Looking North-west from Cliff-top from HPC development site Boundary Showing Hinkley Foreshore Geomorphology

Plate 14.3: Looking North-west from the Range Quadrant Hut, Lilstock towards Kilve Showing Replicate Section Foreshore Geomorphology

14.5.41 The Geological Survey and Mapping report (Ref. 14.96) provides details of the aforementioned study. In summary, the report concludes that a cliff section to the west of Lilstock within the 'Blue Anchor to Lilstock' SSSI provides a high quality replication of the geology found within the cliffs at Hinkley Point (**Plate 14.4**). Furthermore, the report concludes that the replicate section is a more complete example of the exposed units as the greater cliff height enables all of the units to be observed within one discrete section, as opposed to being exposed at a number of different locations throughout the Hinkley Point cliffs. It was also qualitatively demonstrated that the characteristics of the foreshore geomorphology adjacent to the site can be observed elsewhere within the SSSI to the west (**Plate 14.3**).

Plate 14.4: Looking South-east Showing Replicate Geological Section to the South-west of the Range Quadrant Hut, Lilstock

Hydrogeology

14.5.42 The following is a brief overview of the hydrogeology of the HPC development site and surrounding area. Further detail is provided in **Chapter 15** of this volume (Groundwater).

14.5.43 From April 2010, the Environment Agency changed their aquifer designations to be consistent with the Water Framework Directive (WFD). The aquifers previously designated as Major and Minor became Principal and Secondary respectively. The Secondary Aquifers are further divided into Secondary A, Secondary B and Secondary Undifferentiated categories based on the water permeability and storage characteristics of rock layers or drift deposits. The Environment Agency website provides maps of aquifer designations which are split into two different types; superficial and bedrock, these maps (Ref. 14.44) have been reviewed to establish the aquifer properties of the HPC development site. The previous Groundwater Vulnerability Maps (Ref. 14.99) have not been completely withdrawn and should still be referred to when details of soil classes are required. Information on surface soils is not provided on the new maps.

14.5.44 The Blue Lias comprises a Secondary A Aquifer (formerly a Minor Aquifer), with groundwater flow predominantly occurring via bedding planes, joints and fractures in the more competent limestone horizons within the formation. Rocks of the Penarth Group, especially the mudstone and limestone of the Westbury Formation (the lower component) are considered to be generally impermeable, although fault and fracture zones in the Cotham and Langport Members (approximately the upper 4m) may have minor transmissivity. The mudstones of the Mercia Mudstone Group (including the Blue Anchor Formation) are likely to be of insignificant permeability, however are designated as a Secondary B Aquifer (formerly Non-Aquifer).

14.5.45 The Environment Agency Maps (i.e. 1:100,000 scale Groundwater Vulnerability Map (Sheet 42, Somerset Coast) and Aquifer Maps) confirms the HPC development site as being situated on Secondary Aquifers (formerly Minor Aquifer) (variably permeable). Such aquifers can be "*fractured or potentially fractured rocks, which do not have a high primary permeability, or other formations of variable permeability including unconsolidated deposits. Although these aquifers will seldom produce large quantities for abstraction, they are important both for local supplies and in supplying base flow to rivers*".

14.5.46 The lower boundary on the effective groundwater regime in the area may be the base of the Lilstock Formation of the Penarth Group, possibly less than 4m below the base of the Blue Lias.

14.5.47 Regionally, groundwater in the fractures of the Blue Lias is fed by rainfall recharge and flows approximately south to north from the Mercia Mudstone outcrop at Stogursey to discharge into the Bristol Channel, either directly or following baseflow discharge to the surface water system. The Penarth Group/Mercia Mudstone forms a lower boundary to the system.

14.5.48 At the HPC development site, however, this general natural flow regime is intercepted by the upfaulted inlier of Mercia Mudstone along the boundary between the BDAW and the SCPA. The bedrock barrier might effectively 'dam' the groundwater flow sufficiently for water tables to rise and groundwater flow to be diverted into the surface water system as baseflow, especially (in relation to the SCPA) to the Holford Stream.

14.5.49 The HPC development site is likely to be self-contained as a groundwater system, bounded by the Mercia Mudstone/Penarth Groups beneath, the faulted inlier to the south, and the Bristol Channel to the north. There are some minor reversals of groundwater flow due to the geological structure and topography, with some groundwater flowing south into the site surface water drainage features. To the east and west, natural groundwater flow is also generally northwards.

Value and Sensitivity of Geological Receptors

14.5.50 The identified receptors are the on-site geology (i.e. inland geology), the sea cliff exposure and exposed foreshore geology.

14.5.51 The value and sensitivity of the inland on-site geology is assessed as low as no significant visible exposures of bedrock and/or designated/scientific/educational sites of interest occur within the HPC development site. The geology is only of relevance from an engineering perspective (i.e. acting as founding medium or source of engineering fill for the development).

14.5.52 As previously described the eastern limit of the 'Blue Anchor to Lilstock' SSSI extends along the western limit of the coastal frontage of the BDAW (see **Figure 14.3**) by approximately 40m. The value and sensitivity of this section of the cliff exposure and foreshore within the SSSI is considered to be high, as it is nationally designated.

14.5.53 The remaining cliff exposure and foreshore along the frontage of the HPC development site are not designated but are considered by Natural England to include cliff stratigraphy of significant value and interest and therefore the value and sensitivity is considered to be medium.

ii. Land Contamination

Introduction

14.5.54 This section focuses upon the characterisation of baseline soil conditions with respect to radiochemical and non-radiochemical chemical contamination. It also describes baseline contamination characteristics with respect to ground gases as these are often linked to physical and chemical soil conditions and contamination status.

Desk Based Assessment Findings

14.5.55 A review of historical maps and plans undertaken as part desk based assessments for the HPC development site (Ref. 14.84 and Ref. 14.90) has identified that both the BDAW and the SCPA have remained as greenfield agricultural land since the earliest available map (published in 1886). Within the BDAW, Benhole Farm was located in the north-western area until around 1976 when it was demolished to leave a single remnant outbuilding which is still present, along with two other derelict farm buildings. The historical maps and plans also indicate a number of historical ponds on the BDAW, some of which appear to have been infilled.

14.5.56 Within the SCPA a number of historical ponds have been identified, although all but one now appear to have been infilled. Also, a property is identified as being present from 1886 (Corner Farm) and which by 1975 had become derelict and by 2002 had been removed.

14.5.57 The BDAE comprised greenfield, predominantly agricultural land, until the late 1950s when a significant proportion of the BDAE was used during the construction of HPA for construction and fabrication, materials storage, spoil placement, a contractor's accommodation area with associated Above Ground Storage Tanks (ASTs) and boiler houses. Photographic evidence (presented in the desk based assessment (Ref. 14.90) shows the presence of a number of large fabrication buildings and cranes with associated trackways, an access route to the foreshore towards the north-east boundary and spoil deposition in the area of the existing mound feature until 1965 (see **Figure 14.4**).

14.5.58 In 1964, a small sewage treatment works (STW) was constructed towards the western boundary of the BDAE. Later in the 1970s (during the construction of HPB) a further accommodation camp, with associated electrical substations, was constructed on the south-eastern portion of the BDAE (same area as previous accommodation area for HPA).

14.5.59 By 2005 the accommodation camp no longer existed and a visitors' centre (now the British Energy induction centre) was constructed in this area. The BDAE lies within the existing Nuclear Licensed Site.

14.5.60 More recently, an area within the north-western quadrant of the BDAE was used as a temporary spoil placement area (the Nuclear Decommissioning Authority (NDA) temporary spoil mound) to accommodate spoil removed from the construction of the new Intermediate Level Waste (ILW) store on HPA (see **Figure 14.4**). This spoil has since been removed.

14.5.61 Surrounding the HPC development site, land use has remained predominantly agricultural with the exception of the construction and operation of the Hinkley Point Power Station Complex to the east.

14.5.62 From the desk based assessments a number of salient features and potential sources of contamination have been identified for each area. These are summarised as follows, with locations presented on **Figure 14.4:**

- BDAW - historical use of the site as agricultural land, i.e. agricultural crop management and possible sewage and sludge application, the possible storage and maintenance of vehicles and chemicals within farm buildings leading to potential isolated hotspots of contamination, derelict farm buildings and the potential for localised infilling of former pond areas. Possible radionuclide aerial deposition from the existing Hinkley Point Power Station Complex.
- BDAE – presence of infilled ponds, identified areas of materials deposition arising from the construction of the Hinkley Point Power Station Complex, a former waste transfer site (NDA temporary spoil storage area), historical sewage works, former contractor's accommodation areas and construction and fabrication area with associated electrical substations, oil storage tanks and boiler houses. Possible radionuclide aerial deposition from the existing Hinkley Point Power Station Complex.
- SCPA – historical use as agricultural land, i.e. agricultural crop management and possible sewage and sludge application, the possible storage and maintenance of vehicles and chemicals within farm buildings leading to potential isolated hotspots of contamination, derelict farm buildings. Possible radionuclide aerial deposition from the existing Hinkley Point Power Station Complex. The potential for

localised infilling of former pond areas and naturally enriched organic/alluvial deposits.

14.5.63 Within the BDAW and the SCPA the salient features and potential pollutant sources are largely limited to infilled ponds and historical farm buildings. Therefore, there are a limited number of potential contaminative sources including: infilling of historical ponds with potentially contaminated materials; leaks and accidental spills of fuel and oils from agricultural machinery; and use of pesticides, herbicides and fertilisers. A structural survey has identified that there is the potential for cement bonded asbestos to be present within the corrugated roof sheeting on one of the barns (western-most barn, towards the north-western area of the BDAW).

14.5.64 The majority of the identified salient features and potential pollution sources identified on the HPC development site are within the BDAE. Key features include the former sewage treatment works, a licensed waste management site associated with the former NDA temporary spoil placement area, areas of waste disposal/landfill (i.e. the double humped mound feature) and the former accommodation/fabrication compound and associated electrical substations and oil storage tanks and boiler houses (indicative locations are presented on **Figure 14.4**).

Results of the Intrusive Investigations

Intrusive Investigations: Built Development Area West

14.5.65 A series of intrusive investigations have been undertaken on the BDAW. A preliminary non-radiochemical site investigation of near surface soils (<0.3m bgl) was carried in July 2008 (Ref. 14.84). Supplementary investigations were undertaken as part of the extensive first on-shore investigation (August to December 2008) (Ref. 14.88 and Ref. 14.89), with the contaminated land investigations being undertaken in October 2008 (Ref. 14.86). Limited further investigations were also undertaken as part of the second on-shore investigation (November 2009 to August 2010), to target historical pond features and the Made Ground encountered in the vicinity of Benhole Farm (i.e. around exploratory location TRE21). Locations of the exploratory holes advanced on the BDAW are presented in **Figure 14.5**.

14.5.66 The ground conditions as described in Section 14.5 b) i of this chapter comprised natural superficial drift deposits and weathered bedrock, with the exception of a small localised area of Made Ground encountered in the vicinity of Benhole Farm. Selected samples were analysed for a range of chemical contaminants and a risk assessment was conducted in accordance with the methodology outlined in Section 14.4, b) of this chapter. The natural soils were subject to statistical tests using the statistical approach recommended by CL:AIRE/CIEH (Ref. 14.100), resulting in the Upper Confidence Level (UCL) being compared to the critical concentrations (Tier 1 SSVs).

14.5.67 A summary of the investigations including; the frequency and type of exploratory holes, chemical analysis undertaken, summary of the analysis results and risk assessment are presented in **Appendix 14C** and further details are provided in the investigation reports (Refs.14.84, 14.86, 14.88 and 14.89).

14.5.68 The Tier 1 risk assessment identified that all contaminants were recorded at concentrations below the relevant human health SSVs. Thus, it is concluded that there is no source of soil contamination within either the Made Ground or natural soils within the BDAW, which has the potential to pose a significant risk to human health considering a commercial and industrial end use.

14.5.69 The risks to other receptors (i.e. plants, buildings and ecological systems) were also considered as part of the Tier 1 assessment. All concentrations of potentially phytotoxic contaminants were below the SSVs within the natural soils, with the exception of one sample recording an elevated concentration of boron (TRE01, 5.1mg/kg). However, given that the calculated UCL for water soluble boron is below the SSV, water soluble boron at this concentration is not considered to pose a phytotoxic risk in the natural soils.

14.5.70 An elevated zinc concentration (687mg/kg) was identified in a sample of Made Ground (TRE21 0.0-0.3m bgl). The remaining three Made Ground samples taken in the vicinity of TRE21 (area of former Benhole Farm) did show slightly elevated zinc concentrations (328 - 446mg/kg) compared to natural soil concentrations but did not exceed the phytotoxic SSVs. These data along with the elevated concentration (TRE21 687mg/kg) identified in this area suggests the Made Ground does contain slightly elevated concentrations of zinc. However, as only one sample exceeded the phytotoxic SSV for zinc the phytotoxic risk on the BDAW as a whole is considered to be very low.

14.5.71 No concentrations of contaminants in the Made Ground samples exceeded any of the Tier 1 built environment SSVs. Within the natural soils, arsenic was detected at concentrations in excess of the level specified in the WRAS guidance (Ref. 14.60) (i.e. 10mg/kg) but all concentrations were below the WWSSG (Ref. 14.61) value (i.e. 50mg/kg) and therefore arsenic is not considered to pose a risk to water supply pipes. Isolated exceedences of selenium, total TPH and cadmium were identified in natural soils; however, given the isolated and marginal nature of the exceedences the risk posed to the built environment by these contaminants is (as a matter of professional judgement) considered to be negligible. Some slightly elevated pH levels (pH 8.1-8.5), indicating slightly alkaline soil conditions and concentrations of sulphate at two locations (WS85 ES2 0.26% and WS86 WS2 0.4%) were also identified in excess of the level specified in the WRAS guidance. However, given their presence in natural soils it is concluded that the risk posed to water supply pipes by soils within the BDAW is very low.

14.5.72 The slightly elevated concentrations of sulphate identified within the natural soils were also marginally above the BRE Special Digest threshold (0.24%) (Ref. 14.62); however, concentrations were typically low. The concentrations of soluble sulphate indicate that the natural soils pose a low risk of sulphate degradation of buried concrete.

14.5.73 With regards to ecological risk assessment, concentrations of heavy metals (arsenic, cadmium, chromium, copper, nickel, selenium and zinc) observed in both the Made Ground and natural soil samples exceeded the conservative Stage 1 ecological SSVs. Comparison of those elevated concentrations in natural soils with the rural England background soil concentrations (Ref. 14.69 and Ref. 14.70) shows that those concentrations are generally consistent with background levels with the exception of isolated elevated copper and nickel, and marginally elevated selenium and cadmium concentrations. A moderately elevated concentration of cadmium was recorded at one location (TE82, 6-12mg/kg), but this is also considered to be a naturally occurring concentration.

14.5.74 Given the type of materials encountered and that concentrations are largely consistent with rural England background concentrations, the risk posed to ecological systems from contaminants within the natural soils on the BDAW is considered to be negligible.

14.5.75 With respect to the Made Ground, recorded concentrations are generally consistent with rural England background levels (Ref. 14.69 and Ref. 14.70). One slightly elevated concentration of cadmium and a slightly elevated selenium concentration were identified; however, these concentrations are consistent with those found in the natural soils and are therefore not considered to pose a risk. Two elevated concentrations of zinc were identified (446mg/kg and 687mg/kg) which are not consistent with background concentrations and may pose a low risk to ecological systems.

14.5.76 In summary, the range of contaminant concentrations on the BDAW are generally low and considered to be consistent with natural background soil concentrations in the locality and across rural England.

14.5.77 Overall, the intrusive investigations of soils within the BDAW indicate that the risk of significant non-radiochemical contamination being present is very low.

Intrusive Investigations: Built Development Area East

14.5.78 Intrusive investigations have been undertaken on the BDAE as part of the extensive second on-shore investigation between November 2009 and August 2010 (Ref. 14.95). Investigations undertaken to assess the contamination status of this area were undertaken in two phases (November 2009 to February 2010, and June 2010 to July 2010) and comprised the excavation of boreholes, trial pits, windowless sampling holes and hand pits to establish ground conditions, collect soil samples and facilitate gas and groundwater monitoring. Exploratory locations were scoped to provide both representative coverage of the area and to target the identified potential sources of contamination identified during the desk based assessment (Ref. 14.90), (i.e. the former sewage treatment works, the double humped mound feature, areas of Made Ground and former fabrication and accommodation areas). The investigations also included additional exploratory holes advanced to delineate the presence of asbestos-containing materials and one hydrocarbon contaminated area.

14.5.79 In order to facilitate the investigation of the BDAE, the area was divided into six assessment areas based on current and historical land use and topography. Locations of the exploratory holes advanced on the BDAE and assessment areas are presented in **Figure 14.6**.

14.5.80 Intrusive investigations identified the presence of variable depths of Made Ground across the BDAE, ranging from none present to a depth of 9.0m (GB4) within the double humped mound feature. Made Ground deposits typically comprise either reworked natural soils (weathered Blue Lias Formation deposits comprising mudstone and limestone), or demolition and construction materials. Natural superficial (drift) deposits have only been rarely encountered within the BDAE, having been identified in DBH2_23, GB6 and TE61. Apparent sediment deposits (believed to be associated with former infilled ponds) were also identified within TE13 and Tr2_5. Natural Blue Lias deposits (bedrock) were observed at contact depths ranging from 0.1m bgl (DBH2_24) to 9.0m bgl (GB4). Further details on ground conditions are provided in Section 14.5, b).

14.5.81 Selected soil samples were analysed for a range of chemical contaminants and a Tier 1 risk assessment was conducted in accordance with the methodology outlined in Section 14.4 b). This included statistical tests resulting in the UCL of the true population mean (sample populations were dependent on material type, i.e. natural ground or Made Ground and by geographical area) for each contaminant being compared to the Critical Concentrations (Tier 1 SSVs). A summary of the investigations including; the frequency and type of exploratory holes, chemical analysis undertaken, summary of the analysis results and risk assessment are presented in **Appendix 14C** and further details are provided in the investigation reports (Refs. 14.92 and 14.95).

14.5.82 The UCL concentrations for the BDAE are generally below the Tier 1 risk assessment criteria (i.e. relevant SSVs) for risk to human health based on a commercial and industrial end use. However, a potential risk to human health has been identified in the form of the presence of: asbestos-containing materials (ACMs); hydrocarbon contaminated soils in Area 4; and isolated exceedences of PAHs in Area 6.

14.5.83 Asbestos-containing materials were positively identified in isolated areas, primarily associated with the presence of construction and demolition materials within Areas 3 and 4, and isolated locations within Areas 2, 5 and 6 (see **Figure 14.7**). ACMs are discussed in paragraph 14.5.107-14.5.109.

14.5.84 During the advancement of TE418 in Area 4, hydrocarbon-contaminated gravel hardcore (including free phase oil) was encountered between 0.60m bgl and 0.80m bgl. Similar hydrocarbon-impacted shallow Made Ground was also identified in TE418D and TE418E, which were advanced to identify the lateral extent of the contamination found in TE418 (locations presented in **Figure 14.6**). All concentrations of TPH from the visibly hydrocarbon-impacted materials at these locations were found to significantly exceed the relevant Tier 1 human health SSVs.

14.5.85 The contamination within the vicinity of TE418 represents a potential human health risk with the presence of volatile TPH contamination, in excess of the human health screening values. However, the contamination is below the surface beneath a confining layer of hardstanding at 0.6m bgl (exploratory holes logs are included in the Phase 2 Report (Ref. 14.92). Therefore in the current situation, the potential exposure of human receptors at surface is limited and therefore the current risk to human health is considered to be low.

14.5.86 A sample from a shallow horizon of ashy fill deposits in Area 6 (TE63 ES2) was found to exceed the human health Tier 1 SSVs for both total PAHs (100mg/kg) and benzo(a)pyrene (14.1mg/kg). This sample was identified as an outlier, i.e. not chemically representative of the remainder of the Made Ground soils in Area 6 and so was not included in the calculation of the UCL for Area 6. Due to the isolated and marginal nature of the exceedences and the fact that the sample was taken from below the site surface (TE63 ES1 0.5-0.6m bgl) the current risk to human health is considered to be negligible.

14.5.87 With the exception of the ACMs and hydrocarbon-impacted shallow soils, the only visual or olfactory evidence of contamination were observations of hydrocarbon staining in TE42 and the identification of elevated VOCs during in-situ screening of arisings from TE54 using a photoionisation detector (average 6.4 to 10.3ppm, peaks 23.7 and 31.9ppm at 0.3 to 0.5m bgl). The analysis of the soil samples from TE42 showed no elevated concentrations of hydrocarbons and the soil samples from TE54 showed no elevated concentrations of VOCs, therefore no significant contamination is considered to be present at these locations.

14.5.88 Soil pH levels were also identified in marginal exceedence of the BS3882:2007 (Ref. 14.57) limit value for topsoil (8.5pH units) in the natural soils and Made Ground. However, slightly alkaline pH levels are not considered to pose a risk to human health. Moderately alkaline pH levels have been identified in Made Ground in Area 2, 3, 4 and 5 (up to 11.4 units). These alkaline pH values are attributed to the presence of mortar and plaster within construction and demolition materials which can be an irritant to soft tissue. However, the risk to human health from these elevated pH levels is currently negligible.

14.5.89 Concentrations of contaminants in both Made Ground and natural soils within the BDAE were largely below the respective phytotoxic risk thresholds. The Tier 1 threshold for water soluble boron was exceeded in Made Ground in one sample from Area 3 (3.5mg/kg), and one sample from Area 1 (3.6mg/kg). One sample of natural soil was also marginally above the Tier 1 phytotoxicity threshold for boron (4.2mg/kg). Given the marginal and isolated nature of the exceedences the phytotoxic risk posed to vegetation from these concentrations is considered to be negligible.

14.5.90 Within the Made Ground, one sample from Area 5 (TE54 ES2, the location of a former access ramp to the foreshore) was noted to exceed the Tier 1 thresholds for copper (241mg/kg) and zinc (922mg/kg) and one sample from Area 4 (DBH2_27 ES3 at 0.8-0.9m bgl) was noted to exceed the Tier 1 threshold for zinc (589mg/kg). The Made Ground in these locations may pose a low phytotoxic risk to vegetation.

14.5.91 Alkaline pH, above the upper range value (pH 8.5) preferred by most plants (Ref. 14.57), was frequently noted in samples of Made Ground containing significant proportions of construction and demolition materials. Areas of elevated (alkaline) pH (i.e. pH 9.0 or greater, identified only in Made Ground) may therefore pose a low risk to vegetation.

14.5.92 With regard to the built environment, concentrations of total sulphate were frequently identified in Made Ground and, on occasion, in natural soils in exceedence of the BRE DS-1 sulphate class value (0.24%) (Ref. 14.62).

14.5.93 Within the Made Ground, alkaline pH, selenium, sulphate and TPH, and isolated polyaromatic hydrocarbon (PAH) concentrations were recorded slightly above the WRAS risk assessment values (Ref. 14.60). Occasionally elevated sulphate, alkaline pH and isolated selenium concentrations above the WRAS Guidance thresholds have also been recorded in natural soils. As such, the Made Ground, and to a lesser extent natural soils, across the BDAE may not be considered suitable where standard water supply pipes are proposed.

14.5.94 Concentrations of several heavy metals and metalloids and hydrocarbons within both Made Ground and, to a lesser extent, natural soils across the BDAE have been identified in exceedence of Stage 1 ecological soil screening values. Comparison of these concentrations with rural England background soil concentrations (Stage 2) and local background concentrations (Stage 3) identified on the BDAW show that the majority of sample concentrations recorded on the BDAE are consistent with background levels.

14.5.95 The exceptions, which exceed the ecological SSVs, rural England background soil concentrations and local background soil concentrations (i.e. all exceed Stage 2 assessment), in Made Ground are; marginally elevated selenium at isolated locations in Areas 2 and 3 (up to 3.9mg/kg), one sample in Area 4 containing elevated zinc (590mg/kg), one sample in Area 5 containing elevated copper (241mg/kg) and zinc (922mg/kg), elevated PAHs (up to 226.7mg/kg Total PAHs) in Areas 2, 3, 4 and 6 and elevated TPH and PAH in the vicinity of TE418 (up to total TPH Sum C6-C40 up to 28,898mg/kg).

14.5.96 Due to the marginal nature of the exceedences the elevated concentrations of selenium identified are not considered to pose a significant ecological risk. PAHs are present at concentrations which could pose a low ecological risk at one location in Area 2 (WS27), one location in Area 6 (TE63) and in the demolition and construction materials on Areas 3 and 4. Demolition and construction materials at DBH2_27 in Area 4 and TE54 in Area 5 also pose a low ecological risk from zinc and copper, respectively. The hydrocarbon-impacted materials in the vicinity of TE418 also pose an ecological risk.

14.5.97 In the natural soils, one sample in Area 2 and one in Area 4 recorded elevated selenium (3.4 and 3.6mg/kg) and one sample in Area 4 recorded elevated anthracene (2mg/kg). However, due to the marginal and isolated nature of these exceedences they do not pose a significant ecological risk.

14.5.98 No ecological SSV is available for pH, however comparison with background soil pH identifies elevated (alkaline) pH values (above maximum local background, 8.5pH units) in Made Ground and to a lesser extent natural soils. More alkaline pH (pH 9 units and above) which was identified in the Made Ground containing demolition and construction materials may pose an ecological risk, by restricting the range of plant species which may be able to establish and grow successfully in such materials.

14.5.99 In summary, the only significant evidence of contamination identified in site soils within the BDAE relates to the presence of asbestos-containing materials (described below) and a localised zone of hydrocarbon contaminated shallow Made Ground in Area 4 (described below).

Additional Hydrocarbon Analysis

14.5.100 As detailed above, an area of hydrocarbon contaminated soils was noted during the advancement in TE418. During routine groundwater monitoring in CBH2_54 evidence of hydrocarbon contamination was identified in the form of Light Non Aqueous Phase Liquid (LNAPL). A selection of soil, weathered rock and free-phase product samples taken from exploratory holes at and in the vicinity of TE418 (CBH2_56, CBH2_57) and CBH2_54 (CBH2_55) in Area 4 of the BDAE, were submitted for tiered forensic hydrocarbon analysis (Tiers 1 to 3). These forensic tests were largely to confirm the source of the hydrocarbon (i.e. natural or man made), the type of oil, its age and degree of weathering. The initial sampling and testing had already demonstrated that there was an unacceptable risk to human health from the hydrocarbon hotspot around TE418. Therefore the forensic results were not used to further characterise soils within Area 4 for human health risk assessment purposes. A summary of the results of forensic analysis are presented in **Appendix 14C**.

14.5.101 Monitoring and sampling and analysis of groundwaters has been undertaken at the hydrocarbon affected boreholes CBH2_54, and also in CBH2_55, CBH2_56 and CBH2_57. Details of this monitoring are provided in **Chapter 15** of this volume (Groundwater).

14.5.102 In addition to the analysis of the samples identified above for forensic hydrocarbon testing, three samples of shallow natural soil (CBH2_56 ES3 (3.0-3.15m bgl), CBH2_56 ES4 (4.4-4.5m bgl) and CBH2_57 ES1 (6.0-6.1m bgl)) were scheduled for analysis for speciated PAHs, TPH CWG and BTEX testing. A summary of the results is presented in **Appendix 14C**.

14.5.103 The results of analysis show significantly lower hydrocarbon concentrations than those found in Made Ground in TE418, TE418D and TE418E, with a maximum recorded TPH C5-C35 concentration of 308mg/kg (CBH2_56 ES3) and maximum total PAH concentration of 1.25mg/kg.

14.5.104 The results of chemical analysis show marginal exceedences of the human health risk assessment criterion for aliphatic TPH in the carbon band range C12-C16 for the samples taken from CBH2_56 ES3 (3.0-3.15m bgl) and ES4 (4.4-4.5m bgl), and CBH2_57 ES1 (6.0-6.1m bgl), which incorporates volatile contaminants that may pose a potential vapour inhalation risk even in the event that no direct soil particle inhalation or dermal contact pathways may exist. The Tier 1 Human Health SSV for aliphatic C12-C16 is however very conservative as, in line with Environment Agency guidance (Ref. 14.27), the SSV is set at the theoretical solubility saturation limit (24mg/kg) for the specific soil type and fraction of organic carbon. The actual risk based SSV (when not limited by solubility saturation) is 61,000mg/kg, which the concentrations in CBH2_56 and CBH2_57 are significantly below.

14.5.105 The results also indicate a risk may be posed by elevated Total TPH concentrations to potable water services, as the concentrations in all three analysed samples exceeds the 50mg/kg WRAS materials selection threshold (Ref. 14.39) for Total TPH and for some ‘high end' hydrocarbon fractions.

14.5.106 The results are all below the relevant ecological risk assessment criteria with the exception of one sample, CBH2_56 ES4, which at 1.25mg/kg exceeds the most conservative Total PAH SSV (1.1mg/kg). This is however within the rural England background concentration range (up to 16.8mg/kg), and as such is not considered to be significant.

Asbestos Containing Materials

14.5.107 Suspected ACMs have been identified at several locations across the BDAE. **Figure 14.7** shows the locations of the occurrence of suspected and confirmed ACMs identified during site investigation works and **Table 14.8** summarises the locations and types of ACM found. ACMs (confirmed by laboratory testing) have been identified at sixteen locations as both competent, cemented materials (asbestos cement) and as fibrous lagging and insulation materials. The presence of ACMs is restricted to Made Ground and appears to be associated with the occurrence of construction and demolition materials.

14.5.108 The analysis of the soil samples targeting ACMs or suspected ACMs, and further soil samples from elsewhere on the BDAE which were screened for diffuse asbestos fibres, have not been found to contain asbestos fibres in quantities greater than 0.01%w/w (ICRCL 64/85 Asbestos on Contaminated Sites threshold (Ref. 14.101)) with the exception of one location (TE55/WS55A ES2 (0.5-0.8 m bgl), free fibres 2.74% by w/w), in the northern part of Area 5 (within fill occupying the probable former access ramp to foreshore, now infilled). As such the risk from these ACMs and free fibre release from the soils in their current state on the Built Development East is considered to be low.

Table 14.8: Locations of Suspected and Confirmed Asbestos Containing Materials on the Built Development Area East

Location	Depth (m)	Material Type	Ground Conditions & Location
GB2	0.0-2.0	Asbestos cement board	MG Area 6
TE312EX	0.0-0.8	Painted cement with fibres	MG Area 6
TE55/WS55A	0.3-1.2	Fibrous board bonded to wire, fibrous clusters	MG Area 5
	1.2-1.35	Bonded asbestos fibres	
	1.45-1.5	Bonded asbestos fibres	
	1.5-3.8	Loose and bonded asbestos fibres	
TE51	0.1-0.2	Asbestos bonded cement	MG Area 5
TE54 (S)	0.3-0.5	Asbestos pipe lagging	MG Area 5
TE54A	0.3-0.5	Cream and white lagging	MG Area 5
TE54B	0.4-1.7	Asbestos pipe lagging and hard set product	MG Area 5
TE54C	0.2-0.7	Cream and pink lagging	MG Area 5
H2 (Serco sample)	0.4	Asbestos bonded cement and potential asbestos lagging	MG Area 5
BH4 (Serco sample)	0.0-0.5	Asbestos bonded cement	NP Area 5
TE411	0.7-0.9	Amosite pipe lagging	MG Area 4
TE411A	0.0-1.1	Off-white fibres	MG Area 4
TE411B	0.0-1.35	White fibres	MG Area 4
TE412	0.2-0.5	Asbestos bonded cement	MG Area 4
TE415	0.7 and 0.9	Asbestos bonded cement	MG Area 4
TE417	0.4-0.8	Cement bonded tile	MG Area 4
TE418	0.0-0.3	White fibres	MG Area 4
TE418E	0.4-0.6	Tar bound concrete gravel (visible fibres)	MG Area 4
TE425	0.3-0.7	Asbestos cement tiles	MG Area 4
TE426	0.5-0.7	Asbestos cement tiles	MG Area 4
CBH2_57	0.0-0.28	Asbestos bonded cement	MG Area 4

Location	Depth (m)	Material Type	Ground Conditions & Location
DBH2_27	0.5-0.75	Asbestos fibres (crysotile)	MG Area 4
DBH2_27a	0.4-0.8	Black and pale fibres	MG Area 4
DBH2_27b	0.5-0.8	Pale fibres	MG Area 4
DBH2_22	0.0-0.35	Asbestos corrugated cement	MG Area 4
DBH2_22c	0.4-0.5	Asbestos bonded cement	MG Area 4
CBH2_30	0.2-0.4	Vinyl Bonded Asbestos Tile	MG Area 4
TE31	0.3-0.4	Mill board or lagging material	MG Area 3
TE34	0.5-0.8	Asbestos insulation material	MG Area 3
TE34A	0.6-0.8	Asbestos insulation material	MG Area 3
TE34B	0.3-0.4	Asbestos insulation material	MG Area 3
TE37	0.8-1.6	Asbestos bonded cement	MG Area 3
TE37d	0.7-1.5	Asbestos bonded cement	MG Area 3
TE216	0.0-0.3	Asbestos bonded cement	MG Area 2

14.5.109 At the time of writing, further asbestos investigations (principally within Areas 3, 4 and 5) are being undertaken by EDF Energy. These investigations are still 'work in progress', however, any additional areas of ACM that may be found will (wherever possible) be dealt with ahead of the site preparation works as part of the enabling/remedial works consented by Somerset County Council (see paragraphs).

Waste Acceptance Criteria (WAC)

14.5.110 As part of the investigation WAC analysis has been scheduled on 23 samples from across the BDAE to provide an initial assessment of the waste acceptance classification which materials may fall into should they require disposal off-site. All samples analysed were of Made Ground material with the exception of two samples of natural soil materials (weathered Blue Lias mudstone in TE12 ES2 and apparent pond sediment in TE13 ES4). A summary table of results and comparison with assessment criteria is presented in **Appendix 14C**.

14.5.111 The results of WAC testing indicate that exceedences of the leachable criteria for inert waste have been recorded for molybdenum (four samples of Made Ground within Area 3 containing demolition and construction materials and four samples of Made Ground from Area 4) and sulphate (three samples from Made Ground comprising natural reworked soils in Area 3). The two samples taken from the localised zone of visible hydrocarbon contaminated soils in Area 4 (TE418 ES2 and TE418D ES1) also recorded exceedences of the inert waste threshold for mineral oil and Total Organic Carbon (TOC). Concentrations of TOC in these samples also exceeded the threshold for stable non-reactive waste threshold and the concentration recorded in TE418D ES1 also exceeded the threshold for hazardous waste.

14.5.112 The results of WAC testing indicate that concentrations of contaminants are generally below the inert and hazardous waste criteria. However, Made Ground containing construction and demolition materials and some of the natural reworked soils would appear more likely to be categorised as non-hazardous for disposal purposes based on the exceedences of the leachable criteria for inert wastes.

14.5.113 In addition to the standard WAC testing described above, an assessment of the type and concentration of non-radiochemical contaminants in the soils of the BDAE was undertaken to see if they may contain any Dangerous Substances and/or possess any of the Hazard Properties (H1 to H14). The conclusion of this assessment is that with the exception of ACMs and the hydrocarbon contaminated soils present in Area 4 around TE418, the soils on the BDAE would not be deemed to be hazardous waste. Soils containing ACM, or elevated concentrations of hydrocarbons (usually >1000 or 10,000 mg/kg) are likely to be deemed as hazardous waste.

14.5.114 Consultation with the Environment Agency and the receiver of the wastes will be necessary, in the event that off-site re-use or disposal of soil material is required, to determine whether the materials can be accepted as inert waste or alternatively whether a non-hazardous or even hazardous (e.g. in the case of ACMs and the hydrocarbon hotspot at TE418) classification will be applied with respect to chemical contamination.

Soil Leachability Analysis

14.5.115 Soil leachability testing has been carried out on fifteen samples comprising two samples of natural soils, eight samples of Made Ground containing construction and demolition materials (including two samples from the hydrocarbon impacted trial pit TE418, which were analysed for PAHs and TPHs only) and five samples of Made Ground comprising reworked natural soils. The soil leachability results have been used to conduct a Tier 1 controlled waters risk assessment in accordance with the methodology presented in Section 14.4, b). A summary of the results and risk assessment are presented in **Appendix 14C**.

14.5.116 The analytical results for the soil leachate tests indicate concentrations are generally below the Tier 1 assessment criteria with the exception of isolated exceedences of chromium, lead, copper, selenium, cyanide and TPH. These exceedences of metals and cyanide were confined to locations in Area 3 (TE38; copper), Area 4 (TE415; copper, chromium, WS48; cyanide and WS75; chromium) and Area 6 (GB2; copper, lead and TE63; copper, lead) and do not represent a significant source of leachable contaminants which may pose a risk to controlled waters. The leachate analysis for TPH in TE418 (two samples) showed elevated concentrations of aromatic and aliphatic hydrocarbons (mainly aliphatic TPH in the carbon range C16 to C35). The TPH concentrations from both samples (879µg/l and 390µg/l respectively) significantly exceed both the DWS and freshwater EQS Tier 1 screening values, indicating that this contamination poses a potential risk to controlled waters via leaching.

14.5.117 With the exception of the localised zone of hydrocarbon-contaminated soils in the vicinity of TE418, no other mobile contaminant soil source term has been identified within the exploratory holes advanced during the intrusive investigations. Within the BDAE contaminant concentrations in soils do not indicate the presence of gross contamination or a significant potential source of leachable contamination.

Chapter 15 of this volume provides further assessment of groundwater conditions with respect to these hydrocarbon contaminated soils.

Intrusive Investigations: Southern Construction Phase Area

14.5.118 Intrusive investigations have been undertaken on the SCPA as part of the extensive second onshore investigation between November 2009 and August 2010 (Ref. 14.95). Investigations undertaken to assess the contamination status of this area were undertaken in June 2010 and comprised the excavation of boreholes, windowless sampling holes and hand dug pits to establish ground conditions, collect soil samples and facilitate gas and groundwater monitoring. Exploratory locations were positioned to provide coverage of the SCPA in general and to target possible infilled former ponds. Locations of the exploratory holes advanced on the SCPA are presented in **Figure 14.8**.

14.5.119 During the intrusive investigations Made Ground was encountered at one location only (WS75) extending to 0.79m bgl and at the other locations ground conditions generally comprised of topsoil over natural superficial deposits or weathered mudstone. Further details on ground conditions are provided in Section 14.5, b), i. The soils samples were collected and analysed for a range of chemical contaminants and a Tier 1 risk assessment was conducted in accordance with the methodology outlined in Section 14.4, b). The analytical results were subject to statistical tests, the UCL of the natural ground for each contaminant being compared to the relevant Critical Concentration (Tier 1 SSVs). A summary of the investigations including: the frequency and type of exploratory holes, chemical analysis undertaken, summary of the analysis results and risk assessment are presented in **Appendix 14C** and further details are provided in the investigation report (Refs. 14.92, 14.95).

14.5.120 The concentrations recorded in the soil samples from both Made Ground and natural soils were below the human health Tier 1 assessment criteria for residential without plant uptake land use. Levels of pH were in slight exceedence of the BS3882:2007 Topsoil Specification (Ref. 14.57) limit value (8.5pH units) in four natural soil samples (up to 8.9pH units), however, these slightly alkaline pH levels do not pose a risk to human health. No asbestos-containing materials were found in any of the exploratory holes in the SCPA.

14.5.121 Contaminant concentrations in soil samples from both the Made Ground and natural soils were below the phytotoxic SSVs, with the exception of one sample of natural soil (WS713 ES4) which exceeded the water soluble boron phytotoxicity SSV (31.6mg/kg compared to 3mg/kg). This sample was taken from a horizon of peat extending to depths ranging from 1.71m bgl to 3.59m bgl and the elevated boron concentration is of natural origin. This isolated exceedence does not pose a significant phytotoxic risk.

14.5.122 In general, the concentrations of the determinands which may pose a risk to concrete structures and water supply pipe materials have been recorded below the Tier 1 criteria with the exception of sulphate and pH levels. The single sample of Made Ground sample (WS75 ES1) and six of the seventeen natural soil samples exceed the WRAS (Ref. 14.60) sulphate limit (0.2%) and all but one natural soil sample also exceed the BRE SD1 (Ref. 14.62) sulphate value (0.24%). The elevated sulphate concentrations noted in the natural soils are of natural origin, as no physical evidence of anthropogenic contamination of the natural soils was noted, and the SCPA has no history of potentially contaminative use with respect to sulphate. Eleven of the natural soil samples and the Made Ground samples also exceeded the WRAS Tier 1 upper threshold for pH. The presence of naturally elevated pH and sulphate levels may pose a very low risk to potable water supply pipes and buried concrete structures.

14.5.123 One sample of natural soil (WS714 ES4), taken from natural alluvial strata, was found to exceed the WRAS threshold for cadmium. The cadmium concentration (5.2mg/kg) in this sample is noticeably higher than in other natural soil samples on the SCPA. However, this concentration is considered to be naturally occurring, as an elevated cadmium concentration was also identified in natural soil on the BDAW and the sample was taken from a significant depth with natural ground (1.50 – 1.80m bgl).

14.5.124 Elevated concentrations of chromium, mercury, zinc and selenium were recorded in the Made Ground sample when compared to the conservative ecological SSVs, however concentrations are within the rural England background soil concentration ranges. Concentrations of arsenic, chromium, cadmium, mercury, copper, nickel, zinc and selenium in natural soils were also found to exceed the ecological SSVs. Comparison with the rural England and local background concentration ranges indicates marginally elevated cadmium and nickel in one sample (TE714 ES4). However, these concentrations are naturally occurring and given that concentrations of contaminants on the SCPA are generally consistent with rural England background concentrations, the risk posed to ecological systems from contaminants within the soils on the SCPA is considered to be negligible.

14.5.125 Overall the intrusive investigations of soils within the SCPA identified the risk of significant non-radiochemical contamination being present to be very low.

Results of Radiological Surveys and Investigations

Built Development Area West

14.5.126 A series of assessments relating to the radiological conditions on the BDAW were undertaken. A Baseline Radiological Survey (Ref. 14.85) was undertaken in July 2008, which involved a radiological walkover survey and the collection and radiochemical analysis of surface soil samples (surface scrapes <0.2m bgl). This information was augmented by a Phase 2 Supplementary Investigation of Potential Radiological Contamination (Ref. 14.86). Soil samples were collected from the trial trenches excavated as part of the first on-shore investigations in 2008 (Ref.14.88 and 14.89) and selected samples were subjected to analytical testing for a range of radiochemical contaminants. Locations of the radiological survey and sampling on the BDAW are presented on **Figure 14.9**.

14.5.127 A summary of the surveys and investigations including; the frequency and type of exploratory holes, radiochemical analysis undertaken, summary of the analysis results and data assessment are presented in **Appendix 14D** and further details are provided in the investigation reports (Refs. 14.85 and 14.86).

14.5.128 The site radiation walkover survey recorded measurements that were low, being at or below expected background values for the area.

14.5.129 The radiochemical analysis results for the soil samples from the BDAW show that there is no evidence of significant contamination with anthropogenic radionuclides, and that the levels of radionuclides present are generally consistent with background levels. This conclusion is based on the following observations:

- The only anthropogenic radionuclide measurable by gamma spectrometry detected in any of the samples was caesium-137. Caesium-137 was detected in all of the surface samples at levels consistent with background due to global atmospheric fallout and significantly below.
- Carbon-14, which can be present both naturally and from anthropogenic sources, was detected in one of the samples at levels consistent with adopted background values. The level detected was significantly below The Radioactive Substances (Substances of Low Activity) Exemption Order (Ref. 14.78) limit of 0.4Bq g^{-1}.
- Tritium was detected in two of the samples at levels below The Radioactive Substances (Substances of Low Activity) Exemption Order (Ref. 14.78) limit of 0.4Bq g^{-1}.
- There were three instances of naturally occurring radionuclides (one for protactinium-234m and two for radium-226) exceeding screening values derived from the EPR2010 (Ref. 14.19). In all cases, the levels were below the EPR2010 limits for the relevant specified elements.

14.5.130 The results of the radiological investigation of the BDAW were the subject of a paper produced by the Green Audit organisation. This paper alleged, that on the basis of the radiochemical analysis results reported, the BDAW was contaminated with 10 tonnes of enriched uranium. The allegation was based on the derivation of uranium isotope ratios from the high-resolution gamma spectrometry results reported for the soil samples analysed. Green Audit calculated the uranium isotope ratio by taking the ratio of the thorium-234 result (which is an indicator of uranium-238) to the uranium-235 result. Their calculation showed, that in some cases, the isotope ratio was lower than that expected if the uranium was present in the natural isotope ratio, i.e. it was enriched. However, the calculation failed to take into account the analytical uncertainties associated with the results, which for the thorium-234 and uranium-235 measured by high-resolution gamma spectrometry were relatively high. If these were accounted for, the observed isotope ratio for an individual soil sample would range from lower than the natural ratio (enriched) to higher than the natural ratio (depleted) and would include the natural ratio. Due to the high uncertainties associated with the isotope ratio measurement determined by high-resolution gamma spectrometry, the approach adopted by Green Audit for establishing the presence of enriched uranium cannot be considered reliable. The use of high-resolution gamma spectrometry in the BDAW investigation was never intended to be used for determining uranium isotope ratios; it was used to identify and quantify a range of fission and activation products and to provide some quantitative information with regard to naturally occurring radionuclides. A more appropriate technique for measuring uranium isotope ratios reliably is mass spectrometry.

14.5.131 In addition to the unreliable methodology used by Green Audit to establish the presence of enriched uranium on the BDAW, it was considered implausible that 10 tonnes of enriched uranium could be present on the site. Hinkley Point A did not use enriched uranium fuel; hence the origin would be assumed to be from Hinkley Point B. The alleged quantity of enriched uranium present on the BDAW would equate to the entire uranium content of 200 fuel elements from Hinkley Point B, which corresponds to approximately 8000 fuel pins. Leaks from fuel pins are rare and predominantly involve the release of fission products; hence it is inconceivable that large amounts of irradiated fuel could have been lost without a significant release of fission products. Such a release would have been picked up by monitoring carried out by the site operator and the Environment Agency. In addition, the results from the BDAW did not identify the presence of significant levels of fission products. There is therefore not a credible mechanism for the losses of enriched uranium claimed by Green Audit.

14.5.132 In response to Green Audit's enriched uranium allegations, the Environment Agency commissioned a follow-up survey of the BDAW (Ref 14.102), which involved sampling of soil and its analysis specifically for uranium isotope ratios and uranium concentrations. Samples were collected from locations on the BDAW and for comparison purposes from farm land at distances ranging from five to 11km outside the BDAW. The samples were measured by high-resolution inductively coupled plasma mass spectrometry to provide precise and reliable uranium isotope ratio measurements. The results of the survey showed that the uranium isotope ratios were consistent with natural uranium; hence confirmed that enriched uranium was not present on the BDAW. In addition, the uranium concentrations measured were found not to be significantly higher than those expected.

Built Development Area East and Southern Construction Phase Area

14.5.133 A series of assessments relating to the radiological conditions on the BDAE and SCPA were undertaken. A non-intrusive radiological survey (Ref. 14.91) was undertaken on the BDAE and SCPA in October 2009. The survey locations are presented in **Figure 14.10** and **Figure 14.12**. This was augmented by the collection of soil samples during the investigations into the contamination status of the BDAE and SCPA (Ref. 14.92), undertaken from November 2009 to February 2010 and from June 2010 to July 2010. Selected samples were submitted for a range of radiochemical analysis and the analytical data was used to undertake a Phase 2 Radiological Contamination Assessment of the BDAE and SCPA (Ref. 14.93). Sampling locations are presented in **Figure 14.11** and **Figure 14.12**.

14.5.134 During the Phase 2 intrusive investigation works (Ref. 14.92), two locations were identified along the western boundary of the BDAE (TE312 and GB2, see **Figure** 14.11) that provided elevated radiation readings during routine health physics monitoring which was undertaken throughout the on-site works. As a result of this, a further six samples were collected from the two locations and submitted for radiochemical testing for a range of determinands that would enable the identification and quantification of a wide range of both naturally occurring and anthropogenic radionuclides.

14.5.135 A summary of the surveys and investigations including; the frequency and type of exploratory holes, radiochemical analysis undertaken, summary of the analysis results and data assessment are presented in **Appendix 14D** and further details are provided in the investigation reports (Refs. 14.91 and 14.93).

14.5.136 In general, the walkover survey recorded measurements that were low, being at or below expected background values for the area. The environmental gamma dose rates measured were also generally consistent with background levels. The radiological survey did, however, identify an area of elevated radiation readings close to the eastern boundary of the BDAE land adjacent to HPA. These findings were consistent with a previous walkover survey carried out on the BDAE land by Serco Assurance in 2008 (Ref. 14.49). The annual dose in excess of background based on commercial occupancy of the most elevated survey location would be 0.071mSv a^{-1} based on external radiation only. This constitutes 7.1% of the annual dose limit for members of the public (1mSv a^{-1}) (Ref. 14.103), and is 23.8% of the dose constraint adopted by the Environment Agency (0.3mSv a^{-1}) in their contaminated land guidance (Ref. 14.104).

14.5.137 The radiochemical analysis results for the soil samples from the BDAE and SCPA show that there is no evidence of significant contamination with anthropogenic radionuclides and that the levels of radionuclides present are generally consistent with background levels:

- The only anthropogenic radionuclides detected were caesium-137 and americium-241. The levels of caesium-137 detected were consistent with background due to global atmospheric fallout. Americium-241 was detected in two samples at low levels. One of the positive americium-241 results was reported at a level close to the limit of detection and was for a duplicate sample (DBH2_27 ES1D). The americium-241 result for the associated sample from this location (DBH2_27 ES1) was reported as a “less than” value. The other positive americium-241 result reported (0.0140 ± 0.0024 Bq g^{-1}) was for Tr2_5 ES1D. In this case, there was no duplicate sample with which to compare the value reported and there was no analytical reason to discount the result. Overall, levels of anthropogenic radionuclides detected were significantly below The Radioactive Substances (Substances of Low Activity) Exemption Order (Ref. 14.78) limit of 0.4Bq g^{-1}.
- Carbon-14, which can be present both naturally and from anthropogenic sources, was detected in a number of the samples at levels consistent with adopted background values. The levels detected were significantly below The Radioactive Substances (Substances of Low Activity) Exemption Order (Ref. 14.78) limit of 0.4Bq g^{-1}.
- Tritium, which can be present both naturally and from anthropogenic sources, was detected in one sample at a level close to the limit of detection and significantly below The Radioactive Substances (Substances of Low Activity) Exemption Order (Ref. 14.78) limit of 0.4Bq g^{-1}.
- With the exception of samples collected from three locations in Area 6 (TE312, TE312A and GB2), gross alpha and gross beta results were consistent with values reported for the BDAW.
- With the exception of samples collected from three locations in Area 6 (TE312, TE312A and GB2), the levels of naturally occurring radionuclides present would not result in the levels of specified radioelements exceeding EPR2010 (Ref. 14.19) limits.

14.5.138 The results for the targeted samples collected from GB2, TE312, TE312A and TE312B provide no evidence of contamination by anthropogenic radionuclides. However, the levels of naturally occurring radionuclides from the uranium-238 and uranium-235 decay series from selected locations (GB2, TE312 and TE312A) were elevated when compared with the range of results observed for the rest of the BDAE. The levels of uranium-238 series radionuclides observed at these locations fell within the range of 1 - 2Bq g^{-1}. This compares with an upper level for these radionuclides in samples collected from the rest of the site of approximately 0.09Bq g^{-1}. The gross alpha and gross beta levels were also elevated compared with the rest of the site due to the elevated levels of these naturally occurring radionuclides.

14.5.139 The levels of uranium-238 and uranium-235 natural series radionuclides in the samples from these locations are such that the levels of lead, polonium, protactinium, radium and thorium exceed their respective EPR 2010 (Ref. 14.19) elemental limits. However, the levels of all of these elements are below the Radioactive Substances (Phosphatic Substances, Rare Earths etc.) Exemption Order (Ref. 14.79) limit of 14.8Bq g^{-1} and hence should be exempt from radioactive substances regulation. The elevated natural uranium is likely to be associated with granite chippings observed at these locations.

Quantitative Radiological Risk Assessment

14.5.140 The radionuclide data for the HPC development site was compared to adopted screening values derived from the EPR2010 limits and relevant Exemption Orders and with background values from a variety of sources (see **Table 14.3**) . With the exception of samples from three locations along the western boundary of the BDAE (TE312, TE312A and GB2), the soil sample results for the HPC development site are generally consistent with adopted background values and below the adopted screening values.

14.5.141 A generic quantitative risk assessment of the HPC development site was carried out on the basis of the elevated levels of natural uranium identified along the western boundary of the BDAE. The assessment was carried out using the Environment Agency's Radioactively Contaminated Land Exposure Assessment Methodology (RCLEA) which was updated and re-issued in June 2011 to include doses due to radon in buildings. The methodology makes use of a set of mathematical models and data that calculate radiation doses from radionuclides in soil. These are included in a Microsoft Excel® software application published as CLR15 (Ref. 14.105), which is accompanied by a detailed technical report, CLR14 (Ref. 14.106), and user guide, CLR13 (Ref. 14.107).

14.5.142 The assessment was made using the following assumptions and inputs into the RCLEA software:

- the activity concentrations for uranium-238 and uranium-235 were based on the results reported for sample TE312 RAD1D, which provided the highest values for these two radionuclides. The uranium-238 concentration used was calculated by averaging the thorium-234, protactinium-234m, radium-226, lead-214 and bismuth-214 results reported for TE312 RAD1D (1.82Bq g^{-1}) and the uranium-235 value used was the measured result for TE312 RAD1D (0.0902Bq g^{-1});
- the decay series progeny of uranium-238 and uranium-235 were in secular equilibrium with their respective parents;
- the RCLEA model assumes uniform contamination to a depth of 1m bgl;
- the land use is considered to be commercial/industrial;
- the fraction of the land potentially contaminated is set to 0.05 (this is higher than the actual fraction of the land affected on the BDAE); and
- the building type, receptor age and receptor sex are set to worst case.

14.5.143 The assumptions above are generally conservative; hence, the calculated doses are likely to be overestimates. The results of the assessment provided an effective dose and equivalent dose to the skin, based on the assumptions described above, of 11.8 and 0.002mSv per annum respectively.

14.5.144 The assessment showed that in accordance with the Environmental Protection Act 1990 Part 2A regime (Ref. 14.1) definitions of contaminated land where radioactive contamination is concerned, the HPC development site is not contaminated by radioactivity. Harm is not being caused nor is there a significant possibility of such harm being caused, where harm is defined as "lasting exposure to any person resulting from the after-effects of a radiological emergency, past practice or past work activity". Harm is regarded as being caused where lasting exposure gives rise to radiation doses equal to, or in excess of, one or more of the following:

- an effective dose of 3mSv per annum;
- an equivalent dose to the lens of the eye of 15mSv per annum; or
- an equivalent dose to the skin of 50mSv per annum.

Ground Gas Assessment

Built Development Area West

14.5.145 A programme of ground gas monitoring was undertaken within the Built Development Area West. Six gas monitoring visits were undertaken between January 2009 and April 2009 at ten piezometer locations (installed as part of the on-shore investigation undertaken by Structural Soils Ltd in 2008) in accordance with the requirements presented in guidance document CIRIA C665 (Ref. 14.76). During one visit, six gas samples were taken from selected locations and submitted for laboratory analysis for a range of gases. The laboratory analysis was carried out to confirm field data and provide confidence that the field monitoring technique was robust. A ground gas risk assessment was subsequently undertaken in accordance with the methodology presented in Section 14.4 b).

14.5.146 The monitoring locations are presented in **Figure 14.13**; and a summary of the gas monitoring results is presented in **Appendix 14E**. Further details are provided in the Ground Gas Risk Assessment report for the Built Development Area West (Ref. 14.87).

14.5.147 The monitoring and sampling data indicate that concentrations of ground gases during the monitoring period varied across the BDAW but were generally very low.

14.5.148 Concentrations of carbon dioxide were low, with a maximum concentration of 3.0% by volume, and concentrations of methane were very low, with all monitored and gas sample concentrations below the limit of detection (<0.1% by volume).

14.5.149 Trace levels of carbon monoxide were recorded at certain locations with a peak of three parts per million (ppm) being recorded in DBH04. However, all concentrations were below the Occupational Exposure Limits (Workplace Exposure Limits) within EH40 guidance document (2007) (Ref. 14.77) and are therefore not considered to pose a risk to human health.

14.5.150 No hydrogen sulphide or volatile organic compounds (VOCs) were detected within any of the piezometers during any of the monitoring visits.

14.5.151 Recorded gas flow rates were very low, with readings generally slightly above and below a zero flow rate. A maximum positive flow of 5.2l/hr was recorded in DBH09.

14.5.152 In accordance with the methodology in CIRA C665 (Ref. 14.76), Gas Screening Values (GSVs) were calculated for all monitoring locations for carbon dioxide and methane, using the formula: GSV (litres of gas per hour) = maximum gas concentration (%)/100 x maximum piezometer flow. The maximum value GSV was selected as the 'worst case'.

14.5.153 The calculations identified that for the BDAW, the 'worst case' GSV for methane was 0.0052l/hr (DBH09 0.1% by volume of methane (limit of detection taken as worst case) with a flow of 5.2l/hr), this is below the upper threshold limit of Characteristic Situation 1 (CS1). The 'worst case' carbon dioxide was 0.0736l/hr (CBH24 1.6% by volume of carbon dioxide with a flow of 4.6l/hr), this is marginally above the upper threshold for CS1 (<0.07l/hr).

14.5.154 During both field monitoring and laboratory analysis no concentrations of carbon dioxide or methane exceeded the threshold levels used within the CIRIA 665 (Ref. 14.76) guidance (5% by volume and 1% by volume, respectively). Within the BDAW no putrescible or biodegradable wastes were observed and no naturally organically enriched soils (e.g. peat) were found, indicating that the soils were naturally low in organic content and have a low ground gas generation potential. Given that the carbon dioxide GSV is very much a worst case assessment and that the monitoring has also been undertaken during low atmospheric pressure conditions, it is considered that the Characteristic Situation for the BDAW can be reliably defined as CS1 based on the guidance criteria within Table 8.5 of CIRIA 665 (Ref. 14.76). Given the proposed commercial/industrial end use, no special precautions or gas protection measures are required to be incorporated within the planned buildings to protect the end users and buildings themselves.

14.5.155 During the intrusive works, undertaken as part of the first on-shore investigation of the BDAW by Structural Soils Ltd in 2008 (Ref. 14.88) to determine the geotechnical and geological characteristics of the site, elevated concentrations of hydrogen sulphide (up to 17ppm CBH19), nitrogen (94 – 97.8% by volume DBH04 (balance calculation)), and carbon monoxide (up to 200ppm CBH19) were detected in some boreholes during drilling.

14.5.156 Elevated nitrogen concentrations (determined by) and associated depleted oxygen and high gas flow rates were recorded within DBH04 by Structural Soils Ltd immediately after the installation of the piezometer in 2009. The subsequent monitoring programme (2009) indicated a reduction of the nitrogen concentrations (shown by an increase in oxygen concentrations and no high flows).

14.5.157 Structural Soils Ltd undertook limited gas monitoring for the purposes of driller health and safety during the intrusive investigation works as part of the second on-shore investigation (Ref. 14.95). The majority of concentrations recorded by Structural Soils Ltd were consistent with background levels, and not considered to be indicative of a significant risk in the context of worker health and safety. However, during drilling at a limited number of locations (ISS-01A, CBH2_11, CBH2_27, CBH2_32 and CBH2_33) elevated concentrations of nitrogen (up to 98.1% volume, identified by balance calculation) and associated depleted oxygen levels (as low as 0% by volume), methane (up to 12% by volume), hydrogen sulphide (up to 43ppm) and low concentrations of carbon monoxide (up to 4ppm) were recorded. The gas monitoring conducted was for health and safety purposes and therefore not within properly installed standpipes or piezometers. Monitoring of existing piezometer DBH04 again also recorded elevated nitrogen (96% by volume, calculated by balance calculation), associated depleted oxygen levels (as low as 0% by volume) and high gas flow rates (>30l/hr). In order to investigate the elevated concentrations, two identified locations: DBH04 and CBH2_33 were monitored as part of the 2010 monitoring programme (Ref. 14.94) as detailed below.

14.5.158 During the 2010 gas monitoring programme (Ref. 14.94) the elevated nitrogen levels, associated depleted oxygen and high gas flow rates recorded within DBH04 and CBH2_33 by Structural Soils Ltd during drilling were not repeated, with concentrations and flow rates representative of typical site conditions. During the monitoring of DBH04 on one occasion the results showed slightly elevated nitrogen (87.7% by volume, calculated by balance calculation) and reduced oxygen (11.5% by volume) levels and CBH2_33 showed an elevated gas flow rate of 5l/hr, however, these concentrations are not consistent with the significantly elevated concentrations and gas flow rates encountered during drilling works.

14.5.159 The source of the gases identified during the drilling works is likely to be small pockets of gas trapped within the underlying geology or groundwater that have been released during drilling. In the case of hydrogen sulphide, this is thought to be associated with dissolved hydrogen sulphide in groundwater which is probably derived from the breakdown of natural organic matter in the underlying geology.

Built Development Area East and Southern Construction Phase Area

14.5.160 A programme of ground gas monitoring was undertaken within the BDAE and SCPA in accordance with the requirements presented in guidance document CIRIA C665 (Ref. 14.76). Eight monitoring visits were undertaken between June 2010 and September 2010. The monitoring programme was extended to eight monitoring visits to ensure that all piezometers had been monitored on at least six occasions, in accordance with the CIRIA C665 guidance. Monitoring was undertaken at 11 piezometers in the BDAE and seven piezometers in the SCPA, and to supplement existing data as described above, two piezometers in the BDAW were also monitored. During the fourth monitoring visit, eight gas samples were taken from selected piezometers and submitted for laboratory analysis for a range of ground gases and VOCs. The laboratory analysis was carried out to confirm field data and provide confidence that the field monitoring technique was robust. A ground gas risk assessment was subsequently undertaken in accordance with the methodology presented in Section 14.4 b)

14.5.161 The monitoring locations on the BDAE and SCPA are presented in **Figure 14.14** and **Figure 14.15** respectively and a summary of the gas monitoring results is presented in **Appendix 14E.** Further details are provided in the Ground Gas Risk Assessment report for the Built Development Area West (Ref. 14.94).

14.5.162 Across the BDAE and SCPA concentrations of carbon dioxide were low with a maximum concentration of 3.4% by volume in the BDAE (DBH2_20) and 1.2% by volume (WS73) in the SCPA. Concentrations of methane were very low with a maximum concentration of 0.1% by volume in the BDAE and concentrations below the limit of detection (<0.1% volume) in the SCPA.

14.5.163 Trace concentrations (up to 5ppm) of carbon monoxide were recorded in the SCPA and up to 3ppm in the BDAE. Table 1 of the Health and Safety Executive Workplace Exposure Limits within the EH40 guidance document (Ref. 14.77) indicates that the concentrations recorded are well below both the long and short-term exposure limits (30ppm and 200ppm respectively) and are therefore not considered to pose a risk to human health.

14.5.164 Hydrogen sulphide was not detected within any piezometer at a concentration above 1ppm during any of the monitoring visits. These results are in agreement with the gas sample analysis which show that concentrations of hydrogen sulphide were below the relevant limits of detection.

14.5.165 VOCs of up to a maximum (peak) concentration of 44.4ppm in the SCPA and 25.4ppm in the BDAE have been detected. The gas sampling data did not identify any VOCs above the limit of detection (0.2µg/l). During one monitoring visit VOCs above the adopted human health screening value (10ppm, based on the range of concentrations of individual compounds in the EH40 guidance (Ref. 14.77)) were detected in three locations (GB4, GB6 and DBH2_7) up to a peak concentration of 25.4ppm and steady concentration of 15ppm. Since the elevated concentrations were confined to one monitoring visit, they are not considered to represent a significant source of volatile hydrocarbons.

14.5.166 Gas flow rates were low with a maximum negative flow rate of -4.7l/hr and a maximum positive flow rate of 8.7l/hr.

14.5.167 In accordance with the methodology in CIRA C665 (Ref. 14.76) GSVs were calculated for all monitoring locations in the BDAE and SCPA for carbon dioxide and methane, using the formula: GSV (litres of gas per hour) = maximum gas concentration (%)/100 x maximum piezometer flow. The maximum value GSV was selected as the 'worst case'.

14.5.168 The calculations identified, for the SCPA, that both carbon dioxide (0.0272l/hr at WS711 (0.8% by volume carbon dioxide, flow rate 3.4l/hr)) and methane (0.0048l/hr at WS79 (0.1% by volume methane, flow rate 4.8l/hr)) ‘worst case’ GSVs fall below the upper threshold of Characteristic Situation 1 (CS1) (<0.07l/hr gas), therefore concentrations of these gases in the SCPA are considered to pose a very low risk to human health or buildings.

14.5.169 A gas screening value (GSV) for carbon dioxide, 0.2349l/hr (2.7% by volume of carbon dioxide with a flow of 8.7l/hr), was identified in borehole GB3B, located within the large double-humped mound feature within the BDAE. Elevated carbon dioxide and gas flow rates have been identified in GB3B and GB4 (both located in the mound) and are likely to be associated with the greater depth and volume of Made Ground materials in this area. The depth and volume of Made Ground materials present in the mound do not reflect ground conditions across the other areas of the BDAE. Therefore, concentrations at the locations in this area (GB3B and GB4) are not considered to be representative of general site conditions.

14.5.170 The highest GSVs for the BDAE, excluding the double-humped mound boreholes GB3B and GB4, are 0.0912l/hr for carbon dioxide and 0.0057l/hr for methane (GB6 carbon dioxide concentration 1.6% volume, methane concentration 0.1% volume, and maximum flow rate 5.7l/hr). At this location the GSV for methane is within the threshold for Characteristic Situation CS1. However, the GSV for carbon dioxide is very marginally above the upper threshold for CS1.

14.5.171 As stated in the CIRIA C665 (Ref. 14.76), the calculated GSV is a guidance value and not an absolute threshold. In accordance with the guidance it is considered that the gas regime of the BDAE site should remain as CS1 because of the ground conditions and soil types encountered (i.e. low organic content soils), the very low gas concentrations and flow rates in general across the site, the very marginal exceedence of the carbon dioxide GSV guidance threshold in GB6 and the fact that the concentrations of both carbon dioxide and methane have been recorded consistently below the 5% and 1% by volume thresholds respectively. These thresholds are still used as 'additional assessment factors' in Table 4.2 of CIRIA 665 (Ref. 14.76).

14.5.172 The additional monitoring of data for DBH04 and CBH2_33 on the BDAW does not change the original ground gas risk assessment (described above). Gas concentrations were low and largely consistent with previous monitoring, and the 'worst case' GSVs for carbon dioxide and methane at both locations are below the 'worst case' GSVs identified during the 2009 monitoring programme.

Ground Gas Summary

14.5.173 Gas monitoring data indicate that are no significant sources of ground gas within the BDAW, BDAE or SCPA and therefore there is no significant risk posed to human health or buildings by ground gas.

14.5.174 During the review of historical maps and plans (Ref. 14.90) of the HPC development site a small number of historic and potentially infilled ponds were identified. Intrusive locations during the second on-shore investigation (Ref. 14.92) were specifically targeted to investigate some of these former pond features. However, of the ten exploratory holes that were targeted to such features only one recorded ground conditions (e.g. silt and sediments) that were considered to be consistent with a former pond (TE13). Plans overlaying the exploratory locations and gas monitoring boreholes on the locations of the historical/infilled ponds are presented as **Figure** 14.13, **Figure 14.14** and **Figure 14.15**. Ground gas monitoring in a number of boreholes on the HPC development site has not identified any significant concentrations or flow rates of ground gases. Given the low number, small size and very limited potential volume of these historical features it is not considered that they pose a significant potential ground gas risk.

14.5.175 The ground gas risk assessment identified the BDAW, BDAE and SCPA as falling within gas Characteristic Situation 1. There is a negligible risk to human health or buildings by ground gases in the context of the permanent built development. Given the proposed commercial/industrial development (i.e. the power station) with the temporary workers accommodation (i.e. residential flats) no special precautions or gas protection measures are required to be incorporated within the planned buildings in order to protect either the end users or buildings themselves.

14.5.176 Elevated concentrations of nitrogen, hydrogen sulphide and carbon monoxide were occasionally noted during drilling works on-site. The Structural Soils Limited gas monitoring was conducted for the purposes of health and safety and not for the purpose of gas risk assessment. Typically the gas measurements were taken from uninstalled boreholes: this approach does not comply with good practice guidance for gas risk assessment (e.g. C665). Therefore the results of this gas monitoring (i.e. the observed elevated concentrations of nitrogen, hydrogen sulphide and carbon monoxide) may not be reliable for the purposes of gas risk assessment. The significantly elevated gas concentrations and flow rates identified during drilling were not repeated during the subsequent gas monitoring programmes. However, the data generated from the drilling programme cannot be completely ignored and as a precaution a low risk to human health should be assumed via the inhalation of gases potentially present in pockets within the underlying geology or groundwater during confined space working or works which are carried out in deep excavations during construction.

Animal Burial Pits

14.5.177 The Animal Health Division of Defra has been consulted on the potential presence of any animal burial pits arising from foot and mouth or other disease outbreaks. No such pits are recorded within the HPC development site (see email confirmation presented in **Appendix 14F**).

14.5.178 It should be noted that burial pits were not registered before 1972, and individual animals could still be buried without registration up to the early 1990s. The potential for unrecorded burials being present within the HPC development site, although low, cannot be completely discounted (for further details see **Chapter 13** of this volume (Soils and Land Use)).

Existing Baseline and Baseline Prior to Main DCO Works Starting

iii. Conceptual Site Model for Land Contamination

14.5.179 Following a review of the available desk based and site investigation information, a Conceptual Site Model (CSM) has been produced to identify potential risks posed to human health and other receptors by soil contamination which may be present on and adjacent to (i.e. within a 500m radius) the HPC development site given the proposed development and its future use.

14.5.180 Three Conceptual Site Models have been developed to reflect the changes in anticipated site conditions (principally changing source characteristics) throughout the different phases of the development, namely:

- Baseline Conceptual Model Prior to Enabling/Remedial Works;
- Baseline Conceptual Model at start of Construction Phase i.e. post Enabling/Remedial Works; and
- Operational Phase Conceptual Model (i.e. post construction phase).

Schematic diagrams of the CSM models above are presented as **Figures 14.17**, **14.18** and **14.19.** The CSMs are also presented in tabular format in **Appendix 14G.**

Potential Sources of Contamination - On-Site Baseline before Enabling/Remedial Works

Human Health

14.5.181 The Phase 1 desk studies (Ref. 14.90 and Ref. 14.84) concluded that the BDAW and SCPA have remained largely undeveloped agricultural land with no significant historical contaminative uses identified. A number of potentially contaminating activities were identified within the BDAE including a double-humped mound feature containing surplus spoil arising from the construction of the HPA site in the 1960s, a former sewage treatment works, former NDA spoil storage area, general Made Ground deposits and former fabrication/construction facilities and accommodation areas. However, limited visual or olfactory evidence of gross contamination was identified during the site investigations, with the exception of locations where suspected and confirmed ACMs have been identified and the presence of a localised hotspot of hydrocarbon contaminated soils.

14.5.182 Concentrations of non-radiochemical contaminants within soils in the BDAW and SCPA were all below the human health Tier 1 screening values, relevant to the proposed end use, therefore no risk is posed to human health receptors from soils on these areas of the site.

14.5.183 On the BDAE concentrations of non-radiochemical contaminants were generally below the Tier 1 human health screening values for a commercial and industrial end use, with the exception of alkaline pH in Made Ground containing demolition and construction materials, elevated PAHs at one location (TE63), elevated hydrocarbons in the zone of hydrocarbon impacted soils around TE418 and the identification of ACMs at a number of locations in the Made Ground.

14.5.184 Elevated concentrations of total PAHs and benzo(a)pyrene have been identified in ashy materials in TE63 and moderately alkaline pH levels have identified in the Made Ground containing demolition and construction materials. During the construction works there is considered to be a low risk to human health from these materials.

14.5.185 The localised zone of hydrocarbon impacted soil around TE418 in Area 4 is currently confined below surface, therefore the current risk to end users is very low.

14.5.186 The presence of ACMs within the Made Ground at a number of locations presents a theoretical risk to human health. However, only limited quantities of asbestos have been identified and analysis of soils associated with suspected and confirmed asbestos containing materials have not detected diffuse free fibres above 0.01%w/w with the exception of one location (TE55/WS55A). The current risk to end users provided the ground remains undisturbed is very low.

14.5.187 The results of the WAC testing undertaken on the BDAE indicate limited exceedences of the inert waste criteria for molybdenum and sulphate; however concentrations are below the non-reactive hazardous waste and hazardous waste thresholds. Therefore, the soils on the BDAE would typically not be classified as hazardous waste. The exceptions to this are the zone of hydrocarbon impacted soils which identified concentrations of Total Organic Carbon above the non-reactive hazardous waste and hazardous waste thresholds and the ACMs which are likely to be classified as hazardous waste.

14.5.188 The radiological investigations (Ref. 14.86 and Ref. 14.93) determined that the HPC development site is not contaminated by radiochemical contaminants. Generally concentrations of radiochemical contaminants were not in excess of regulatory thresholds and levels were consistent with background values in the UK and as a result the risk to human health within the study area is considered to be negligible.

14.5.189 The results of the RCLEA assessment demonstrate that the calculated effective dose and equivalent dose to the skin, based on the assumptions described above, are 1.8 and 0.002mSv per annum respectively. The assessment shows that in accordance with Part 2A regime definitions of contaminated land where radioactive contamination is concerned, the BDAE and SCPA land areas are not contaminated by radioactivity. Harm is not being caused nor is there a significant possibility of such harm being caused, where harm is defined as "*lasting exposure to any person resulting from the after-effects of a radiological emergency, past practice or past work activity*". Harm is regarded as being caused where lasting exposure gives rise to radiation doses equal to or in excess of one or more of the following:

- an effective dose of 3mSv per annum;
- an equivalent dose to the lens of the eye of 15mSv per annum; or
- an equivalent dose to the skin of 50mSv per annum.

Soil Quality and Ecological Systems (Ecotoxicity)

14.5.190 Contaminant concentrations in the majority of the soils within the HPC development site are considered to be reflective of natural background concentrations and do not pose a significant ecological or phytotoxic risk. However, some Made Ground materials on the BDAE and the isolated area of Made Ground on the BDAW contain contaminant concentrations which may pose a low risk to ecological systems should they be re-used in areas of soft landscaping or agricultural and habitat restoration.

14.5.191 Isolated contamination by heavy metals was encountered in the highly localised area of Made Ground on the BDAW (zinc) and in isolated locations (zinc in DBH2_27 and copper in TE54) within the BDAE. Also within the BDAE, elevated concentrations of hydrocarbons were identified at specific locations (WS27 and TE63) and in Made Ground containing demolition and construction materials. Materials of this type and/or at these locations may also pose a low risk to ecological systems.

14.5.192 Also, within the Made Ground containing demolition and construction materials on the BDAE, moderately alkaline pH levels (>9pH units) were identified which could restrict the number of plant species which may establish successfully in such materials. The high pH levels associated with these materials may also pose a low risk to ecological systems.

Controlled Waters

14.5.193 No significant sources of soil contamination have been identified on the BDAW or SCPA therefore the risk to controlled waters from soils in these areas is considered to be negligible. Soil leachability testing on the BDAE does not indicate the presence of significant mobile contamination in soils, with the exception of the isolated area of hydrocarbon contaminated soils. Therefore the potential for soils to impact controlled waters via leaching on the BDAE in general is considered to be negligible. Leachate testing of the hydrocarbon contaminated soils indicates leachate concentrations in two samples (TE418 ES2 and ES3) to exceed the screening criteria for TPH and therefore this small, isolated area of soil contamination is considered to pose a moderate risk to controlled waters.

Ground Gases

14.5.194 Gas monitoring data indicate that there are no significant sources of ground gas within the HPC development site and therefore there is no significant risk posed to human health or buildings by ground gas given the proposed site end use.

14.5.195 However, elevated concentrations of nitrogen, hydrogen sulphide and carbon monoxide were occasionally noted during drilling works on-site. There is therefore a low risk to human health via the inhalation of gases potentially present in pockets within the underlying geology or groundwater, confined space working or works which are carried out in deep excavations during the construction phase.

Potential Sources of Contamination - On-Site Baseline Post Enabling/Remedial Works

14.5.196 It should be noted that the above summary of contamination sources represents a summary of the baseline conditions, before, the enabling/remediation works covered by Planning Application are completed. Remediation works to be completed as part of the enabling works include removal of hotspots of ACM contamination from within the BDAE (apart from the known ACMs under the location of the new HPA and HPB car park) identified during the intrusive investigations, removal of the hydrocarbon hotspot around TE418 and removal of the double humped mounded feature and areas of known ACM within it for off-site disposal. The baseline contamination sources included in the Conceptual Model Post Enabling/Remedial Works assume that these known areas will have been removed before the site preparation works (bulk earthworks) and main construction works begin. This will significantly reduce (but not entirely eliminate) the potential for encountering ACM during the preliminary and main site works.

Potential Sources of Contamination - On-Site Operational Phase (Post Construction Works)

14.5.197 A number of potential contaminant sources will be present on the site during the operational phase, including for instance (note that this list is not meant to be exhaustive):

- fuel storage tanks;
- hazardous waste storage areas;
- electrical sub stations and switchgear;
- chemical storage areas;
- generators, boilers and turbines;
- radioactive waste and materials storage areas and ponds; and
- drainage systems and sumps.

14.5.198 Soils remaining on-site during the operational phase (i.e. those soils and other materials re-used during the construction works) will be suitable for use and therefore unlikely to be significantly contaminated.

Off-Site Sources of Contamination

14.5.199 A Phase 1a desk study (Ref. 14.90 and Ref. 14.84) and review of available reports relating to HPA and HPB identified some potential and confirmed contamination sources. Given that the topographical, geological and hydrogeological gradients generally fall towards the north/north-east, the likelihood of any contamination migrating onto the HPC Development Site from off-site sources under existing conditions is considered to be low. Hydrogeological modelling has been undertaken, which has included modelling of the effects on the groundwater regime as a result of the dewatering of deep excavations during the construction phase. This model has been used as part of the assessment of impacts associated with the mobilisation and migration of contaminants in groundwater. The hydrogeological model is detailed in **Chapter 15** of this volume (Groundwater).

14.5.200 With the exception of the existing Hinkley Point Power Station Complex, the majority of the land surrounding the HPC development site is currently (and has been since at least the 1880s) agricultural/greenfield land. In view of this, the likelihood of significant off-site sources within these areas is considered to be 'unlikely'. In addition, the potential physical extent of any such off-site sources on these lands is as assumed to be small/localised, therefore the potential magnitude of contamination is assumed to be 'very low' (i.e. as per the BDAW and SCPA).

Potential Pathways and Exposure Mechanisms

14.5.201 The following potential pathways/exposure mechanisms are relevant in the context of the proposed development. Note that not all pathways will be active during all phases of the development. For instance, indoor soil and vapour and ground gas inhalation is not relevant to the baseline prior to the construction phase, as there are no significant buildings currently on-site. Likewise, the potential for direct contact/ingestion of contaminated soils during the operational phase is very unlikely due to the amount of buildings and hardstanding that will be present on the site:

- indoor soil vapour and ground gas inhalation from ingress of ground gases and vapours via service entry points and cracks/joints;
- migration via man made pathways such as drains and underground services (includes permeation into and distribution via water service pipes);
- phytotoxic risk to vegetation via plant uptake;
- inhalation of soil vapours or soil particles/wind blown particulates, dermal contact/ingestion of soil particles and direct exposure;
- migration via permeable ground;
- transfer of contaminants via surface run-off (see **Chapter 16** of this volume (Surface Water));
- transfer of contaminants via groundwater flow (see **Chapter 15** of this volume (Groundwater));

- air/windborne transport (on-site and off-site) of soil and dust from areas of exposed soils;
- ingestion, inhalation, dermal contact by ecological fauna and flora; and
- predation / bioaccumulation by ecological fauna.

14.5.202 The following activities may create and/or introduce new pathways and/or disturb and mobilise contamination during the proposed development:

- excavation and filling operations ('Cut and Fill') particularly using granular and permeable soils and fills;
- general earthworks/regrading;
- groundwater dewatering (see **Chapter 15** of this volume (Groundwater)); and
- installation of drainage network.

Potential Receptors

14.5.203 The following are considered to be potential receptors for soil contamination in the context of the proposed development:

- Human health: On-site – construction workers, future end users and future maintenance/construction works during the operational phase of the development.
- Human health: Off-site – local residents (e.g. Doggetts Farm, Shurton, Knighton), adjacent site workers (existing HPA and HPB), farm workers on adjacent agricultural land, members of the public using public footpaths across and adjacent to HPC development site.
- Terrestrial ecological receptors (animals, wildlife, plants, trees, and other vegetation (excluding crops)) on-site and off-site. Details of terrestrial ecology are contained in **Chapter 20** of this volume (Terrestrial Ecology and Ornithology).
- Crops and livestock on-site and off-site (for details see **Chapter 13** of this volume (Soils and Land Use)).
- Soil Environment: On-site and off-site soils from land contamination including a basic assessment of soil ecological risk (soil ecotoxicity).
- Built Environment: On-site and off-site buildings, infrastructure and/or services.
- Controlled Waters: On-site groundwaters – on-site Secondary Aquifers and on-site surface waters – drainage ditches and Holford Stream (the scope of this assessment is the direct impact to on-site controlled waters from actual or potential land contamination only, any further indirect impacts are considered in **Chapter 15** of this volume (Groundwater) and **Chapter 16** of this volume (Surface Water).

Receptor Value and Sensitivity

14.5.204 The value and sensitivity of the identified potential receptors for soil contamination are detailed below:

- On-site humans (i.e. construction workers or future maintenance works and end users): Construction/maintenance workers and future end users are considered to have high value and sensitivity to contaminants. However, health, safety and environmental legal requirements, and good practices which would be adopted, specifically those relating to the use of appropriate personal protective equipment (PPE) and hygiene, would reduce this. Therefore, the overall value rating for value and sensitivity of on-site humans is considered to be low, as possible exposure to land contamination should be prevented or minimised through normal good practices.

- Off-site humans (i.e. users of local footpaths and local residents): Off-site humans are considered to be of high value and sensitivity as they would not be using appropriate PPE and are clearly of high intrinsic value.
- On-site ecology is considered to be of medium value/sensitivity overall, based on the presence of protected species (bats) and Nationally Scarce invertebrates within the site as well as the range of habitats present. (see **Chapter 20** of this volume for further details).
- The off-site ecology value and sensitivity is considered to be high, due to the presence of statutory designated sites and protected species near to the site, including Bridgwater Bay SSSI, and the Severn Estuary SPA and Ramsar Site, (see **Chapter 20** of this volume for further details).
- On-site and off-site crops and livestock: This is primarily through potential phytotoxic/toxic effects from exposure to soil contamination. For the purposes of this ES, the value and sensitivity of crops and livestock has been based on the agricultural land use classification (ALC) as detailed in **Chapter 13** (Soils and Land Use) of this volume. The value of the on-site crops and livestock is medium on the basis of the potential of the on-site land, in terms of its ALC, for productive farming activity. The value and sensitivity of the off-site crops and livestock has been rated as medium to high on the basis of its ALC grade for productive farming activity (medium) and sensitivity of stock and (potentially) household pets (high) to diseases from disturbed animal burial pits (see **Chapter 13** of this volume for details). As a conservative approach, a high value and sensitivity has been selected for off-site crops and livestock for this assessment.
- On-site soil environment (including soil ecotoxicity): The value and sensitivity of the on-site soils to current or future land contamination[2] is considered to range from very low for Made Ground/engineering fills, to high for soils (topsoils and subsoils) scheduled for potential re-use in more sensitive areas such as soft landscaping and agricultural/habitat restoration. The soil ecology (i.e. soil organisms) is important in maintaining the structure and nutrient content of the soils, through the processes of organic matter decomposition and nutrient cycling. Therefore the value and sensitivity of soil ecology also ranges from very low for engineering fills to high for soils scheduled for re-use in soft landscaping and agricultural/habitat restoration, where the maintenance of good soil structure and nutrient cycling by soil organisms are important to ensuring the integrity of the resource. As a conservative approach, a high value and sensitivity has been selected for the on-site soil environment for this assessment.

[2] The value and sensitivity given above is on the basis of existing soil types to current and potentially future land contamination. The ranges of value and sensitivity may therefore be different to those used in Chapter 13 (Soils and Land Use) as Chapter 20 is concerned with potential impacts to soils from physical disturbance, compaction and handling rather than contamination impact and therefore the value and sensitivity of the soil may be different.

- Off-site soil environment (including soil ecotoxicity): The value and sensitivity of the off-site soil environment to current or future land contamination[2] ranges from very low in adjacent commercial and industrial areas, i.e. the existing Hinkley Point Power Station Complex to high in adjacent agricultural and designated areas. The soil ecology (i.e. soil organisms) is important in maintaining the structure and nutrient content of the soils. Therefore the value and sensitivity of soil ecology also ranges from very low for soils in the adjacent existing Hinkley Point Power Station Complex to high in adjacent agricultural and designated areas, where the maintenance of good soil structure and nutrient cycling by soil organisms are important in ensuring the integrity of the resource. As a conservative approach, a high value and sensitivity has been selected for the off-site soil environment for this assessment.
- The built environment: The value and sensitivity of the built environment is considered to range from very low (e.g. potable water pipes and car park areas) to high (for main nuclear island buildings and structures). This evaluation is based on the economic cost, structural sensitivity and strategic importance of the structures with respect to energy supply and the requirement that they remain in a safe structural and operating condition throughout their design life. As a conservative approach, a high value and sensitivity has been selected for the on-site built environment for this assessment.
- Controlled waters (i.e. on-site groundwaters and on-site surface waters): The value and sensitivity of controlled waters is considered to be low for on-site groundwater (see **Chapter 15** Groundwater of this volume) and low to high for on-site surface water (see **Chapter 16** of this volume (Surface Water)). As a conservative approach, a high value and sensitivity has been adopted for on-site surface waters.

14.6 Assessment of Impacts

a) Introduction

14.6.1 This section provides an assessment of the key project elements which have the potential to impact on geology and land contamination during the Hinkley Point C development.

14.6.2 Prior to the construction of HPC, it is intended that a series of enabling works will be completed within the BDAE, which have been progressed and are ongoing (as at October 2011) under a planning consent from Somerset County Council. **The effective completion of these enabling works is assumed as the baseline condition for the following impact assessment**. Note that this is different to the baseline condition described above in Section 14.5 which is the baseline condition before the enabling works.

14.6.3 The enabling works will include the removal and disposal of any contaminated soils (principally soils contaminated with ACM within Areas 3, 4 and 5) within the BDAE, apart from known hotspots currently below inaccessible areas (e.g. ground under the enabling works contractors compound and under the location of the new HPA and HPB car park). Within this car park area there are a number of asbestos hotspots and the area of hydrocarbon contaminated soils in the locality of TE418 (illustrated on **Figure 14.16**). The car park has been constructed over the identified hotspots and the resultant hard surface will act as a physical barrier, preventing both contact with contaminated soils and the generation of contaminated dusts. Therefore there will be no risk to human health during the period when the car park is in use. The areas of contamination beneath the contractors compound and car park will be remediated, with associated verification and validation reporting, when the contractors compound and car park are no longer required and prior to any construction works commencing in this part of the BDAE.

14.6.4 All the other known hotspots within the BDAE would be removed and the remediation works would be verified and validated prior to the commencement of the bulk earthworks associated with site preparation works in the relevant areas. With the exception of the hotspots beneath the contractors compound and car park, the existing consent requires all on-site remediation works within the BDAE to be completed by 31 August 2011 (a formal request has recently been made by EDF Energy to extend this until the end of February 2012). The provision of a validation report for the BDAE should not preclude site preparation works commencing elsewhere on-site or other site preparation activities commencing on the BDAE.

14.6.5 In addition to the removal of the known contamination hotspots, the consented works also include for the transfer of 50,000m^3 of suitable materials arising from the existing double-humped mound within the BDAE to the HPA turbine hall, where they will be used to backfill the basement of this building.

14.6.6 As detailed in Section 14.4 the potential land contamination impacts are assessed in terms of potential receptors i.e. human health (on-site and off-site), ecology (on-site and off-site), crops and livestock (on-site and off-site), the soil environment (on-site and off-site) the built environment (on-site and off-site site) and controlled waters (on-site groundwater and surface water).

14.6.7 Currently there are no UK soil guidelines or threshold values for assessing the health risk to construction workers from soil contaminants. As a result the guidelines and methodologies used to assess whether soils and other materials are ‘hazardous’ under the Chemical (Hazard Information and Packaging Supply) Regulations 2009 (CHIP4) (Ref. 14.108), Hazardous Waste (England and Wales) Regulations 2005 (Ref. 14.56) and Approved Supply List Edition 8 (Ref. 14.109), have been used for this impact assessment. This is because many of the criteria for hazardous wastes are based on short-term, i.e. acute hazard properties (such as toxicity, corrosivity, flammability and irritability, etc.), which are relevant to the short-term exposures that may be experienced by construction workers.

b) Environmental Management and Protection Measures

14.6.8 In the UK, modern construction and operational sites are subject to a number of ‘standard’ health, safety and environment control requirements. These include both legal requirements and/or standard good health, safety and environment practices. Adoption of these practices is assumed as a baseline for this impact assessment.

i. Legal Requirements

14.6.9 In some cases there are basic legal requirements which prescribe in detail and/or set overarching objectives, for health, safety and/or environmental protection. **Table 14.9** lists some of the key UK health, safety and environmental legislation which relates to construction works and the operational phase and development of land which may be contaminated.

Table 14.9: Key UK Construction and Operation Health, Safety and Environment Legislation

Legislation	Main Requirement/Objectives
The Control of Asbestos at Work Regulations 2006 (SI 2739)	These regulations relate to asbestos in non-domestic premises. Requires management of the risk from asbestos by: • determining whether asbestos is present within the premises, the amount and what condition it is in, • presuming materials contain asbestos, unless there is strong evidence that they are not present, • making and maintaining an up to date record of the location and condition of asbestos containing or assumed asbestos containing materials within premises, • carrying out a risk assessment on materials containing asbestos, • preparing and implementing a plan that sets out in detail how the risk from this material is going to be managed; • reviewing and monitoring the plan and the arrangements, and • providing information on the location and condition of the material to anyone who is liable to work on or disturb it (including staff).
Health and Safety at Work Act 1974 (as amended)	This is the main piece of UK health and safety legislation. It places a duty on all employers "to ensure, as far as is reasonably practicable, the health, safety and welfare at work" of all their employees. Among other provisions, the Act also requires: • safe operation and maintenance of the working environment, plant and systems, • maintenance of safe access and egress to the work place, • safe use, handling and storage of dangerous substances, • adequate training of staff to ensure health and safety, and • adequate welfare provisions for staff at work.
The Management of Health and Safety at Work Regulations 1999	These regulations place a duty on employers to assess and manage risks to their employees and others arising from work activities. Employers must also make arrangements to ensure the health and safety of the workplace, including making arrangements for emergencies, adequate information and training for employees, and for health surveillance where appropriate.
Workplace (Health, Safety and Welfare) Regulations 1992	These regulations are concerned with the working environment. They place a duty on employers to make sure that the workplace is safe and suitable for the tasks being carried out there, and that it does not present risks to employees and others. The regulations cover all aspects of the working environment, including: • maintenance of the workplace, equipment, devices and systems, • ventilation, • cleanliness and waste materials, • washing facilities, • drinking water, • accommodation for clothing, • facilities for changing clothing, and • facilities for rest and to eat meals.

Legislation	Main Requirement/Objectives
The Personal Protective Equipment at Work Regulations 1992	These regulations seek to ensure that where the risks cannot be controlled by other means, Personal Protective Equipment (PPE) is correctly selected and used.
Construction (Design and Management) Regulations 2007	The key aim of the CDM regulations is to integrate health and safety into the management of the project and to encourage everyone involved in the design and construction of a development to work together to : • improve the planning and management of the project, and • identify hazards early on so they can be eliminated or reduced at the design stage and any remaining risks properly managed. Under CDM requirements any hazards or risks associated with the design, construction and future operation of a building(s) or structure(s) should be taken into account to eliminate, reduce or manage any associated hazards and risks to the people involved in the construction and operation of the buildings and the buildings infrastructure itself.
Site Waste Management Plans Regulations (2008)	The regulations set out the requirements for a site waste management plan (SWMP) to be produced by any party who intends to carry out a project on a construction site with an estimated cost of £300,000 or more. A SWMP conforming to these regulations must be prepared before construction work begins. The regulations set out the requirements for the SWMP, including the requirement for a declaration that "all waste from the site is dealt with in accordance with the waste duty of care in Section 34 of the Environmental Protection Act 1990 and the Environmental Protection (Duty of Care) Regulations 1991".
Nuclear Installations Act 1965	The Nuclear Installations Act 1965 is the primary legislation which covers the issuing of Nuclear Site Licence. As part of this process and the GDA process any hazards and risks associated with the construction, commissioning, operation and decommissioning of the site must be assessed and where possible eliminated, reduced or otherwise managed. This will include potential risks to the end users of the site, the public, the wider environment and the buildings and associated infrastructure itself.
Environmental Permitting (England and Wales) Regulations 2010 (SI 675)	For main requirement/objectives see Section 14.3 of this chapter.
Control of Pollution (Oil Storage) (England) Regulations 2001 (SI 2954)	For main requirement/objectives see Section 14.3 of this chapter.

ii. Construction Phase Measures

Standard Good Practices/Control Measures

14.6.10 The following impact assessment has been undertaken assuming legislative compliance and the adoption of standard good practice.

14.6.11 Legislative compliance and good practice require that the manner in which materials arising from earthworks are controlled and re-used is subject to appropriate planning and management decisions.

14.6.12 Other plans that are of relevance and which will be adopted for the construction works will include:

- Materials Management Plan; and
- Soil Management Plan.

14.6.13 These documents will describe how excavated materials are to be screened against acceptability criteria as they arise during the works and how their chemical and geotechnical suitability will be determined for specific re-use on the site. The documents will also set out procedures for the tracking and recording of the placement of different material types on-site and describe how any unforeseen ground conditions are to be dealt with. Typical requirements in this context include quarantining of any unexpected material and subjecting it to representative sampling and analysis to inform appropriate decision making with respect to the fate of the material.

14.6.14 Typical measures to be employed on-site include standard procedures to prevent contamination occurring from construction operations and which will incorporate the appropriate use and storage of fuel oils and other chemicals and dust and surface run off controls.

Control Measures for Contaminated Soils

Human Health

14.6.15 Asbestos contamination has been identified at a number of locations across the BDAE. The risk of mobilising potential ACMs and free fibres is increased during proposed earthworks and construction. Exposure to free fibres can result in permanent health effects and there is a moderate risk to human health from asbestos contamination on the BDAE. However, the asbestos contamination is limited to localised specific areas of the BDAE associated with the presence of demolition and construction materials in Made Ground.

14.6.16 As part of the enabling works ACMs within the BDAE, apart from the known ACMs under the location of the contractors compound and new HPA and HPB car park, will undergo removal, disposal and associated verification and validation reporting. In the area of the contractors compound and car park the resultant hard surface will act as a barrier, preventing both contact with contaminated soils and the generation of contaminated dusts. Therefore there will be no risk to human health during the period when the car park is in use and the ACMs will be remediated when the car park is no longer required. However, there is still the possibility that further pockets of ACMs will be encountered during further earthworks in certain areas of the BDAE. As such, a watching brief will be maintained throughout the site preparation earthworks within the BDAE and any significant asbestos contamination (should it be found) will be removed off-site, through appropriate procedures specifically orientated to the effective identification, segregation and management of any ACMs.

14.6.17 The hydrocarbon-contaminated soils identified around TE418 in the north-eastern area of the BDAE could pose a risk to human health during earthwork activities. However, the isolated area of hydrocarbon-contaminated soils is within the footprint of the new HPA and HPB car park and will be confined by the resultant hard surface. Therefore it will not pose a risk to human health during the period when the car park is in use. When the contractors' compound and car park are no longer required the contamination will be remediated, with associated verification and validation reporting. This will also remove the risk to water supply pipes, controlled waters and ecological receptors posed by the hydrocarbon contaminated soils.

14.6.18 The elevated Total PAH and benzo(a)pyrene concentrations identified in TE63 were in exceedence of the Tier 1 human health risk assessment screening criteria. The contamination is associated with the presence of localised ashy deposits. The risk posed by this material can be managed by selective excavation and segregation of the ashy material within this area and careful materials management to ensure that such materials are only re-used below areas of hardstanding or buildings. No significant volatile hydrocarbon risk has been identified associated with the material.

14.6.19 Moderately alkaline pH levels (up to 11.4pH units) have been identified in Made Ground materials containing demolition and construction materials. The alkaline pH levels are considered to be due to the presence of plaster, concrete and mortar within this specific type of Made Ground. Elevated pH (for example in plaster dust) can be an irritant therefore exposure to high pH materials is not desirable. Any risk can be managed by appropriate materials management including the exclusion of Made Ground materials containing demolition and construction materials from the upper 1m of the soil profile in areas of soft landscaping, agricultural restoration or new habitat creation.

14.6.20 The results of the ground gas monitoring indicate there are no significant sources of ground gases within the HPC development site and therefore there is no significant risk posed to human health or buildings by ground gases. However, elevated concentrations of nitrogen, hydrogen sulphide and carbon monoxide have been identified during drilling investigations. Therefore as a precautionary measure during the construction phase, contractors should have due consideration for, and assess the health and safety risk of potential ground gas concentrations and adopt appropriate mitigation measures, in particular during confined space working or during works which are carried out in deep excavations.

Built Environment

14.6.21 Investigations on the BDAE have identified generally low concentrations of contaminants (e.g. sulphate, hydrocarbons, pH and ground gases) which could potentially attack, degrade or otherwise damage the built environment. Furthermore, the HPC permanent development will be designed and constructed with appropriate and suitable specifications of building materials which will ‘design out’ any risk from potential impacts from ground contamination during the construction and/or operational phases.

Ecological Systems including Plants, Trees, Crops and Other Vegetation

14.6.22 The majority of the soils within the HPC development site pose no significant ecological or phytotoxic risk, with contaminant concentrations considered to be reflective of natural background concentrations. However, some Made Ground materials in specific locations within the BDAE and the localised area of Made Ground on the BDAW pose a low risk of potential phytotoxic effects and a low risk to ecological receptors from alkaline pH levels (> 9pH units), and from limited hydrocarbon, copper and zinc contamination.

14.6.23 Although no specific criteria are available for assessing the risk to ecological receptors from pH, the presence of moderately elevated soil pH values (> 9 pH units) may pose a risk to ecological systems in that high pH may restrict the range of plant and animal species which will be able to establish and grow successfully. The highest pH levels have been identified in the Made Ground soils containing construction and demolition materials.

14.6.24 A potential low risk to ecological receptors has been identified at the following isolated locations on the BDAE; WS27 within shallow Made Ground (Total PAH); DBH2_27 within Made Ground containing ash and slag (zinc); TE54 within Made Ground in area of the former access route to the foreshore (copper and zinc); ashy materials in TE63 (Total PAH and benzo(a)pyrene), and in the isolated area of Made Ground on the BDAW at TRE21 (zinc).

14.6.25 Management of the ashy materials in TE63 and the Made Ground in the area of the former access route to foreshore in TE54 is required to control the risk to human health from elevated PAHs and asbestos, respectively. The management measures which are described above will also facilitate management of any risk posed to ecological systems.

14.6.26 The risk to ecological systems including plants, trees, crops and other vegetation from the areas of Made Ground in DBH2_27 and WS27, the Made Ground containing demolition and construction materials on the BDAE and the localised area of Made Ground on the BDAW, can be managed by ensuring that these materials are not placed within the upper 1m of the soil profile within any areas proposed for soft landscaping, agricultural land restoration or new habitat creation.

14.6.27 It is considered that the delineation and management of materials at specific ‘hotspot’ locations can be conducted as part of the construction earthworks given the employment of appropriate management methods. Thus there is no requirement to undertake a specific independent delineation and removal/remediation of individual hotspots.

Summary

14.6.28 In accordance with standard good practice, appropriate materials management will be employed to ensure that any unsuitable materials (e.g. ACMs, wood, paper, plastic metals, old drums, etc.) and/or soils contaminated above acceptable thresholds[3] will be removed, remediated and/or re-used (in appropriate locations and at appropriate depths) during the enabling works and subsequent site preparation earthworks.

14.6.29 An awareness flag will then be maintained during any subsequent construction earthworks, so that in the event that additional areas of unsuitable materials or suspected contaminated soils are encountered, these areas will be isolated, segregated (e.g. in a specific ‘quarantine’ area) and tested to decide whether they are suitable for re-use on-site, require further remediation on-site to enable re-use, or will be disposed off-site.

[3] the criteria for ‘unacceptable’ contamination thresholds will be developed but may include any soils with contaminant concentrations in excess of commercial and industrial land use Soil Screening Values (SSVs) and residential land use without plant uptake for SCPA – accommodation blocks/areas and Hazardous Waste/Material thresholds.

14.6.30 A **LCMP** has been prepared which also outlines measures to be implemented with respect to planned activities and the discovery of any unexpected contamination. The mitigation requirements are also outlined. The mitigation requirements are stated within this chapter and other supporting land contamination related general control measures using best practice guidance. In summary the measures for controlling risk from contaminated soils will include:

- Removal and off-site disposal of any asbestos-containing materials (ACMs) which may remain after the completion of the enabling/remediation works. A monitoring plan, (possibly inclusive of asbestos air fibre monitoring) specific health and safety risk assessments and the definition of appropriate working practices will be required to support the remediation of any remaining ACM contamination during construction earthworks;
- The remediation or removal of the hydrocarbon contaminated soils identified in the vicinity of TE418 in the north-eastern area of the BDAE;
- Appropriate management and re-use of materials to ensure that potentially unsuitable Made Ground materials (either because of slightly elevated ecological and/or phytotoxic contaminants, elevated pH (pH9.0 or greater), contaminants above human health risk assessment criteria, high proportions of construction and demolition materials, poor substrate, poor grading of materials, low nutrient and/or organic content, etc.) are not re-used within the upper 1m of the soil profile in soft landscaped, ecological habitat creation or agricultural restoration areas;
- The use of the appropriate specification of potable water service pipes, e.g. 'Protecta-Line' type barrier pipe. The specification will need to be agreed with Wessex Water.
- Appropriate specification of sulphate resistant concrete for use in buried structures will be necessary.
- Removal of any significant quantities of putsrescible materials from existing site won Made Ground and natural soils prior to re-use as general or engineering fill in areas where buildings and other structures will be placed.

iii. Operational Phase Measures

Standard Good Practices/Control Measures

14.6.31 The site will be regulated under an Environmental Permit and Radioactive Substances Authorisation. The Environment Agency has stipulated a series of indicative Best Available Techniques (BAT) within several of their recent guidance documents on environmental permitting for a variety of process industries and large installations such as nuclear power stations. Examples of indicative BAT practices which represent standard control measures are described below.

14.6.32 For subsurface structures, the indicative BAT requirements are:

- engineer systems to minimise leakages from pipes and ensure swift detection if they do occur, particularly where hazardous substances (i.e. substances in List I or List II of the Groundwater Regulations) are involved; and
- provide secondary containment and/or leakage detection for subsurface pipework, sumps and storage vessels.

14.6.33 For surface features, the indicative BAT requirements are:

- ensure that surfacing and containment or drainage facilities are adequate for all operational areas, taking into consideration collection capacities, surface thicknesses, strength/reinforcement, falls, materials of construction, permeability, resistance to chemical attack, and inspection and maintenance procedures;
- implement an inspection and maintenance programme for impervious surfaces and containment facilities; and
- provide secondary containment for all liquids, whose emission to water or land could cause pollution, unless the operator has used other appropriate measures to prevent or, where that is not practicable, to minimise, leakage and accidental spillage from the primary container.

14.6.34 For bunds, the indicative BAT guidance requires that bunds should:

- be impermeable and resistant to the stored materials;
- have a capacity greater than 110 percent of the largest tank or 25 percent of the total tankage, whichever is the larger; and
- be fitted with a high-level probe and an alarm, where not frequently inspected.

14.6.35 For storage areas for intermediate bulk containers (IBCs), drums, and bags, the indicative BAT requirements state that such areas should be designed and operated to minimise the risk of releases to the environment, including:

- Undercover storage should be considered where pollution can be significantly reduced by so doing.
- The maximum storage capacity of storage areas should be stated and not exceeded, and the maximum storage period for containers should be specified and adhered to.
- Containers should be stored with lids, caps and valves secured and in place (this also applies to emptied containers).
- Procedures should be in place to deal with damaged or leaking containers.

Control Measures for Contaminated Soils

14.6.36 Leaks and accidental spillages could potentially occur during the operational phase despite the BAT control measures outlined above, thus resulting in soil contamination. If such an event occurs the incident should be fully investigated, the environmental risks from the contamination assessed, and where necessary (i.e. where unacceptable environmental risks exist) a mitigation or remediation plan instigated.

c) Construction Impacts

i. Geology

Construction Activities on Geology

14.6.37 A number of activities such as fencing, ground preparation works, installation of the drainage system and the excavation of below ground structures and foundations to be undertaken as part of the construction phase have the potential to impact geology. The potential impacts to geology will be site-specific, permanent and direct.

14.6.38 The earthworks and site levelling/terracing element of the construction works would require the excavation of weathered rock from areas where deeper excavations are required using mechanised plant. The maximum depth of excavations during these works would be in those areas which would be occupied by deep foundations for buildings, or underground structures associated with the proposed power station. Intrusion into the geology would also occur during the installation of the deep drainage pipes, water management ponds and installation of wells for dewatering purposes as part of the drainage network and to a lesser extent during fencing activities (depending on the thickness of topsoil and subsoil materials in these areas).

14.6.39 The likelihood of an impact occurring is 'certain,' i.e. the impacts would definitely occur. The spatial extent of excavations during the site preparation works will include a significant proportion of the HPC development site, however deeper excavations during the main construction phase would be restricted to a smaller area. As a result, the magnitude of the impact is assessed as medium because a permanent change would occur to the existing geological conditions such that it is unrecognisable compared to baseline conditions.

14.6.40 The value and sensitivity of the on-site geology (notwithstanding the areas of cliff exposure and foreshore geomorphology which would not be impacted by the construction activities outlined above) is assessed as low as it has no significant scientific, educational or aesthetic value and sensitivity. The geology is thus only of relevance from an engineering perspective, i.e. acting as a founding medium or source of fill/aggregate for the development.

14.6.41 The significance of the impacts of the construction activities outlined above on geology is assessed as **minor adverse**, and therefore no mitigation is required.

Construction of Temporary Jetty, Sea Wall and Drainage Outfall

14.6.42 The proposed new sea wall will be a gravity, mass concrete wall of 760m in length, by approximately 10m wide with a crest level of 13.5m AOD and with rock armour protection at the toe (see **Chapters 2** and **3** of this volume for details). Also as part of the drainage network, a single discharge outfall point would be constructed along the frontage and incorporated into the sea wall (see **Chapters 2** and **3** of this volume for details).

14.6.43 Access onto the foreshore will be required during the construction of the sea wall and the drainage outfall. The access road would be located where there is a low point in the cliff with minimal cliff exposures present. The sea wall and drainage outfall will not extend into the Blue Anchor to Lilstock geological/geomorphological SSSI. The cliff section lies within the Bridgwater Bay National Nature Reserve (NNR), which is considered by Natural England to include cliff stratigraphy of significant value and interest.

14.6.44 Whilst most of the jetty's construction would take place from the sea using water based equipment, its initial bridge spans would be installed from the foreshore using land based equipment and, therefore, there would be a requirement for land based equipment to have limited temporary access to and along the upper foreshore. Access to the foreshore would be via a temporary service road via a low point in the cliff. Vehicle movements would be confined to a designated route along the upper foreshore to minimise the area of foreshore potentially impacted. Vehicle movements along the foreshore would be low; it is anticipated that approximately 10 vehicle movements per day would be required. Furthermore, access would only be required for a limited duration during the jetty's construction phase (i.e. during the installation of the furthest landward jetty bridge spans).

14.6.45 The construction works for the temporary jetty bridge would comprise 38 to 52 steel tubular piles approximately 864mm diameter installed approximately 4 to 5m into the bedrock layer. The current estimated spacing of the piles is between 25 and 35m, some of which would be installed within the foreshore.

14.6.46 The new sea wall and drainage outfall would directly impact the cliff exposure adjacent to the HPC development site. The sea wall would obscure the cliff exposure for the lifetime of the sea defence system and the toe and rock armour protection of the structure would extend a limited distance onto the foreshore and therefore have a limited spatial impact. During construction there would be a limited requirement for vehicles to track across the foreshore which could directly impact the foreshore. As stated above, the access road would be located in close proximity to the drainage outfall work site (within approximately 100m; see planning application drawing HPCSPW002a) to minimise the area of foreshore which may be impacted. Vehicle movements along the foreshore during the construction of the sea wall and drainage outfall would be confined to a designated route approximately along the upper foreshore to minimise the area of foreshore potentially impacted. As such the magnitude of the impact from vehicle movements on the foreshore is considered to be very low and the significance of the impact would be **minor adverse**.

14.6.47 The design of the jetty is such that it would not damage or destabilise the cliff during construction, operation and dismantling as the height of the jetty deck would lie above the existing cliff face, thus no cutting into the actual cliff face is assumed to be required. Therefore there would be no impact to the cliff exposure during the jetty development. A cliff stability assessment has been undertaken by Jacobs (14.110) to assess the specific aspects of the jetty development which might have a direct impact on cliff stability. The report concluded that the piles required for the jetty (landside and foreshore) are unlikely to impact the cliff stability.

14.6.48 A portion of the jetty development falls with the Blue Anchor to Lilstock SSSI, see **Figure 14.3**.

14.6.49 The area of foreshore to be impacted during piling is restricted to the footprint of each pile, therefore the spatial extent of the impacts is limited to small isolated locations. It is anticipated that an area in the region of approximately 18-21m^2 in the intertidal zone (approximately 25-30 piles) would be lost to piles from a total 28,000m^2 of designated foreshore adjacent to the HPC development site. It is envisaged that drilling arisings during piling works would be collected and appropriately disposed of off-site.

14.6.50 Consultation has been undertaken with Natural England over the potential loss of the exposed geological units and foreshore features adjacent to the HPC development site. Natural England has indicated during consultation that the identification of a replicate accessible section of units within the Blue Anchor to Lilstock SSSI (to the west) is likely to be acceptable to offset the loss of the units exposed within the cliff and foreshore at Hinkley Point. The geological mapping study (Ref. 14.96) has demonstrated that a section to the west of Lilstock within the SSSI provides a high quality replication of the geology found within the cliffs at Hinkley Point and characteristics of the foreshore can also be observed elsewhere.

14.6.51 The impacts from the construction of the sea wall and drainage outfall on the cliff geology would be site-specific, direct and permanent (i.e. irreversible: once the geology is lost it cannot be reinstated exactly how it was). The likelihood that this impact would occur is assessed as 'certain'. No impact on the cliff geology is predicted from the construction (and subsequent operation and dismantling) of the temporary jetty.

14.6.52 The loss of cliff exposure (sea wall and drainage outfall) and foreshore (temporary jetty, sea wall and outfall) will not result in a significant loss of the relevant geological or geomorphological features present at Hinkley Point as these are replicated elsewhere. As a result the magnitude of the impact to the cliff exposure and foreshore is considered to be low.

14.6.53 The value and sensitivity of the cliff and foreshore geology impacted by the temporary jetty, sea wall and drainage outfall construction are rated as medium, as they are not nationally designated but are considered to be of regional importance. The significance of the construction phase on the cliff exposure and foreshore is considered to be **minor adverse**, therefore no mitigation is required.

ii. Land Contamination

14.6.54 Construction phase impacts relating to land contamination can principally arise from:

- the potential for existing contamination on-site and/or off-site to be mobilised, by construction activities e.g. soil disturbance and dust generation during earthworks; or
- the potential for contamination of the soils to occur during construction works (e.g. from escape of fuels and oils from plant and storage tanks).

14.6.55 A construction phase schematic Conceptual Site Model is presented as **Figure 14.17** and in tabular format in **Appendix 4G**.

Construction Activities on On-Site Human Health

14.6.56 During activities to be undertaken as part of the construction phase there is the potential for the health of construction workers on-site to be impacted from any existing on-site contamination and from any contaminated soils as a result of leakage and spillage from mechanised plant. These activities include those undertaken as part of the site preparation works, site clearance, fencing, ground preparation works, demolition of barns, installation of the drainage system, construction of the temporary jetty and other activities undertaken as part of the main construction works. Construction workers may also be impacted via the inhalation of ground gases during works in confined spaces or during deep excavations.

14.6.57 Potential impacts to construction workers could occur via direct contact, inhalation and/or ingestion and could be adverse, temporary or possibly (depending on the nature of the health impact) permanent, direct and indirect.

14.6.58 The value and sensitivity of the construction workforce personnel on-site in the absence of any standard good practice measures is high. However, no member of the construction workforce would be permitted to work on-site without adequate training in, and use of, appropriate full personal protective equipment (PPE); such measures reduce the overall sensitivity of the construction workforce to low.

14.6.59 The likelihood of impact to construction workers being exposed to contaminated soils varies according to the different parcels of land. Within the BDAW and SCPA, no known soil contaminants are present at concentrations which exceed any of the hazardous waste threshold criteria presented in regulations and guidance citied in **Table 14.1**. The likelihood of construction workers being exposed to potentially hazardous concentrations of soils contamination on the BDAW and the SCPA is assessed as unlikely.

14.6.60 Within the BDAE, no known soil contaminants are present which exceed any of the hazardous waste threshold criteria, with the exception of the hydrocarbon contaminated soils in the north-eastern area of the BDAE (TE418) and hotspots of ACMs. These works will significantly reduce the likelihood and risk of construction workers being exposed to ACMs on the BDAE during the construction phase. However, there is still the limited potential for unidentified asbestos contamination and/or other contamination to be present in other areas of the BDAE. Accordingly, the likelihood of construction workers being exposed to potentially hazardous concentrations of soil contamination on the BDAE following the enabling remedial works is assessed as possible.

14.6.61 Any potential asbestos contamination which may be present on-site following the enabling remedial works will be localised and of limited quantity and could be dealt with through the implementation of appropriate control procedures. The roofing material within one of the existing on site barns comprises asbestos bonded cement, from which the risk of free fibre release is low during mechanical handling. Furthermore the asbestos sheeting would be removed in a safe and controlled manner prior to the demolition of the barn structure. Appropriate control measures will be employed in order to prevent the generation of asbestos contaminated dust and free asbestos fibres during the removal process.

14.6.62 The spatial extent of the construction phase would cover the majority of the HPC Development, and the activities undertaken as part of this phase of works would include excavations which may result in the exposure of construction workers to isolated pockets of possible existing contamination (predominantly on the BDAE). However, the investigations across the HPC development site have only identified limited contamination (on the BDAE only) with respect to human health risk, therefore during the construction phase any remaining contaminated soils will be confined to small, localised areas of the BDAE. This is because any accessible areas of contamination would have been have been remediated as part of the enabling/remedial works.

14.6.63 The potential impact to construction workers would further be reduced by the adoption of standard good practices, particularly the dampening down of soils and appropriate materials management, which would be employed to ensure that any areas of unsuitable materials (e.g. ACMs, wood, paper, plastic metals, old drums, etc.) and/or soils contaminated above unacceptable thresholds identified during the construction works would be remediated or removed from site. The magnitude of potential impact to construction workers from contaminated soils during the construction phase works is therefore considered to be low and the significance of the impacts is assessed as **minor adverse**.

14.6.64 During the use of mechanised plant as part of the construction phase there is the potential for accidental spillage or leakages of contaminating liquids such as diesel and hydraulic oil. However, any accidental spills or leaks are likely to be of very low volume and highly localised, and the potential for construction workers to be exposed to contaminated soils as a result of such an event is considered unlikely. The potential impact can be further reduced by the application/adoption of standard good practices and control measures, particularly those relating to vehicle and equipment maintenance and dealing with associated leaks or accidental spills. The magnitude of the potential impact to construction workers from leakage or accidental spillage is therefore considered to be very low and the significance is assessed as **negligible**.

14.6.65 Construction workers could also be impacted via the inhalation of ground gases in confined spaces or during deep excavations. The programme of gas monitoring and subsequent ground gas risk assessment indicates that no significant sources of ground gas are present within the HPC development site. However, occasionally elevated concentrations of nitrogen, hydrogen sulphide and carbon monoxide at some locations on the BDAW have been identified during investigative drilling works. As a result there is a low risk to construction workers via the inhalation of gases potentially present in pockets within the underlying geology or groundwater during any confined space working or during works which are carried out in deep excavations. The risk would be managed through routine gas and vapour monitoring in such locations supported by appropriate exposure control measures. The magnitude of the impact to construction workers from pockets of ground gas in the underlying strata is therefore considered to be very low and the significance is assessed as **negligible**.

14.6.66 Given that the potential impacts to construction workers during the construction activities have been assessed as negligible to minor adverse, no specific formal mitigation is required.

Construction Activities on Off-Site Human Health

14.6.67 Risk to human health for off-site receptors from soil contamination could only occur in the event that contamination migrates off-site as a result of the ground preparation works. The most probable mechanism for such off-site migration would be via uncontrolled contaminated dust and/or odour generation, runoff and wind transport. This could occur if existing contaminated soils are disturbed during the topsoil strip and stockpiling and/or subsequent site levelling and terracing. Any potential contaminated soils generated by leakage or accidental spillage from the use of mechanised plant is unlikely to be of sufficient volume or extent to result in the generation of significant contaminated dust and/or odour generation or otherwise migrate off-site by other means. Potential impacts to off-site humans could be adverse, temporary or possibly permanent (depending on the nature of the health impact), and indirect.

14.6.68 As detailed above, the likelihood of encountering contaminated soils on the BDAW and SCPA is ‘unlikely’ and on the BDAE is ‘possible’. Any remaining hotspots of contaminated soils on the BDAE after the completion of the enabling/remediation works are expected to be few in number and localised in size and area.

14.6.69 The area immediately surrounding the site is sparsely populated, with all off-site residential receptors, including Doggetts Farm, located over 900m from the BDAE (where the isolated areas of contamination have been identified). The adoption of standard good practice, specifically those relating to dust control, would reduce the potential for the mobilisation of contaminants (see **Chapter 12** of this volume (Air Quality) for details). The potential for the transport of contaminated dust over such distance is considered to be unlikely. The magnitude of impact to off-site human receptors from contaminated dust (and odour generation) is therefore considered to be very low.

14.6.70 As the off-site human receptors are considered to have a high value and sensitivity, the significance of the impact to off-site humans from the mobilisation of potential existing contaminated soils via contaminated dust and/or odour generation during the construction activities is assessed as **minor adverse**. Therefore no specific formal mitigation is required.

Construction Activities to the On-Site Soil Environment

14.6.71 A number of activities during the construction phase have the potential for uncontaminated soils to be impacted by mixing with any existing contaminated soils on-site and for the generation of contaminated soils as a result of any leakage or accidental spillage from mechanised plant and equipment. These activities include those undertaken as part of the site preparation works, site clearance, fencing, installation of the drainage system, temporary jetty construction and other activities undertaken as part of the main construction works.

14.6.72 The potential impacts associated with existing contaminated soils and uncontaminated soil are likely to be adverse, temporary and/or permanent, direct and indirect.

14.6.73 The concentrations of ecotoxic contaminants on the BDAW and SCPA are reflective of natural background concentrations and are not considered to pose an ecological risk, with the exception of a localised area of Made Ground on the BDAW. On the BDAE isolated elevated concentrations of hydrocarbons and metals were identified in the Made Ground and these are considered to represent minor localised hotspots, which may pose a low ecological risk. Moderately alkaline pH levels in Made Ground containing demolition and construction materials have also been identified on the BDAE which may pose a low ecological risk. However, appropriate materials management would be employed to ensure that any soils contaminated above unacceptable thresholds would be removed and/or remediated during the preparatory earthworks. The likelihood of soil contamination, including ecotoxic soil contamination, being present is considered ‘unlikely’ on the BDAW and SCPA and ‘possible’ on the BDAE.

14.6.74 The construction works are on a large scale and would cover the majority for the HPC development site. However, as described above the likelihood of contaminated soils being present on the HPC development site ranges from ‘unlikely’ on the BDAW and SCPA to ‘possible’ on the BDAE (following the enabling/remedial works) and should any contaminated soils arise, they are likely to be localised and of low volume. Furthermore, the adoption of standard good practices such as dampening down of contaminated materials, controlling contaminated surface runoff and appropriate materials management to ensure that any soils contaminated above unacceptable thresholds would be removed and/or remediated during the preparatory earthworks, would reduce the potential for any impact to the uncontaminated soil environment during the construction works.

14.6.75 The use of mechanised plant as part of the construction phase creates the potential for accidental spillage or leakages of contaminating liquids such as diesel and hydraulic oil. However, as outlined in paragraph **14.6.64** above, the impact magnitude from these leaks and spills would be very low.

14.6.76 Therefore, given the adoption of standard good practice the magnitude of the impact from existing contamination, or soils contaminated as a result of the use of mechanised plant, on the uncontaminated soil environment during the construction works is considered to be very low.

14.6.77 The value and sensitivity of the on-site soil environment ranges from very low for engineering fills, to high for soils (topsoils and subsoils) which may be re-used in more sensitive areas such as soft landscaping and agricultural and/or habitat creation. For the purpose of this impact assessment, the worst-case value and sensitivity (i.e. high) has been chosen to make the assessment conservative. The significance is therefore assessed as **minor adverse**. Therefore no mitigation is required.

Construction Activities to the Off-Site Soil Environment

14.6.78 Risk to off-site soils could only occur in the event that soil contamination migrates off-site via uncontrolled contaminated dust generation, wind transport and/or surface runoff. This could occur if existing contaminated soils are disturbed during the topsoil stripping and stockpiling and/or subsequent site levelling and terracing as part of the site preparation works.

14.6.79 The likelihood of ecotoxic soil contamination being present is considered to be ‘unlikely’ on the BDAW and SCPA and ‘possible’ on the BDAE.

14.6.80 The magnitude of impact to off-site soils from the excavation, movement, stockpiling and placement of contaminated soils is considered to be very low since any effects are likely to be confined to a limited zone within a few tens of metres of the main construction area. During the construction works, there would be a buffer zone (approximately 250m wide) adjacent to the southern HPC development site boundary (southern extent of main construction works). This buffer zone together with the application of standard good practices, particularly those relating to dust control and surface water runoff, would minimise the potential for contaminant distribution into off-site areas. Furthermore any unsuitable materials and/or unacceptably contaminated soils identified would be remediated or removed from site.

14.6.81 The value and sensitivity of the off-site soil environment ranges from very low in adjacent commercial and industrial areas (Hinkley Point Power Station Complex) to high in adjacent agricultural areas and designated sites. For the purpose of this impact assessment, the worse case value and sensitivity (i.e. high) has been chosen to make the assessment conservative. The significance of the impact of from existing contaminated soils on the off-site soil environment during the construction works is assessed as **minor adverse**. Therefore no mitigation is required.

Construction Activities on On-Site Ecological Receptors

14.6.82 Any legally protected and/or high value and sensitivity ecology (e.g. badgers) that may be present on-site will have been removed under licence from the development area ahead of the construction works and hence will not be present on-site at the start of the construction works. Most of the lower value and sensitivity ecology (e.g. grassland and hedgerows) will be removed due to the construction works. Impacts to any remaining on-site ecological receptors could occur during the various construction activities as a result of mobilisation and/or mixing with any existing contaminated soils on-site and the generation of contaminated soils as a result of any leakage or accidental spillage from mechanised plant and equipment. These activities include those undertaken as part of the site preparation works, site clearance, fencing, ground preparation works, installation of the drainage system, construction of the temporary jetty and other activities undertaken as part of the main construction works.

14.6.83 The potential impacts of contaminated soils upon on-site ecology are likely to be adverse, temporary and/or permanent, direct and indirect.

14.6.84 Soil analysis has demonstrated that contaminant concentrations in the majority of the soils within the HPC development site are considered to be reflective of natural background concentrations and do not pose a significant ecological or phytotoxic risk. Some Made Ground materials on the BDAE and the isolated area of Made Ground on the BDAW have been identified which contain contaminant concentrations which may pose a low risk to ecological systems should they be re-used in the upper 1m of the soil profile within areas of soft landscaping, agricultural land restoration or habitat creation. However, appropriate materials management would be employed to ensure that any soils contaminated above unacceptable thresholds would be removed, remediated during the ground preparation earthworks or only re-used in suitable locations and at suitable depths. The likelihood of soil contamination, including ecotoxic and/or phytotoxic soil contamination, is considered ‘unlikely’ on the BDAW and SCPA and ‘possible’ on the BDAE.

14.6.85 During the use of mechanised plant as part of the construction phase there is the potential for accidental spillage or leakages of contaminating liquids such as diesel and hydraulic oil. However, the impact magnitude from these leaks and spills would be very low.

14.6.86 Therefore, given the adoption of standard good practice the magnitude of the impact from existing contamination, or soils contaminated as a result of the use of mechanised plant, to the on-site ecology during the construction works is considered to be very low. The value and sensitivity of the on-site soil ecology is assessed as medium.

14.6.87 The significance is therefore assessed as **minor adverse**. Therefore no mitigation is required.

Construction Activities to Off-Site Ecological Receptors

14.6.88 Risks to off-site ecology could only occur in the event that soil contamination migrates off-site via uncontrolled contaminated dust generation, wind transport and surface runoff.

14.6.89 The likelihood of ecotoxic and/or phytotoxic soil contamination being present is considered 'unlikely' on the BDAW and SCPA and 'possible' on the BDAE.

14.6.90 The magnitude of impact to off-site ecological receptors from the excavation, movement, stockpiling and placement of contaminated soils is considered to be very low since any effects are likely to be confined to a limited zone within a few tens of metres of the main construction area. During the construction works, there would be a buffer zone (approximately 250m wide) adjacent to the southern HPC development site boundary (southern extent of main construction works). This buffer zone together with the application of standard good practices particularly those relating dust control and surface water run-off, would minimise the potential for contaminant distribution into off-site areas. Furthermore any unsuitable materials/contaminated soil identified would be remediated or removed from site or only re-used in suitable locations and depths.

14.6.91 The value and sensitivity of the off-site ecology is assessed as high.

14.6.92 The significance of the impact of from existing contaminated soils and/or spills and leaks from construction plant to off-site ecological receptors during the construction works is assessed as **minor adverse**. Therefore no mitigation is required.

Construction Activities to On-Site Crops and Livestock

14.6.93 No crops and livestock will be present on-site during the construction phase. As such **no impact** to on-site crops and livestock will occur during the construction works.

Construction Activities to Off-Site Crops and Livestock

14.6.94 Potential impacts to off-site crops and livestock could occur in the event that contamination on-site is mobilised during the construction works.

14.6.95 The likelihood of toxic, ecotoxic and/or phytotoxic soil contamination being present is considered 'unlikely' on the BDAW and SCPA and 'possible' on the BDAE.

14.6.96 The magnitude of impact to off-site crops and livestock is considered to be very low.

14.6.97 The value and sensitivity of the off-site crops and livestock ranges from medium to high. For the purpose of the impact assessment a worst-case of high has been adopted in order to make the assessment conservative.

14.6.98 The significance of the impact from existing contaminated soils and/or spills and leaks from construction plant to off-site crops and livestock during the construction works is assessed as **minor adverse**. Therefore no mitigation is required.

Construction Activities on the Built Environment – On-Site

14.6.99 Buried concrete (for example in the form of foundations and drainage pipes) can be degraded by inorganic contaminants, principally sulphates. Buried services such as plastic water pipes, gas pipes and electrical services can potentially be degraded and/or permeated by organic contaminants such as fuels and solvents which may be released into the soil environment from leaks or accidental spills. The potential impacts resulting from leaks and spills from contamination of soils to the built environment may be site-specific, adverse, permanent, direct and indirect.

14.6.100 The ground gas monitoring and subsequent ground gas risk assessment which has been undertaken, indicates the risk of ground gas ingress into buildings and buried structures on the HPC development site, and subsequent explosion/fire is negligible. As such, no special precautions or gas protection measures are required to protect buildings and their occupants.

14.6.101 Any accidental spills or leaks are likely to be of very low volume and highly localised. Therefore a direct impact to built environment receptors is considered to be unlikely. The magnitude of the impact from contaminated soils is therefore considered to be very low.

14.6.102 The inherent value and sensitivity of the buildings and infrastructure including services is considered to range from very low to high (very low for infrastructure such as buried water pipes and high for the main nuclear island buildings). This evaluation has been made on the basis of the importance of the built structures and infrastructure with respect to energy supply and the requirement that they remain in a safe structural and operating condition throughout their design life. However, all built infrastructure will be designed and constructed with appropriate specification of materials therefore any risk from land contamination will be designed out. As such, **no impacts** relating to land contamination are predicted to the built environment.

Construction Activities on the Built Environment – Off-Site

14.6.103 Off-site built environment receptors (i.e. buried concrete and services) will not be impacted by the proposed construction activities as with adoption of good practice the impacts of these works will be limited to the vicinity of the proposed development site.

Construction Activities to Controlled Waters – On-Site

14.6.104 Impacts to on-site controlled waters (i.e. on-site groundwater and surface waters) could occur through physical mobilisation (such as soil erosion, run-off and sediment deposition) and disturbance of existing contaminated soils during earthworks or increased infiltration and leaching once the topsoil is removed and areas of open excavations exposed. Impacts on controlled waters would be direct and adverse. The impacts would be typically temporary (although if contamination of groundwaters has occurred, depending on contaminant type, it could persist). For potential impacts from physical mobilisation see **Chapter 15** (Groundwater) and **Chapter 16 (**Surface Water) of this volume.

14.6.105 The ground preparation works cover the majority of the HPC development site. Despite the scale of the works the potential magnitude is assessed as very low because the likelihood of encountering any contaminated soils on the BDAW and the SCPA is considered 'unlikely' and, if present, such areas are likely to be very small and highly localised. On the BDAE, the results of WAC and soil leachability testing do not indicate the presence of significant contamination with the potential to impact controlled waters via leaching (with the exception of the hydrocarbon contaminated soils in the north-eastern area of the BDAE (TE418), which would be removed/remediated prior to commencement of any bulk earthworks or other construction activities in this area). Therefore the likelihood of any impact to controlled waters on the BDAE is also considered to be 'unlikely'.

14.6.106 The value and sensitivity of on-site groundwater is assessed as low on the basis that the site is underlain by a Secondary A Aquifer, has no significant local use at or adjacent to the site in or down-gradient of the likely area of influence and is not within a Source Protection Zone (see **Chapter 15** of this volume on Groundwater). The value and sensitivity of on-site surface watercourses ranges from low to high dependent on the watercourse. Hinkley Point C Drainage Ditch is assessed as low because it is an ephemeral agricultural drainage ditch with highly variable water quality conditions, including elevated suspended solids. Holford Stream has been assessed as high because it is of moderate water quality status and is an important water supply to freshwater wetland habitats of Wick Moor and Bridgwater Bay SSSI (see **Chapter 16** of this volume on Surface Water). For the purpose of this assessment, the worst-case value and sensitivity (high) has been adopted to make the assessment conservative.

14.6.107 The significance of the impact of contaminated soils on controlled waters during the activities is assessed as **minor adverse**. Therefore no mitigation is required.

Operation of Site Compounds to Human Health, Ecology, Crops/Livestock, Soil Environment, Built Environment and Controlled Waters – On-Site and Off-Site

14.6.108 Contractor's compound areas will be established on-site during the site preparation works. The compound areas would be covered by hardcore or asphalt in the case of the haul roads and other elements, e.g. the concrete batching plant and weighbridge. The covering of the surfaces would act as a physical barrier between any existing contaminated and/or uncontaminated land from potential receptors or potential new sources of contamination in this area. Therefore, no potential pollutant linkage exists and no associated potential impacts would arise.

14.6.109 The construction compounds would operate as a controlled environment, with the adoption of standard good practices and control measures and, as such, it is not considered that there will be any potential impacts to on-site or off-site receptors from any activities relating to the site compounds.

d) Cumulative Construction Impacts

i. Geology

Construction of Drainage Outfall, Sea Wall and Temporary Jetty on Foreshore Geology

14.6.110 During the construction works there is the potential for the foreshore geology to be impacted as a result of the construction of the drainage system outfall structure, sea wall and temporary jetty.

14.6.111 The magnitude of these impacts has been assessed as low. The foreshore geology also has the potential to be impacted by piling activities associated with the construction of the temporary jetty. The magnitude of this impact has been assessed as very low.

14.6.112 There is the potential for an additive cumulative impact to the foreshore geology as a result of these activities, which would be direct, permanent and certain to occur. The geological mapping study (Ref. 14.96) has demonstrated that the characteristics of the foreshore adjacent to the site can be observed elsewhere within the 'Blue Anchor to Lilstock' SSSI, therefore the loss of foreshore associated with the HPC Development would not result in an overall loss of the relevant foreshore geological features. The total area of foreshore which would be impacted by these project elements is very small when compared to the area of the foreshore adjacent to the HPC development site. The magnitude of the cumulative impact of the construction of the drainage outfall structure, the sea wall and the temporary jetty on the foreshore geology is therefore assessed as low.

14.6.113 The overall value and sensitivity of the foreshore for the purpose of this cumulative assessment is assessed as medium.

14.6.114 The significance of this cumulative impact is assessed as **minor adverse** and therefore no mitigation is required.

ii. Land Contamination

On-Site Human Health, On-Site Ecology, On-Site Soil Environment and On-Site Controlled Waters During Construction Works

14.6.115 There is the potential for an additive cumulative impact to the on-site construction workforce, any remaining on-site ecology, on-site soil environment and on-site controlled waters from land contamination generated as a result of leakage and accidental spillage and disturbance of existing land contamination during concurrent construction activities. However, given the adoption of standard good practice and appropriate control measures any potential accidental leakage or spillage would be very low volume and highly localised, and any existing land contamination would be of limited quantity, highly localised and managed through appropriate control procedures. The potential for receptors to be exposed to significant contamination from both sources at the same time is considered unlikely. Therefore there is considered to be no significant potential for cumulative impacts to the on-site construction workforce, any remaining on-site ecology and soil environment or to controlled waters from different sources of contamination during concurrent construction activities.

Off-Site Human Health, Ecology, Crops/Livestock, and Soil Environment During the Construction Works

14.6.116 During the construction works, potential impacts to off-site receptors (human health, ecology, crops/livestock, and soil environment), have only been identified as a result of single sources during the ground preparation works. It is not anticipated that these receptors will be subject to impacts during other construction activities or from greater than one source, therefore there would be no cumulative impacts to these receptors as a result of the construction works.

e) Operational Impacts

i. Geology

14.6.117 The operational phase (including commissioning) of the development would not result in any excavation into the underlying geology and therefore there would be **no impacts** on geology during the operational phase.

ii. Land Contamination

14.6.118 Following the completion of the construction works only soils which are suitable for use would be present on-site, i.e. all unacceptable contaminated soils would have been removed from site or remediated to render them suitable for use (e.g. only using contaminated soils in areas of hardstanding or at depths of greater than one metre in areas of proposed soft landscaping, agricultural land restoration or habitat creation). Contaminated soils above acceptability criteria[4] could potentially be re-used on-site during the construction phase (and hence very limited residual contamination could still be present during the commissioning and operational phase) provided that:

- they are managed in accordance with an agreed Materials Management and Land Contamination Management Plan and under the Code of Practice (Ref. 14.111);
- the soils are re-used in an appropriate manner (e.g. placed at greater than 1m if being re-used in areas of soft landscaping and/or agricultural and habitat restoration) and with supporting risk assessments to demonstrate they are 'suitable for use' even though they may be contaminated above acceptability criteria;
- testing demonstrates that the contaminants present in the soils are not readily mobile, leachable or otherwise bioavailable;
- they are re-used with the agreement of relevant stakeholders; and
- accurate records of the location, depth and type of contamination are kept.

14.6.119 A range of hazardous, non-radiochemical substances and materials including diesel, kerosene, solvents, oils, transformer oils, paints, acids, and alkalis would be stored and used on-site during the commissioning and operational phase of the development. These substances have the potential to cause land contamination if uncontrolled discharges to ground should occur.

14.6.120 An operational phase schematic Conceptual Site Model is presented as **Figure** 14.19.

14.6.121 In accordance with the Environmental Permit, pollution prevention infrastructure would be provided in accordance with BAT requirements which would significantly reduce the likelihood of any potential future accidental spillage or leakage and the resultant potential for ground contamination to occur. Therefore any potential contaminated soils arising as a result of operational activities are unlikely to be of sufficient volume to form a significant source of contaminated dust which could migrate off-site or alternatively constitute a source which could impact controlled waters on-site. As a result there are considered to be no potential impacts to off-site human health, off-site ecology, off-site crops/livestock, off site built environment, off-site soil environment, and/or off-site controlled waters during the operational phase (including commissioning).

[4] Acceptability criteria may vary depending on location of proposed re-use, depth of re-use, soil type, end use, environmental context/sensitivity, and contaminant type.

Operational Activities on On-Site Human Health

14.6.122 There is a potential risk to human health from soil contamination during the commissioning and operational phases to on-site maintenance and construction workers who may be required to undertake works in the subsurface environment (e.g. for repairs to underground infrastructure). These worker groups may come into close contact with potentially contaminated soil (particularly during excavations) arising as a result of commissioning and operational activities or residual contaminated soils placed there during the construction phase. Potential impacts to construction workers could be adverse, temporary, or possibly (depending on the nature of the health impact) permanent, direct and indirect.

14.6.123 The majority of the site would be covered by buildings and hardstanding. Therefore workers engaged in activities above ground would not be exposed to potential soil contamination via the direct contact or ingestion exposure routes.

14.6.124 In accordance with the Environmental Permit, pollution prevention infrastructure would be provided to significantly reduce the likelihood of any potential future accidental spillage or leakage and the resultant potential for ground contamination to occur. In addition, any future planned ground works during the operation of HPC would require a risk assessment to be undertaken in advance, which would consider the potential for ground contamination to be present. Exposure to potential in-ground contamination would then be managed if necessary through the use of appropriate control measures. Therefore the magnitude of the potential impact is considered to be very low.

14.6.125 The value of people on-site is high and therefore the initial significance of the impact is assessed as minor adverse. However, workers would not be permitted to be exposed to contaminated materials and would be provided with personal protective equipment (PPE) to prevent any adverse impact. Accordingly, the significance of the impact from commissioning and operational activities on on-site human health is considered to be **negligible**. Therefore no control measures beyond the standard good practice (as described above) are required.

Operational Activities to On-Site Ecological Receptors.

14.6.126 The presence of ecological receptors within the main nuclear island area of the proposed HPC site is likely to be very limited, and probably restricted to small areas of ornamental soft landscaping of very low value and sensitivity. As such, the potential for impacts to on-site ecology in these areas of the site during the commissioning and operational phases are considered to be negligible. However, ecological receptors will be present within the areas of agricultural land restoration new habitat creation that will principally be located in the areas to the south and west of the main nuclear island.

14.6.127 The potential for ecological receptors in these areas to be impacted by possible residual contamination deposited in these areas during the construction works and/or leaks and spills from the operational site area is very low. The potential for, and magnitude of, spills and leaks from the operational area will be controlled by good operational practice and pollution prevention infrastructure. Therefore the magnitude of potential impact to on-site ecological receptors during the operational phase is very low.

14.6.128 The value and sensitivity of the on-site ecology within the agricultural and natural habitat restoration areas is considered to be medium. The resulting impact significance is considered to be **minor adverse**.

Operational Activities to On-Site Crops and Livestock

14.6.129 Crops and livestock will not be present within the built development area. However, areas of arable farming (but not grazing i.e. livestock) will be present in the agricultural restoration areas. The magnitude of potential impacts to on-site crops either from residual contaminated soils deposited in the area during the construction phase and/or leaks and spills from the operational site is considered to be very low. The value and sensitivity of these arable areas is assessed as medium (see **Chapter 13** of this volume for details (Soils and Land Use)). The resulting impact significance is therefore **minor adverse**.

Operational Activities to the On-Site Soil Environment

14.6.130 There is the potential for the on-site soil environment to be impacted by possible residual contaminated soils deposited in the area during the construction phase and/or leaks and spills from the operational site. The potential impacts from such releases to the on-site soils are likely to be site-specific, adverse, permanent and direct.

14.6.131 The potential impact to soil is likely to be limited in extent and volume. Any contaminated soils that are re-used/re-deposited during the construction earthworks would only be done so if 'suitable for use'. During the commissioning and operational phase, the majority of the site would be occupied by hardstanding, particularly those areas used for the storage of chemical and fuels, therefore the amount of soil that could be potentially impacted is low. Further to this the Environmental Permit would require pollution prevention infrastructure to be provided, which would significantly reduce the likelihood of any potential future accidental spillage or leakage and the resultant potential for ground contamination to occur. Thus although the likelihood of potential impact to soil is considered to be 'possible', the magnitude of the potential impacts to soil is considered to be very low.

14.6.132 The value and sensitivity of the on-site soils within the permanent built development area which could be directly impacted is very low as the soils present would be engineering fills. The value and sensitivity of on-site soils used in the landscaped areas is high. For the purpose of this impact assessment a worst-case of high has been chosen to make the assessment conservative.

14.6.133 The significance of this impact is assessed as **minor adverse**. Therefore no specific mitigation is required.

Operational Activities to On-Site Built Environment

14.6.134 During the commissioning and operational phases, potentially aggressive chemicals (e.g. acids, alkalis, sulphates, chlorides, diesel and solvents) would be stored and used on-site, therefore there is the potential impact upon the built environment from uncontrolled releases of potentially aggressive contaminants. Any contaminated soils potentially re-used on-site during the construction phase would be demonstrated to be suitable for use. The potential impacts from contaminated soils to the on-site built environment are likely to be site-specific, adverse, permanent and direct and/or indirect.

14.6.135 The likelihood of potential impacts to the on-site built environment is considered to be unlikely. The Environmental Permit requires pollution prevention infrastructure to be provided, which would significantly reduce the likelihood of any potential future accidental spillage or leakage and the resultant potential for the release of chemically aggressive contaminants. Therefore the magnitude of the potential impact is considered to be very low.

14.6.136 The inherent value and sensitivity of the buildings, services and other infrastructure is considered to vary from very low to high (very low for pipes and high for buildings). However, the built infrastructure would be designed and constructed with appropriate specifications of materials such as potential impacts from land contamination will be designed out. As such, **no impacts** from uncontrolled release of aggressive contaminants during operational activities on buildings, services and other infrastructure are predicted.

f) Cumulative Operational Impacts

i. Geology

14.6.137 No impacts to any geological receptors have been identified during the commissioning or operation of HPC there is therefore no potential for any cumulative impacts.

ii. Land Contamination

14.6.138 The only potential impacts associated with land contamination identified during the commissioning or operation of Hinkley Point C are the potential impacts to on-site human health (workers), on-site ecology, on-site crops and the on-site soil environment from potential residual contaminated soils deposited during the construction phase and/or leakage or accidental spillage of contaminants. Given potential impacts are restricted to only two possible sources and in accordance with good practice, any potential leakage and accidental spillage will be located and remediated there is no potential for any cumulative impacts to receptors.

g) Landscape Restoration Impacts

14.6.139 On completion of construction, final landscaping works would be implemented, which would involve the non-operational areas of the HPC development site. The works would involve the re-use of stored topsoil, subsoil and other material to provide agricultural land and wildlife habitat creation.

14.6.140 The potential impacts relating to geology and land contamination from these elements are provided below.

i. Geology

14.6.141 The dismantling of the jetty is not anticipated to further impact foreshore geology beyond those impacts associated with its construction as no additional excavation of the on-site geology is anticipated and therefore there would be **no impact** to geology during the removal of the temporary jetty.

14.6.142 Following the dismantling of the jetty the aggregates storage area would be restored to its former agricultural use. This would be undertaken as part of the overall land restoration of the HPC development site. It is not anticipated that the restoration would involve excavation of the underlying geology and therefore **no impacts** to geology from restoration activities are anticipated.

ii. Land Contamination

14.6.143 Any unacceptable soil contamination identified during the construction works would have been remediated or removed from site therefore the restoration is unlikely to involve the disturbance of any potential previously existing contaminated soils. However, some contaminated soils above acceptability criteria[5] could potentially be re-used in areas of planned agricultural and habitat restoration provided that:

- they are managed in accordance with an agreed Materials Management Plan and Land Contamination Management Plan and under the Code of Practice;
- the soils are managed in an appropriate manner (e.g. placed at greater than 1m depth) and with supporting risk assessments to be suitable for use even though they may have be contaminated above acceptability criteria;
- testing demonstrates that the contaminants present in the soils are not particularly mobile, leachable or otherwise bioavailable/accessible;
- they are re-used with the full agreement of key stakeholders; and
- accurate records of the location, depth and type of contamination are kept.

14.6.144 The final landscaping works would require the use of mechanised plant, which has the potential to generate contaminated soils which may impact on-site human health (i.e. construction workers) and on-site soils. Any potential contaminated soil generated by leaks or accidental spills from the use of mechanised plant is unlikely to be of sufficient volume to result in the generation of significant quantities of contaminated soils.

h) Cumulative Restoration Impacts

i. Geology

14.6.145 Given no impacts to any geological receptors have been identified during restoration works there is no potential for any cumulative impacts.

ii. Land Contamination

14.6.146 The only potential impacts associated with land contamination identified during the restoration phase are the potential impacts to on and off-site human health, ecology, crops/livestock, soil environment and on-site controlled waters from the mobilisation and re-use of potentially contaminated soils and leakage or accidental spillage of contaminants from plant and machinery. The potential cumulative impacts are **minor adverse** assuming the worst-case.

[5] Acceptability criteria may vary depending on location of proposed re-use, depth of re-use, soil type, end use, environmental context/sensitivity, and contaminant type.

14.7 Mitigation of Impacts

a) Geology

14.7.1 As the geological units within the cliffs along the northern boundary of the HPC development site are fossiliferous, a watching brief would be maintained for identification of any finds of scientific importance during any excavations associated with the cliffs, such as during the construction of the drainage system outfall structure and construction of the sea wall

14.7.2 Paragraphs 14.5.37 – 14.5.41 identify that the eastern extent of the 'Blue Anchor to Lilstock' Site of Special Scientific Interest (SSSI) extends into the western part of the BDAW frontage by approximately 40m. The small area of the development site that falls within the SSSI is designated on the basis of the geological cliff exposures and limestone pavement (geomorphology) on the foreshore. The remaining cliff face and foreshore along the frontage of the BDAW and BDAE whilst not being within the SSSI still contains geology and geomorphology of significant value and interest.

14.7.3 Following consultation with Natural England, a geological survey along 10km of coastline identified a high quality, publically accessible replication of the geology found within the cliffs at Hinkley Point elsewhere within the SSSI. It was also qualitatively demonstrated that the characteristics of the foreshore geomorphology adjacent to the site can be observed elsewhere within the SSSI to the west and that these other examples are acceptable replication that will offset any loss of the units exposed within the cliff and rock pavement at Hinkley Point as part of the development. It should be stressed that this acceptable replication is not considered or proposed here as formal mitigation but, is mentioned here for completeness.

14.7.4 The foreshore along the northern boundary of the HPC development site is also fossiliferous, therefore, a pre-construction survey to identify any palaeontological finds of scientific importance is intended on the foreshore and intertidal wave-cut platform within the footprint of the jetty access road and the area to be impacted by piling works. A watching brief for fossils is not considered necessary during the jetty construction given the small diameter (864mm) of each pile and the very limited area of the foreshore to be excavated.

b) Land Contamination

14.7.5 Since the impact assessment is based on adherence to legislative requirements and adoption of standard good construction and operational practices (see Paragraphs 14.6.9 – 14.6.14 and 14.6.31 – 14.6.36), no moderate or major adverse impacts relating to contaminated soils have been identified.

14.8 Residual Impacts

14.8.1 As no mitigation measures are considered necessary none will be applied (see previous paragraph 14.7.5); therefore the residual impacts of the proposed development will be the potential impacts identified in Section 14.6.

14.9 Summary of Impacts

a) Geology

14.9.1 A summary of potential geological impacts during the proposed development are presented in **Table 14.10**.

b) Land Contamination

14.9.2 A summary of potential contaminated soils impacts during the proposed development are presented in **Table 14.11**.

Table 14.10: Summary of Impacts to Geology

Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
Construction							
On-site surface geology	Construction activities on geology	Medium	Site specific Direct Adverse Permanent	Low	Minor adverse	None proposed	Minor adverse
Cliff and foreshore geology	Construction of sea wall and drainage outfall	Very low to Low	Site specific Direct Adverse Permanent	Medium (As area that will be impacted is **not** in SSSI but only in NNR)	Minor adverse	None proposed. However, a watching brief would be maintained for identification of any finds of scientific importance during any excavations associated with the cliffs.	Minor adverse
Foreshore geology	Temporary jetty bridge construction	Very low	Site Specific Localised Direct Adverse Permanent	High (As part of area that will be impacted is within the SSSI)	Minor adverse	None proposed in response to consultation with Natural England as geological exposures are not unique to HPC and are present elsewhere within the SSSI. However, a pre-construction survey to identify any palaeontological finds of scientific importance is intended on the foreshore and inter-tidal wave-cut platform.	Minor adverse
Foreshore geology	Operation of temporary jetty	N/A	N/A	N/A	N/A	N/A	N/A
Commissioning							
On-site surface geology	Commissioning activities	N/A	N/A	N/A	N/A	N/A	N/A

Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
Operation							
On-site surface geology	Operational phase	N/A	N/A	N/A	N/A	N/A	N/A
Restoration							
On-site surface geology	Dismantling of jetty	N/A	N/A	N/A	N/A	N/A	N/A
On-site surface geology	Restoration works	N/A	N/A	N/A	N/A	N/A	N/A

Table 14.11: Summary of Impacts Relating to Land Contamination

Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
Construction							
On-site human health (i.e. workers involved in demolition, preparation and construction works)	Construction activities	Very Low to Low	Site Specific Direct Indirect Adverse Temporary Permanent	Low (construction worker with full PPE)	Negligible to Minor Adverse	None proposed. However please see Section 14.6 (b).	Negligible to Minor Adverse
On-site human health (i.e. construction workers working in confined spaces or deep excavations)	Inhalation of ground gases	Very Low	Site Specific Direct Adverse Temporary Permanent	Low (construction worker with full PPE)	Negligible	None proposed. However please see Section 14.6 (b).	Negligible

Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
Off-site human health (i.e. local residents and members of the public)	Construction activities	Very Low	Wider environment Indirect Adverse Permanent Temporary	High	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
Controlled waters (i.e. on-site groundwater and surface water)	Construction activities	Very Low	Site Specific Direct Adverse Permanent Temporary	High	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
On-site soil environment	Construction activities	Very Low	Site Specific Direct Indirect Adverse Permanent Temporary	High	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
Off-site soil environment	Construction activities	Very Low	Wider Environment Direct Indirect Adverse Permanent Temporary	High	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
On-site ecology (including plants, trees and other vegetation)	Construction activities	Very Low	Site Specific Direct Indirect Adverse Permanent Temporary	Medium	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse

Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
Off-site ecology (including plants, trees and other vegetation)	Construction activities	Very Low	Wider Environment Direct Indirect Adverse Permanent Temporary	High	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
On-site Crops and Livestock	Construction activities	N/A	N/A	N/A	N/A	N/A	N/A
Off-site Crops and Livestock	Construction activities	Very Low	Wider Environment Direct Indirect Adverse Permanent Temporary	High	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
On-site built environment (i.e. water supply pipes and underground concrete)	Construction activities	N/A	N/A	N/A	N/A	N/A	N/A
Off-site built environment	Construction activities	N/A	N/A	N/A	N/A	N/A	N/A
On-site human health	Operation of site compound	N/A	N/A	N/A	N/A	N/A	N/A
Off-site human health	Operation of site compound	N/A	N/A	N/A	N/A	N/A	N/A
On-site ecology (including plants, trees and other vegetation)	Operation of site compound	N/A	N/A	N/A	N/A	N/A	N/A
Off-site ecology (including plants, trees and other vegetation)	Operation of site compound	N/A	N/A	N/A	N/A	N/A	N/A

Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
On-site crops and livestock	Operation of site compound	N/A	N/A	N/A	N/A	N/A	N/A
Off-site crops and livestock	Operation of site compound	N/A	N/A	N/A	N/A	N/A	N/A
On-site built environment	Operation of site compound	N/A	N/A	N/A	N/A	N/A	N/A
Off-site built environment	Operation of site compound	N/A	N/A	N/A	N/A	N/A	N/A
On-site soil environment	Operation of site compound	N/A	N/A	N/A	N/A	N/A	N/A
Off-site soil environment	Operation of site compound	N/A	N/A	N/A	N/A	N/A	N/A
On-site controlled waters	Operation of site compound	N/A	N/A	N/A	N/A	N/A	N/A
Off-site controlled waters	Operation of site compound	N/A	N/A	N/A	N/A	N/A	N/A
Commissioning and Operation							
On-site human health (i.e. maintenance/construction workers)	Commissioning and operational activities	Very low	Site Specific Direct Indirect Adverse Permanent Temporary	Low (construction worker with full PPE)	Negligible	None proposed. However please see Section 14.6 (b).	Negligible
Off-site human health	Commissioning and operational activities	N/A	N/A	N/A	N/A	N/A	N/A
On-site Controlled waters	Commissioning and operational activities	N/A	N/A	N/A	N/A	N/A	N/A
On-site soil environment	Commissioning and operational activities	Very Low	Site Specific Direct Indirect	High	Minor Adverse	None proposed. However please see Section 14.6	Minor Adverse

Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
			Adverse Permanent Temporary			(b).	
On-site soil environment	Commissioning and operational activities	N/A	N/A	N/A	N/A	N/A	N/A
On-site ecology (including plants, trees and other vegetation)	Commissioning and operational activities	Very Low	Site Specific Direct Indirect Adverse Permanent Temporary	Medium	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
Off-site ecology (including plants, trees and other vegetation)	Commissioning and operational activities	N/A	N/A	N/A	N/A	N/A	N/A
On-site Crops (no livestock)	Commissioning and operational activities	Very Low	Site Specific Direct Indirect Adverse Permanent Temporary	Medium	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
On-site Crops (no livestock)	Commissioning and operational activities	N/A	N/A	N/A	N/A	N/A	N/A
On-site built environment (i.e. water supply pipes and underground concrete)	Commissioning and operational activities	N/A	N/A	N/A	N/A	N/A	N/A
Off-site built environment	Commissioning and operational activities	N/A	N/A	N/A	N/A	N/A	N/A
Restoration							
On-site human health (i.e. construction works)	Removal of jetty and restoration	Very Low	Site Specific Direct	Low (construction worker with full	Negligible	None proposed. However please	Negligible

Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
			Indirect Adverse Permanent Temporary	PPE)		see Section 14.6 (b).	
Off-site human health	Removal of jetty and restoration	Very Low	Wider Environment Direct Indirect Adverse Permanent Temporary	High	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
On-site Controlled waters	Removal of jetty and restoration	Very Low	Site Specific Direct Indirect Adverse Permanent Temporary	High	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
On-site soil environment	Removal of jetty and restoration	Very Low	Site Specific Direct Indirect Adverse Permanent Temporary	High	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
Off-site soil environment	Removal of jetty and restoration	Very Low	Wider Environment Direct Indirect Adverse Permanent Temporary	High	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
On-site ecology (including plants, trees and other vegetation)	Removal of jetty and restoration	Very Low	Site Specific Direct Indirect	Medium	Minor Adverse	None proposed. However please see Section 14.6	Minor Adverse

Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
			Adverse Permanent Temporary			(b).	
Off-site ecology (including plants, trees and other vegetation)	Removal of jetty and restoration	Very Low	Wider Environment Direct Indirect Adverse Permanent Temporary	High	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
On-site crops (no livestock)	Removal of jetty and restoration	Very Low	Site Specific Direct Indirect Adverse Permanent Temporary	Medium	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
Off-site crops and livestock	Removal of jetty and restoration	Very Low	Wider Environment Direct Indirect Adverse Permanent Temporary	High	Minor Adverse	None proposed. However please see Section 14.6 (b).	Minor Adverse
On-site built environment	Removal of jetty and restoration	N/A	N/A	N/A	N/A	N/A	N/A
Off-site built environment	Removal of jetty and restoration	N/A	N/A	N/A	N/A	N/A	N/A

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CHAPTER 15: GROUNDWATER

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15. GROUNDWATER

15.1 Introduction

15.1.1 This chapter of the Environmental Statement (ES) provides an assessment of the potential impacts to groundwater associated with the construction and operational phases of Hinkley Point C (HPC). Where required, mitigation measures are identified to prevent, reduce and where possible off-set any potential adverse impacts that are identified to be of significance.

15.2 Scope and Objectives of Assessment

15.2.1 The scope of the assessment has been determined through a formal Environmental Impact Assessment (EIA) scoping process undertaken with the Infrastructure Planning Commission (IPC). It has also been informed by formal consultation carried out during the Stage 1 and Stage 2 Consultations and specific additional consultation with the Environment Agency and local authorities as necessary. In the case of the former, meetings were held with various consultees as shown in **Table.15.1**.

Table.15.1: Groundwater Consultations

Date	Consultee	Type/Purpose of Consultation
09/12/2008	Local Authorities (Sedgemoor and West Somerset)	Scoping consultation meeting.
12/12/2008	Environment Agency	Copy of draft outline groundwater monitoring plan sent to the Environment Agency for comment.
15/12/2008	Environment Agency	Scoping consultation meeting.
04/02/2009	Environment Agency	Correspondence to discuss first results of groundwater monitoring etc.
28/07/2009	Environment Agency	MALG meeting/presentation at which Phase 1 and Phase 2 non-radiological groundwater quality results and findings were discussed and proposals for further site investigation presented; groundwater conceptual model also presented.
27/07/2010	Environment Agency	Presentation of groundwater and contaminant transport modelling and conclusions to date.
06/04/2011	Environment Agency	Presentation of updated groundwater and contaminant transport modelling and conclusions to date.
11/04/2011	Local Authorities (Sedgemoor and West Somerset)	Presentation of updated groundwater and contaminant transport modelling and conclusions to date.

Stage 2 Consultation

15.2.2 The Stage 2 consultation process resulted in the submission of a number of groundwater related comments from consultees on the Environmental Appraisal document. The principal comments related to groundwater, include the following:

- groundwater modelling;
- extent of site investigations;
- scope of assessment for the sea wall, jetty and pumping rates;
- impacts on groundwater quality; and
- impacts on the Bridgwater Bay SSSI.

15.2.3 Consultation on groundwater issues has formed part of the overall consultation process. Principally, the consultation comments raised have been resolved due to completion of BDAE and SCPA onshore investigations and subsequent development of the groundwater numerical model. BDAE and SCPA onshore investigations and the groundwater numerical model were not finalised prior to the Stage 2 consultation being undertaken.

15.2.4 The topics listed above were discussed during the stakeholder meetings listed in **Table.15.1** Further information may be found in the **Consultation Report**.

15.2.5 The assessment of groundwater impacts on key sensitive receptors arising from the proposed development has been undertaken adopting the methodologies described in Section 15.4 below. The existing baseline conditions, against which the likely environmental effects of the development are assessed, have been determined through a programme of site investigation (reported in more detail in **Chapter 14** of this volume), conceptual model development and groundwater modelling as described in Section 15.5; this section also identifies the existing and future receptors which are of relevance to groundwater.

15.2.6 The study area for this assessment, as illustrated in **Figure 15.1**, comprises the HPC Development Site and surrounding area off-site which may be influenced by construction and operational phase activities. The HPC Development Site comprises three separate parcels of land (**Figure 15.2**) which are referred to as the Built Development Area West (BDAW), the Built Development Area East (BDAE) and the Southern Construction Phase Area (SCPA).

15.2.7 The off-site highway improvements schemes have also been considered with respect to the scope of the groundwater assessment. The schemes principally represent modifications to roads that are already in place or would otherwise require physical works of a very limited nature. For existing roads which would be modified pollution control measures such as grit traps and interceptors will already exist as required to protect the road drainage and any seepage to subsoil from road-related contamination. It is assumed that the improvement schemes will augment these measures as appropriate. As the highway improvements would not involve extensive deep excavations, and any groundwater inflows from the anticipated superficial and/or solid formations would not be significant any dewatering would be of a temporary and minor magnitude. As a result there would be negligible impact on the groundwater environment and therefore none of the highway improvements schemes are considered further in the impact assessment.

15.2.8 Section 15.6 assesses the potential groundwater impacts on key sensitive receptors, including (where they have not previously been scoped out from baseline or modelling assessments):

- construction dewatering impacts on controlled waters, including groundwater and potential groundwater impact on surface water bodies such as Holford Stream and the drainage on Wick Moor (groundwater levels, groundwater quality, saline intrusion and abstractions);
- construction dewatering impacts on buildings and infrastructure; and
- impacts from building foundations and structures built below the water table on controlled waters (groundwater levels, sea water intrusion and groundwater quality).

15.2.9 Appropriate mitigation measures aimed at preventing, reducing and, where possible off-setting any potential adverse impacts that are identified to be of significance are presented in Section 15.7. The assessment of residual impacts, as required, following implementation of the mitigation measures is provided in Section 15.8.

15.2.10 The objectives of the assessment were to:

- interpret site investigation and other sources of information with respect to hydrogeology;
- construct a groundwater conceptual model to identify and describe likely baseline groundwater behaviour within the study;
- identify key sensitive receptors within the study area;
- design and build a groundwater model to replicate baseline groundwater conditions;
- predict construction and operational impacts on groundwater using the same model;
- predict groundwater quality impacts using a contaminant transport model;
- recommend mitigation measures, if considered necessary, to reduce potential adverse impacts of the proposed development on groundwater; and
- assess the residual impacts of the construction and operational phases of the proposed development on groundwater.

15.3 Legislation, Policy and Guidance

15.3.1 This section identifies and describes legislation, policy and guidance of relevance to the assessment of potential groundwater impacts associated with the construction and operational phases of the proposed development.

15.3.2 The Overarching National Policy Statement (NPS) for Energy (NPS EN-1) when combined with the NPS for Nuclear Power Generation (NPS EN-6) provides the primary basis for decisions by the IPC on applications for nuclear power generation developments that fall within the scope of the NPSs.

15.3.3 Notwithstanding this, the IPC may consider other matters that are both important and relevant to its decision-making. This could include Planning Policy Statements (PPSs), Planning Policy Guidance Notes (PPGs), regional and local policy documents, although, if there is a conflict between these and the NPS, the NPS prevails for the purposes of IPC decision making.

15.3.4 Further, the Planning Act 2008 provides that the IPC must, in making its decision on an application, have regard to any Local Impact Report (LIR) prepared by relevant local authorities. It is anticipated that the LIRs will rely in part on PPSs, PPGs, regional and local policy to provide a context for their assessment. On this basis, regard has been given to these documents (where relevant to the technical assessment) since they are likely to inform the LIRs prepared by the relevant local authorities.

a) International Legislation

i. Water Framework Directive (2000/60/EC)

15.3.5 The overall purpose of the Water Framework Directive (WFD) (Ref. 15.1) is to establish a framework for the protection of surface freshwater, estuaries, coastal water and groundwater. The objectives of the WFD are to enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands, promote the sustainable use of water, reduce pollution of water (especially by 'priority' and 'priority hazardous' substances), and ensure progressive reduction of groundwater pollution. The main features of the WFD are:

- Member states should take all necessary measures to ensure that groundwater quality does not deteriorate and to prevent the input of pollutants to groundwater.
- Discharges of hazardous substances must cease or be phased out within 20 years of their identification as a priority hazardous substance.
- All inland and coastal waters within defined river basin districts must reach at least good status by 2015. The WFD defines how this should be achieved through the establishment of environmental objectives and ecological targets for surface waters.

15.3.6 The WFD has an associated annex which comprises a list of 'priority' and 'priority hazardous' substances. This annex has now been replaced by the Directive on Priority Substances (2008/105/EC) (Ref.15.2), in which Annex II identifies 33 'priority substances' (including lead and nickel in addition to organic compounds) of which 20 are classified as 'priority hazardous' substances (including cadmium and mercury amongst organic compounds). It also includes a list of eight organic substances for determination whether they should be included in the list of priority substances or priority hazardous substances. In July 2006, the European Commission published a proposal for a directive on environmental quality standards in the field of water policy (COM 2006 397) (Ref. 15.3) which will set limits on concentrations in surface waters for the priority substances.

15.3.7 The WFD will ultimately lead to the repeal of several other long standing key directives, including the Protection of Groundwater from Dangerous Substances (80/68/EEC) (Ref.15.4) and Substances Discharged into the Aquatic Environment (76/464/EEC) (Ref. 15.5).

15.3.8 In England and Wales, the WFD is primarily implemented through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (Ref. 15.6). The Regulations establish a system of river basin management planning. The water bodies of England and Wales have been allocated to river basin areas depending on catchment areas and a plan drawn up for each. The plans contain a programme of measures tailored to each catchment designed to ensure that its water bodies achieve and maintain the appropriate status in accordance with the timelines set out in the WFD.

15.3.9 As part of the ongoing implementation of the WFD, the Environment Agency has recently been given the power to apply environmental standards to individually defined WFD water bodies via the River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010 (Ref. 15.7), and the River Basin Districts Surface Water and Groundwater Classification (Water Framework Directive) (England and Wales) Directions 2009 (Ref. 15.8). The thresholds and descriptions of water body typology within these Directives are largely based upon the research work by the United Kingdom Technical Advisory Group (UKTAG).

ii. Groundwater Directive (80/68/EEC and 2006/118/EC)

15.3.10 This Directive, which was adopted in 1979, aims to protect groundwater against pollution caused by dangerous substances. The Directive required the prevention of the discharge of List I substances (now ‘priority’ or ‘priority hazardous’ substances) to groundwater, and the investigation of List II substances (’non-hazardous’ substances) prior to direct or indirect discharge. The Directive is due to be repealed in 2013 by the Water Framework Directive (2000/60/E) (Ref. 15.1). The Directive is primarily implemented in England and Wales by the Environmental Permitting (England and Wales) Regulations 2010 (SI 2010/675) (Ref. 15.9).

15.3.11 The EU has now also adopted a more recent directive relating to groundwater, the Directive on the Protection of Groundwater Against Pollution and Deterioration (2006/118/EC) (Ref. 15.10). The aim of this Directive (the Groundwater ‘Daughter’ Directive) is to ensure good groundwater quality by 2015, in line with the requirements of the WFD. The Groundwater ‘Daughter’ Directive sets out specific measures for preventing and controlling groundwater against pollution and deterioration.

iii. Nitrates Directive (91/676/EEC)

15.3.12 The Nitrates Directive (Ref. 15.11) requires member states to identify waters which are, or could become, polluted by nitrates and to designate as Nitrate Vulnerable Zones (NVZs) all land which drains to those waters and which may contribute to the pollution.

15.3.13 The following criteria are laid down in the Directive for use in identifying polluted waters:

- surface freshwaters which contain or could contain, if preventative action is not taken, nitrate concentrations greater than 50mg/l;
- groundwaters which contain or could contain, if preventative action is not taken, nitrate concentrations greater than 50mg/l; and
- natural freshwater lakes, or other freshwater bodies, estuaries, coastal waters and marine waters which are eutrophic or may become so in the near future if protective action is not taken.

15.3.14 The whole of the HPC Development Site falls within an NVZ.

b) National Legislation and Guidance

15.3.15 All of the above Directives are implemented in the UK though a series of primary (Acts) and secondary legislation (Regulations); including those detailed below.

i. Environmental Permitting (England and Wales) Regulations 2010 (SI 2010/675)

15.3.16 The Groundwater Regulations 1998 (SI 2746) (Ref. 15.12) came into force in 1999 and implemented the 1980 EU Groundwater Directive. The Regulations are designed to protect groundwater from pollution arising mainly from industrial and agricultural activities. These were replaced from 31 October 2009 by the 2009 Groundwater Regulations (SI 2009/2902) (Ref. 15.13), and from 6 April 2010 by the Environmental Permitting (England and Wales) Regulations 2010 which harmonise the regulations with the Groundwater 'Daughter' Directive (2006/118/EC) (Ref. 15.10).

15.3.17 The main activities likely to lead to a direct or indirect discharge of priority substances or non-hazardous pollutants require formal authorisation. Direct discharges of hazardous substances are prohibited. Activities which may result in indirect discharges (from tipping or disposal) of hazardous substances may only be authorised if prior investigation shows that the groundwater is permanently unsuitable for other uses. Such authorisation should contain conditions to ensure that necessary technical precautions are taken to prevent an indirect discharge of priority substances. Non-hazardous discharges will only be authorised with conditions if prior investigation can demonstrate that groundwater pollution can be prevented. Where a discharge is authorised, the authorisation will specify the discharge to be made as well the quantities of any substances allowed in the discharge and monitoring requirements. Authorisations (permits) may be reviewed at any time.

15.3.18 A discharge may be taken to include leachate from waste materials or leakage from an above ground or below ground storage tank, soakaway etc.

15.3.19 It is an offence to "cause or knowingly permit" the discharge of hazardous substances or non-hazardous pollutants which might lead them to enter groundwater without an authorisation (permit).

ii. Water Resources Act (1991)

15.3.20 Part II of the Water Resources Act (WRA) 1991 (Ref. 15.14) covers the licensing of water abstractions (including groundwater).

15.3.21 Section 29 of the WRA, 1991 covers the exemption of construction dewatering from the abstraction licensing process by stating in S.29 (2) that:

> *"the restriction on abstraction shall not apply to any abstraction of water from a source of supply in so far as the abstraction … is necessary (a) to prevent interference with any mining, quarrying, engineering, building or other operations (whether underground or on the surface); or (b) to prevent damage to works resulting from any such operations."*

15.3.22 The exemption of construction dewatering from the terms of Part II of the WRA is also explained on the Environment Agency's Netregs website http://www.netregs.gov.uk/netregs/businesses/construction/62335.aspx (Ref. 15.15):

15.3.23 "If, as part of your works, you are de-watering or pumping water that has gathered in an excavation, then you will not require an abstraction licence if the water is to be disposed of solely to prevent interference to your building operations. If you intend to use water from a de-watering operation for dust suppression or pressure testing on site, you may require an abstraction licence."

15.3.24 The WRA also empowers the Environment Agency to undertake anti-pollution works in relation to controlled water (including groundwater) and recover the expenses involved from the person who caused or knowingly permitted polluting substances to be present or pollution to have occurred. The Environment Agency may also serve a works notice upon such persons requiring them to undertake anti-pollution works.

iii. Water Act (2003)

15.3.25 The Water Act (2003) (Ref. 15.16) includes a provision to remove the exemption referred to in the previous paragraphs, but this has not yet been enacted. At present it is understood that an abstraction licence for construction dewatering will not be required, but ongoing liaison with the Environment Agency on this matter will be maintained.

iv. Environment Agency Groundwater Protection: Policy and Practice (GP3) 2008

15.3.26 This guidance document (Ref. 15.17) provides a framework for the regulation and protection of groundwater resources. It comprises a number of parts: Part 1 outlines the Environment Agency's approach to the management and protection of groundwater; Part 2 provides a technical framework which sets out key principles and concepts; Part 3 provides guidance in the tools available for analysing and assessing the risks to groundwaters and Part 4 provides the Environment Agency's position and polices with respect to developments and other activities which may present a risk to groundwater. It also provides guidance on the key groundwater legislation and how to interpret it.

15.3.27 The Environment Agency Groundwater Protection: Policy and Practice (GP3) 2008 is risk based. To assist in this, the Environment Agency has developed a series of Groundwater Vulnerability Maps and Source Protection Zones (SPZs). Vulnerability maps identify where a groundwater resource is at risk from pollution (should a pollution source exist) due to the nature of the soil, unsaturated zone or inherent characteristics of the aquifer. SPZs show the level of risk for water quality at and around abstraction points due to activity on or in the ground. They have three divisions, with SPZ1 (Inner) closest to the source indicating the area of highest risk.

15.3.28 The Environment Agency Groundwater Protection: Policy and Practice (GP3) 2008 document contains a series of general and specific policies as follows:

- general approach to groundwater protection (including storage of pollutants);
- solid waste management;
- discharge of liquid effluents into the ground;
- diffuse sources;
- management of groundwater resources;

- river augmentation from groundwater;
- contamination; and
- groundwater flooding.

c) National Planning Policy

i. Overarching National Policy Statement for Energy (NPS EN-1)

15.3.29 NPS EN-1 states that where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment as part of the ES or equivalent (para 5.15.2).

ii. National Policy Statement for Nuclear Power Generation (NPS EN-6)

15.3.30 NPS EN-6 states that in carrying out an assessment, applicants should also consider the effects of the construction of a new nuclear power station on the groundwater regime and its effects on terrestrial/coastal habitats (para 3.9.3).

iii. Planning Policy Statement 1: Delivering Sustainable Development (PPS1) (2005)

15.3.31 PPS1 (Ref. 15.18) was published in 2005 and sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system.

15.3.32 Paragraph 5 states that planning should facilitate and promote sustainable and inclusive patterns of urban and rural development by, amongst other things: protecting and enhancing the natural and historic environment, the quality and character of the countryside, and existing communities.

d) Regional Planning Policy

15.3.33 The Government's revocation of regional strategies was quashed in the High Court on 10 November 2010. However, on that same date the Government reiterated in a letter to Chief Planners its intention to revoke regional strategies through the Localism Bill. This letter was also challenged but, on 7 February 2011, the High Court held that the Government's advice to local authorities that the proposed revocation of regional strategies was to be regarded as a material consideration in their planning development control decisions should stand. The decision of the High Court was upheld by the Court of Appeal on 27 May 2011. Therefore, the regional strategies remain in place but in the case of development control decisions it is for planning decision makers to decide on the weight to attach to the strategies (see **Volume 1, Chapter 4** for a full summary of the position regarding the status of regional planning policy).

i. Regional Planning Guidance 10 for the South West 2001 – 2016 (RPG10) (2001)

15.3.34 RPG 10 (Ref. 15.19) sets out the broad development strategy for the period to 2016 and beyond. Policy RE1 (Water Resources and Water Quality) states that to achieve the long term sustainable use of water, water resources need to be used more efficiently. The policy also states that local authorities, the Environment Agency, water companies and other agencies should seek to, amongst other things, protect groundwater resources.

ii. The Draft Revised Regional Spatial Strategy (RSS) for the South West Incorporating the Secretary of State's Proposed Changes 2008 – 2026 (July 2008)

15.3.35 **Chapter 7** of the Draft Revised Regional Spatial Strategy for the South West Incorporating the Secretary of State's Proposed Changes 2008 – 2026 (July 2008) (Ref. 15.20) deals with Enhancing Distinctive and Cultural Life. Policy RE6 (Water Resources) states that the region's network of ground, surface and coastal waters and associated ecosystems will be protected and enhanced. It also advises that surface and groundwater pollution risks must be minimised so that environmental quality standards are achieved and where possible exceeded.

iii. Somerset and Exmoor National Park Joint Structure Plan Review 1991-2011 (2000) (Policies 'saved' from 27th September 2007)

15.3.36 The Somerset and Exmoor National Park Joint Structure Plan (Ref. 15.21) was adopted in 2000 with relevant policies saved from 27 September 2007. All policies have been saved with the exception of Policy 53 which is unrelated to groundwater impacts. The Plan provides a strategic base for all land use planning within the plan area for the period up to 2011.

15.3.37 Policy 59 (Safeguarding Water Resources) states that protection will be afforded to all surface, underground and marine water resources from development which could harm their quality or quantity.

e) Local Planning Policy

i. West Somerset District Local Plan (2006) (Policies 'saved' from 17 April 2009)

15.3.38 The West Somerset Local Plan forms part of the development plan for West Somerset. The Local Plan (Ref. 15.22) was adopted in April 2006 (with relevant policies 'saved' from 17 April 2009). The Proposals Map indicates that the Main Site itself is not subject to any specific groundwater designations. The site is outside of the defined Development Boundary.

15.3.39 The following saved policy is considered to be potentially relevant:

15.3.40 Policy W/2 (Surface Water Protection) states that development which would adversely affect the quantitative and quality aspects of surface, underground or coastal waters will only be permitted where acceptable mitigating works are undertaken as an integral part of that development.

ii. West Somerset District Local Development Framework (LDF) Core Strategy (Options Paper) (January 2010) (Ref. 15.23)

15.3.41 The Core Strategy is at a preliminary stage of preparation and the Options Paper does not include any specific policies relating to groundwater impacts.

iii. Supplementary Planning Guidance

15.3.42 Sedgemoor District Council and West Somerset Council have jointly prepared draft supplementary planning guidance in relation to the HPC Project. Public consultation on the Consultation Draft version of the Hinkley Point C Project Supplementary Planning Document (the draft HPC SPD) commenced on 1 March 2011 and concluded on 12 April 2011. EDF Energy has submitted representations which object to the draft HPC SPD. See **Volume 1, Chapter 4** for a full summary of the position regarding the status of the draft HPC SPD.

15.3.43 The draft HPC SPD provides advice in relation to the HPC proposals, expanding upon the policy context for the proposals. This includes associated development.

15.3.44 The draft HPC SPD does not set out any specific guidance in relation to groundwater impacts at the Main Site.

15.3.45 Further planning policy context is provided in the Legislative Planning Policy Context chapter (**Volume 1, Chapter 4**) and the Introduction chapter (**Volume 2, Chapter 1**).

15.4 Methodology

a) Study Area

15.4.1 The geographical extent of the study area for this chapter includes the HPC Development Site and extends to the adjacent Hinkley Point A (HPA) site and land as far south as Stogursey, covering the outcrop and recharge area of the Lower Lias strata which may influence groundwater behaviour within the development site (see **Figure 15.1**).

b) Baseline assessment

15.4.2 The two main documented sources of information which have been used to establish the existing topography of the study area are the Ordnance Survey (2005) Explorer Map 1:25,000 scale 'Quantock Hills & Bridgwater' Sheet 140 (Ref. 15.24) and digital topographic data (Ref. 15.25). These data sources have been augmented by information derived from site visits and reconnaissance.

15.4.3 The baseline geological conditions of the study area been determined with reference to historical intrusive investigations and associated factual and interpretive reports supported by other data sources including: the British Geological Survey (BGS) published geological maps, a commercially available GroundSure Geology and Ground Stability report, and direct evidence derived from recent intrusive investigations and geological field mapping undertaken for EDF Energy.

15.4.4 The hydrogeology of the site was assessed through reference to previous work (see below), site-specific ground investigation, monitoring, soil and groundwater analysis and groundwater modelling.

15.4.5 The groundwater baseline conditions presented in this chapter identify the following aspects:

- aquifer existence and type (as defined by Environment Agency vulnerability criteria);

- aquifer characteristics (permeability and storage, derived from reviewed documents and results from the onshore site investigation and a pumping test within the BDAW);
- groundwater levels and flow directions (groundwater levels from reviewed documents and from monitoring of boreholes within the HPC Development Site);
- groundwater quality, non-radiological and radiological, from reviewed documents and from monitoring of boreholes within the HPC Development Site; and
- groundwater use from licensed abstractions.

15.4.6 The main documented sources of information which have been used to determine the baseline assessment with respect to the geology of the study area are:

- British Geological Survey (BGS) 1:50000 BGS Sheet 279; Weston-Super-Mare (Ref. 15.26).
- Whittaker, A. and Green, G.W. (1983). Geology of the country around Weston-Super-Mare: Memoir for 1:50,000 geological sheet 279, New Series, with parts of Sheets 263 and 295. Institute of Geological Sciences. London (Ref. 15.27).
- Rendel Palmer and Tritton (1986). Hinkley Point 'C' Power Station Pre-Application Studies, Volume 2 Geotechnical Report (Ref. 15.28).
- Allot Atkins Mouchel (1988). Hinkley Point 'C' Power Station Geotechnical Studies, Geotechnical Summary Report – Chapter 7. Report Ref: HPC 1101/57 (Ref. 15.29).
- Aspinwall & Company (1996). Analysis of Groundwater Conditions at Hinkley Power Station. Report Ref: NU5101B for Nuclear Electric (Ref. 15.30).
- Structural Soils Ltd (August 2009). Factual Report on Ground Investigation: On Shore Investigations for Hinkley Site, Report Ref: 721763 (Ref. 15.31).
- EDF Energy (October 2010). Onshore geological, geotechnical and hydrogeological interpretive report. Report Ref: EDTGG090141A (Ref. 15.32).
- GroundSure (June 2008). Environmental Data Report (Ref. 15.33)

15.4.7 During the onshore investigation conducted by Structural Soils in 2008 (Ref. 15.31) (please refer to **Chapter 14** of this volume for a summary of this investigation), 36 rotary cored and 23 rotary open holed destructive boreholes were drilled within the BDAW. A total of 24 of these boreholes were completed with piezometers to allow groundwater level monitoring and sampling to be undertaken.

15.4.8 For groundwater level monitoring, transducers were installed to measure the pressure of the water column above them within each monitored borehole. These readings were taken automatically every hour. Periodically (usually during sampling) the readings stored in the transducers' dataloggers were downloaded for processing. Manual water level readings were taken at this time to calibrate the transducers, and the automatic readings were converted to water level in metres below ground and above sea level datum. Correction for barometric pressure was carried out automatically. The transducers also record water temperature and electrical conductivity.

15.4.9 Groundwater quality characterisation has made use of site-specific monitoring campaigns which have been carried out within the BDAW, BDAE and SCPA.

15.4.10 From the baseline geology and groundwater data a conceptual groundwater model was produced which assisted in the description and in some cases the scoping out of some potential impacts. A numerical model (see **Section 15.5** for details) has been developed to assess baseline behaviour in the Blue Lias aquifer, and groundwater flow and contaminant transport implications during construction dewatering.

15.4.11 The groundwater model has been developed using the United States Geological Survey (USGS) MODFLOW 2000 code running under Groundwater Vistas v5.51 Build 3. The model requires Groundwater Vistas v5.51 or later in order to run correctly.

c) Assessment Methodology

i. Value and Sensitivity

15.4.12 **Volume 1, Chapter 7** describes the assessment methodology for this EIA. In addition the specific methodology was applied for the determination of receptor value and sensitivity and impact magnitude as described in the following sections.

15.4.13 The value and sensitivity of groundwater as a receptor can be most readily defined from the following:

- environment Agency designated aquifer status (Primary Aquifer, Secondary A Aquifer, Secondary B Aquifer, Unproductive);
- presence of abstractions from within the study area;
- presence of groundwater Source Protection Zones (Inner, Outer, Catchment); and
- presence of any other specific groundwater uses (particularly abstraction and/or baseflow support to surface watercourses).

15.4.14 Sensitivity is based on the assessment of tolerance against a benchmark level of change in an environmental factor, and the likely recoverability from change. In order to help define the level of value and sensitivity, the generic guidance provided in **Volume 1, Chapter 7** has been tailored to be specific to groundwater (see **Table 15.2**, which sets out guidelines for the assessment of the value and sensitivity of groundwater as a receptor). With respect to groundwater, aquifers are more sensitive to changes in quality than level (the depth at which groundwater occurs) because of the timescales involved in groundwater flow and natural flushing/attenuation of any groundwater quality (contamination) impact.

Table 15.2: Guidelines for the Assessment of Groundwater Receptor Value and Sensitivity

Value and Sensitivity	Guideline
High	Primary Aquifer with significant public water supply abstractions. Site is within Inner or Outer Source Protection Zones.
Medium	Primary Aquifer with significant public water supply abstractions. Site is within a Catchment Source Protection Zone; or Minor Aquifer with significant water supply abstractions. Site is within Inner or Outer Source Protection Zones.

Value and Sensitivity	Guideline
Low	Secondary A Aquifer with water supply abstractions. Site is within a Catchment Source Protection Zone.
Very low	Secondary A/B Aquifer without abstractions in area of activity; or Unproductive.

ii. Magnitude

15.4.15 In addition to the generic guidance provided in **Volume 1, Chapter 7**, specific guidance on assessing the magnitude of impacts on groundwater has been developed and is presented in **Table 15.3**.

15.4.16 The magnitude of impact has been based on the consequences that the proposed development would have upon groundwater receptors and has been considered in terms of high, medium, low and very low magnitude ratings. **Table 15.3** provides a guide to the assessment of magnitude of impact for groundwater. Where an impact could reasonably be placed within more than one magnitude rating, conservative professional judgement has been used to determine which rating would be applicable.

Table 15.3: Guidelines Used in the Determination of Magnitude of Change for Groundwater Resources.

Magnitude	Guideline
High	Very significant change to key groundwater regime characteristics to the extent that UK and European legislation is contravened. Change in groundwater level, quality or available resource usefulness is chronic, permanent or prolonged significantly beyond the activity causing the change, and irreversible. Permanent loss of aquifer as useful groundwater resource. Changes are spatially extensive beyond the area in which the effect may occur (e.g. drawdown into adjoining areas or contamination down gradient of site into adjoining areas).
Medium	Significant change to key groundwater regime characteristics to the extent that UK and European legislation may be contravened. Groundwater quality may be affected permanently or at least for 10 years. Change in groundwater level, quality or available resource usefulness is prolonged more than two years beyond the activity causing the change, and only reversible after significant remediation activity. Permanent or long-term loss of aquifer as useful groundwater resource. Changes are spatially extensive beyond the area in which the effect may occur (e.g. drawdown into adjoining areas or contamination down gradient of site into adjoining areas).
Low	Noticeable but insignificant changes in groundwater levels or quality for more than two years, or significant changes for more than six months but less than two years, or barely discernible changes for more than two years. Reversible without external action required. Changes confined largely to the area of effect only. No contravention of UK or European legislation.

Magnitude	Guideline
Very low	Barely discernible changes in groundwater levels or quality for more than two years, or noticeable but insignificant changes for more than six months but less than two years. Changes confined largely to the area of effect only and reversible without external action. Changes of lower magnitude than baseline seasonal changes. No contravention of UK or European legislation.

iii. Significance of impacts

15.4.17 The significance of the impact is judged on the relationship of the magnitude of impact to the assessed sensitivity and/or importance of the resource. The methodology for rating of the significance of the impacts, without mitigation, is outlined in **Volume 1, Chapter 7**.

15.4.18 For the purpose of this assessment, mitigation measures have been proposed where there is an adverse impact of greater than minor significance and the impact magnitude, spatial scope and temporal nature make it appropriate to do so.

iv. Cumulative Impacts

15.4.19 **Volume 1, Chapter 7** of this ES sets out the methodology used to assess cumulative impacts. Additive and interactive effects between site-specific impacts are considered within this chapter. The assessment of cumulative impacts with other elements of the HPC Project and other proposed and reasonably foreseeable projects are considered in **Volume 11** of this ES.

d) Limitations, Assumptions and Uncertainties

15.4.20 The approach and methodology adopted for this chapter are consistent with relevant guidance, notably the Environment Agency Groundwater Protection: Policy and Practice (GP3) 2008 (Ref. 15.17).

15.4.21 A number of assumptions and limitations have been identified as follows:

- A range of enabling works will be completed within the BDAE prior to bulk earthworks associated with the site preparation works commencing in this area. The effective completion of the enabling works is assumed as the baseline for the impact assessment presented in this ES.
- Specific aquifer property data are relatively limited in spatial extent, essentially to the BDAW and BDAE, although there is no reason to suggest that there will be major differences beyond the two development areas within the modelled domain (see Model geometry and grid definition in Section 15.5 of this chapter, and **Figure 15.19**). There are, however, no specific data on the conditions on Wick Moor (alluvial thickness, permeability, groundwater levels) and assumptions have had to be made in accordance with informed professional judgement.
- Specific groundwater level data are limited spatially to the BDAW, BDAE and part of the SCPA; and to some data relating to the existing Hinkley Point Power Station Complex. The site-specific data are limited temporally to a maximum of just over two years on the BDAW, and less than one year on the BDAE and SCPA. The SCPA is to the south of the faulted inlier which is described below and is hence outside of the groundwater model domain. The groundwater model is described

later in this chapter. It is therefore not considered essential to have a complete temporal water level dataset for the SCPA.

- Rainfall recharge data are limited to estimates based on rainfall and available reports. Spatial distribution is estimated based upon distribution of known development and the reduction due to installed drainage and hardstanding. Temporal variation is limited to annualised average monthly values.
- Groundwater quality and baseline contaminant data outside the HPC Development Site are limited to accessible reports on HPA.
- Uncertainties regarding tritium (H-3) contamination on the Hinkley Point A (HPA) power station site. This has been modelled conservatively with the aim of bounding all reasonably foreseeable uncertainties.

15.5 Baseline Environmental Characteristics

a) Introduction

15.5.1 This section describes the groundwater baseline for the proposed HPC Development Site. Further details regarding baseline groundwater chemistry can be found at **Appendices 15E** and **15F**.

b) Study Area Description

i. Historical and Current Land-use

15.5.2 The HPC Development Site is generally open countryside, primarily in agricultural use (mixed pasture and arable) with some areas of woodland and minor development associated with the current nuclear installations within the BDAE. Adjacent land use (to the south and west) is also primarily agricultural with the exception of the Hinkley Point Power Station Complex to the east.

15.5.3 A review of historical maps and plans has identified that both the BDAW and SCPA have remained as greenfield agricultural land since the earliest available map was published in 1886. A farm (named Benhole Farm) was located in the north-western part of the BDAW until around 1976 when it was demolished to leave a single remnant outbuilding which is still present on site, along with two other derelict farm buildings.

15.5.4 The BDAE was historically undeveloped, agricultural land until the late 1950s when areas of the site were used for construction and fabrication of the adjacent Hinkley Point A (HPA) station. The activities carried out at this time included materials storage, spoil disposal, a contractor’s accommodation area with associated above ground storage tanks and boiler houses, and a small sewage works.

15.5.5 Later in the 1970s a further accommodation camp and associated electricity substations were constructed within the south eastern portion of the BDAE (using the same locations as the HPA accommodation area) during the construction of Hinkley Point B (HPB).

15.5.6 By 2005 the accommodation camp no longer existed and a visitor centre for the Hinkley Point Power Station (subsequently the British Energy induction centre) had opened on the eastern area.

15.5.7 Further details on current and historical land use are provided in **Volume 2, Chapter 14.**

ii. Topography and Drainage

15.5.8 The topography of the study area generally comprises undulating countryside, terminating at Bridgwater Bay to the north at a natural cliff line which descends to a shingle beach.

15.5.9 Across the BDAW and BDAE ground elevations range from approximately 10 to 35mAOD and across the SCPA ground elevations range from approximately 5 to 28mAOD (**Figure 15.3**).

15.5.10 Within the BDAW and SCPA are a series of east-west trending ridges and depressions. The lowest terrain within the study area is formed by an east-west trending linear depression which runs along the boundary between the SCPA and the BDAW. The base of the depression is occupied by a drainage ditch at an elevation ranging from 4.1 to 5.1mAOD.

15.5.11 North of this depression, within the BDAW, the ground rises sharply towards a ridge that crests at a maximum elevation of 35.3mAOD. North of the ridge, the topography comprises a series of east-west trending undulations and the ground generally falls towards the north before it is intercepted by the path of an agricultural drainage ditch (Hinkley Point C Drainage Ditch), which runs from west to east before changing course to head north towards the coastline, along the boundary of the BDAW and BDAE. To the north of the east-west trending length of the drainage ditch the land rises at a moderate gradient from around 19 to 22mAOD and then gently falls again to the coastline. Elevations near the cliff edge adjacent to the BDAW are typically around 15mAOD. In the north-eastern area of the BDAW the ground surface dips and a lower elevation along the cliff line is maintained through the BDAE area (ranging from 10.7 to 13.3mAOD).

15.5.12 Within the SCPA the gently undulating ground continues from the depression referred to above with the land gently rising to around 5.8mAOD and then increasing in gradient to a maximum of between 21.1 and 24.8mAOD. The land then gently falls towards the south where elevations typically range between 15 and 16mAOD adjacent to Bum Brook. A small hillock is located towards the south-west corner of the SCPA where the land crests at an elevation of 28.7mAOD.

15.5.13 The topography of the BDAE comprises areas of variable relief. The southern boundary of the BDAE is occupied by higher ground peaking at 26.2mAOD. The relief then falls northwards and levels out with a large proportion of the area lying at elevations ranging between 14mAOD and 16mAOD. The double-humped spoil mound on the BDAE reaches elevations of 21m and 24mAOD. As part of the enabling works a large proportion of the mound will be removed.

15.5.14 A number of surface watercourses are present within the study area. Holford Stream runs west to east within the northern part of the SCPA. This watercourse flows under Wick Moor Drove and drains into Wick Moor to the east. There are also a series of agricultural drainage ditches present on site, running along field boundaries. Two drainage ditches are present on the BDAW, one running west to east along a field boundary in the northern part of this land parcel before turning northwards towards the coastline (Hinkley Point C Drainage Ditch, as referred to above). The other drains west to east at the base of the depression along the boundary of the BDAW and SCPA.

15.5.15 **Figure 15.4** shows the main surface watercourses around Hinkley Point (these are described fully in **Volume 2, Chapter 16**). It is likely that some of the watercourses are originally structurally controlled, with those flowing west to east following the trends of the strike faults and fold axes, and those flowing south-west to north-east following structures parallel to the Hinkley Point Fault (as well as merely following the topography to the Bristol Channel). It appears that one of these streams (Bayley's Brook, joining Bum Brook) may follow an unmarked extrapolation of the Hinkley Point Fault.

15.5.16 Given the topography, geology and groundwater flow regime (see below) it is likely that the surface watercourses are in at least partial hydraulic continuity with the groundwater, probably with substantial groundwater contributions to baseflow and possible groundwater recharge in places. Streams from the south of Stogursey running off the Mercia Mudstones some 2km to the south of the Hinkley Point Development Site could contribute to groundwater recharge under some circumstances (during low water table conditions).

15.5.17 Rainfall recharge provides the principal input to the groundwater regime. Discharges from the groundwater regime can occur as springs at outcrops of lower permeability strata, where the water table intersects the surface (onshore or offshore), and also as baseflow to surface watercourses.

iii. Geology

15.5.18 A summary of the lithostratigraphical sequence identified within the study area is provided in **Table 15.4** and further described below.

Table 15.4: Lithostratigraphical Sequence for Rocks Identified within the Study Area.

Stage and Formation			'Up-to' Thickness (m)	Lithology
Lower Lias	Blue Lias (including the Angulata and Lower Liasicus Zones)		140	Alternation of shale/mudstone/limestone/mudstone sequences
Penarth Group	Lilstock Fm	Langport Member	2	Pale grey limestones with interbedded grey to bluish grey mudstones
		Cotham Member	2	Pale grey to greenish grey calcareous mudstones, limestones, siltstones and sandstones
	Westbury Fm		14	Very dark shaly mudstones and dark grey argillaceous limestones
Mercia Mudstone Group	Blue Anchor Fm		38	Thin dark grey mudstone beds and green to greenish grey mudstone and siltstone beds. Some are dolomitic in part.
	Undifferentiated		484	Upper units are reddish brown mudstones and siltstones (occasionally greenish grey) with halite, gypsum and anhydrite as minor components

Note: *Fm = Formation*

15.5.19 **Figure 15.4** shows geological information generated using the electronic British Geological Survey 1:50,000 scale published geological map which includes the HPC Development site. **Figure 15.5** shows the transect location plan and the lines of section are presented in detail in **Figures 15.6** and **15.7**, which are south-north cross-sections illustrating the principal features of the geology across the BDAW.

15.5.20 **Figure 15.4** and the BGS map sheet (Ref. 15.26) show that the areas to be occupied by the proposed site preparation works and deep excavations are underlain mostly by strata of the Jurassic Lower Lias. Between the BDAW and the SCPA is a faulted inlier of older Permo-Triassic strata of the Penarth Group, the Blue Anchor Formation, and Mercia Mudstones (the Penarth and Blue Anchor strata are essentially transitions between the red mudstones of the Mercia Mudstone Group and the Lower Lias).

15.5.21 An onshore investigation (Ref. 15.32) as detailed in **Chapter 14** of this volume) shows that there is a further likely fault north of those shown on the 1:50,000 scale published map. This brings another outcrop of Penarth Group strata within the study area as shown in the cross-section in **Figures 15.6** and **15.7**, with the postulated fault lying at about northing 145630 between boreholes CBH29 and CBH12 (Ref. 15.31).

15.5.22 The Lower (Blue) Lias consists of grey mudstone with varying proportions of dark blue-grey limestone. This tends to be well-jointed and the limestone layers provide groundwater-bearing material even though the Lias as a whole is not considered to be a significant aquifer. **Figure 15.8** shows the typical appearance of the strata at outcrop along the foreshore to the north of the HPC Development Site.

15.5.23 The Lower Lias overall is up to 175m in thickness, although only the lower sections are present at Hinkley Point, consisting of mudstones and shales with thin, nodular limestones and alternating limestones and shales.

15.5.24 Below the Lias, and outcropping in a band running across the site and briefly at the southern margin of the site, the Penarth Group generally comprises dark limestones and mudstones. It is subdivided into the upper Lilstock Formation (itself subdivided into the Langport and Cotham Members) and the Westbury Formation. The Lilstock formation is less than 4m in thickness, with the Langport Member consisting of interbedded limestone and mudstone and the Cotham Member being predominantly a grey/green calcareous mudstone. The Westbury Formation comprises over 10m of dark grey shaly mudstone with argillaceous limestone.

15.5.25 The Blue Anchor Formation consists of grey and green mudstone with minor limestone and dolomite, formerly known as the Grey Marl and Tea Green Marl at the top of the Mercia Mudstones. Veins and nodules of gypsum (hydrated calcium sulphate) are present.

15.5.26 The Mercia Mudstone Group comprises a thick sequence (over 400m) of red mudstone, sometimes silty or dolomitic and containing evaporite minerals including gypsum and halite (sodium chloride).

15.5.27 In places, and particularly in the areas around the villages of Shurton and Burton south of the site, the Lias is covered with Head, a poorly sorted sandy and silty periglacial weathering product which forms a mantle around 1m to 2m thick. The stream courses of Holford Stream and Bum Brook are infilled with alluvium, as is the expanse of Wick Moor to the south-east of the HPA and HPB stations. The latter comprises estuarine and marine alluvium rather than terrestrial material.

15.5.28 **Figure 15.4** shows the Hinkley Point Fault oriented northeast-southwest passing under the HPA and HPB sites and running past the south-east corner of the HPC Development Site. The Penarth Group/Mercia Mudstone inlier is fault-bounded, and the Lower Lias is subject to flexures, with east-west synclinal and anticlinal fold axes crossing the HPC Development site (which may be faulted locally).

15.5.29 The geological sheet memoir (Ref. 15.27) refers to general dips of strata in a direction just east of north at angles of 5–10 degrees.

15.5.30 The geological structure and its implications for the groundwater assessment are addressed in the conceptual model section (see Section 15.5).

iv. Hydrogeology

15.5.31 The baseline hydrogeology of the study area and its immediate surroundings is described in terms of:

- aquifers and aquifer characteristics;
- groundwater levels and flow;
- rainfall recharge;
- groundwater – surface water interactions;
- groundwater use; and
- groundwater quality.

15.5.32 In the following text, each of the above aspects of hydrogeology is described as appropriate, and data from current investigations is distinguished from data from past investigations. The adequacy and relevance of past data have been reviewed and if necessary included in the limitations, assumptions and uncertainties section of this chapter (Section 15.4 e).

Aquifer Characteristics - General

15.5.33 Groundwater flow in the Blue Lias Formation occurs predominantly via bedding planes, joints and fractures in the more competent limestone horizons within the formation. Rocks of the Penarth Group, especially the mudstone and limestone of the Westbury Formation (the lower component) are considered to be generally impermeable, although locally this may vary (see actual test results below) and in particular fault and fracture zones in the Lilstock Formation (the upper 4m of the Penarth approximately) may have higher permeability and transmissivity, albeit the latter is limited by formation thickness. The mudstones of the Mercia Mudstone Group (including the Blue Anchor Formation) are likely to be of very low permeability.

15.5.34 Until March 2010 aquifers were designated as Major, Minor or Non-aquifers, and these designations indicated spatially on 1:100,000 scale Groundwater Vulnerability Maps by the Environment Agency together with information on the leaching potential of the superficial soils. The Groundwater Vulnerability Map (Sheet 42) for the Somerset Coast indicates the HPC Development Site as being situated on a Minor Aquifer (variably permeable). The distribution of the designated groundwater units is shown on **Figure 15.9**. Under this previous aquifer classification system, the Blue Lias formation, which outcrops over most of the area, was designated as a Minor Aquifer, with varying degrees of leaching potential due to presence of drift deposits. The Penarth and Mercia Mudstone formations were designated as Non-Aquifers.

15.5.35 In April 2010, new aquifer designations (details of which are available on the Environment Agency website) were introduced to comply with the requirements of the Water Framework Directive, as follows (see **Figure 15.10**):

- Principal (generally equivalent to Major Aquifers): Layers of rock or drift deposits that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.
- Secondary A (generally equivalent to Minor Aquifers): Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. It should be noted that this is a generic definition and the last point does not apply to conditions at Hinkley Point.
- Secondary B (generally equivalent to water-bearing parts of Non-Aquifers): Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.
- Unproductive: These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

15.5.36 The Blue Lias is now Secondary A aquifer under the new classification system, and the similar lithologies of the Lilstock Formation of the Penarth Group are also likely to be Secondary A. The Westbury, Blue Anchor and Mercia Mudstones are Secondary B due to their low yield.

15.5.37 River alluvium in the Holford Stream valley is designated as Secondary A, and the marine alluvium to the south and east of Hinkley Point A and B (North Moor, Wick Moor etc) is designated as Secondary Undifferentiated, meaning it is not definitively attributable to either Secondary A or B.

15.5.38 The published Groundwater Vulnerability maps on which **Figure 15.9** is based are still valid for the definition of soil leaching potential, which is not covered by the new aquifer definition maps.

15.5.39 The lower boundary on the major active groundwater regime in the area may be the base of the Lilstock Formation of the Penarth Group, possibly less than 4m below the base of the Blue Lias.

Aquifer Characteristics - Previous Studies

15.5.40 Allott Atkins Mouchel Power Consultants (1988) (Ref. 15.29) and Aspinwall & Company (1996) (Ref. 15.30) contain extensive sections on hydrogeology and conceptualisation which are relevant to this assessment.

Hinkley Point A

15.5.41 With respect to the area occupied by the HPA station, tests reported by Foundation & Exploration Services Ltd (1989) (Ref. 15.34) provided permeability data for the Blue Lias derived from constant head, single packer and double packer tests in three boreholes, all sited immediately to the west of the Hinkley Point A turbine hall and reactor buildings and so fairly close to the shoreline. The logs are not geologically interpreted, and all the tests are in lithologies comprising mostly mudstones with some crystalline limestone bands. These tests gave ranges as shown in **Table 15.5**.

Table 15.5: Blue Lias Permeability Values from Hinkley Point A

Borehole	Depth (m bgl)	Method	Permeability (m/s)
GW1	10^{-13}	Constant head	9.8×10^{-7}
	17^{-21}	Double packer	2×10^{-6}
	27^{-31}	Double packer	<1 x 10-7 (no flow)
	43^{-47}	Single packer	$<7.5 \times 10^{-8}$ (no flow)
GW2	4^{-7}	Constant head	3×10^{-6}
	16^{-21}	Double packer	2×10^{-7}
	33^{-37}	Double packer	6×10^{-7} (no flow)
	48^{-52}	Double packer	$<7 \times 10^{-7}$
	65^{-70}	Double packer	$<9.5 \times 10^{-8}$
	75^{-79}	Double packer	$<7.5 \times 10^{-7}$
	80^{-84}	Single packer	$<8 \times 10^{-8}$ (no flow)
GW3	21^{-25}	Double packer	$<1 \times 10^{-7}$ (no flow)
	60^{-64}	Double packer	$<6.5 \times 10^{-7}$
	64^{-67}	Single packer	3×10^{-6}

15.5.42 The tabulated data show that permeability values are low to very low and generally decrease with depth in GW1 and GW2. In GW3 the data show an apparent increase in permeability with depth, although these types of tests are not very reliable for groundwater model scales since they sample a very localised volume of 'aquifer' which may be disturbed by the drilling process, and are subject to generally low test flows.

15.5.43 Because fractured limestone forms a small part of the Blue Lias, unless the testing was specifically targeted, these results may under-represent the few thin bands of high permeability that probably provide the bulk of the transmissivity.

Hinkley Point B

15.5.44 Rising head tests carried out by Foundation Engineering Ltd (1979) (Ref. 15.35) exhibited permeability values between 4.3×10^{-3} and 2.06×10^{-7}m/s; packer tests exhibited values between 0 and 4.79×10^{-5}m/s.

Hinkley Point C (former CEGB proposed PWR station)

15.5.45 Royal Haskoning (2009) (Ref. 15.36) summarised aquifer properties recorded in previous studies such as Aspinwall & Company (1996) (Ref. 15.30).

15.5.46 Aspinwall (Ref. 15.30) reported that permeability tests were undertaken in boreholes at Hinkley Point during the investigation by Soil Mechanics (1990) and by Norwest Holst (1983/84). These tests were carried out for different depth ranges. The average hydraulic conductivity (K) values calculated from the results of this test ranged from 10^{-6}m/s to 10^{-5}m/s.

15.5.47 Values of hydraulic conductivity (K) at shallow depths range from 10^{-6} to10^{-4}m/s, whereas below this zone the aquifer is described as being only slightly permeable, with K values reported to range from 10^{-8} to 10^{-7}m/s. As flow at depth is restricted, discharge to Bridgwater Bay and the Bristol Channel occurs by upward vertical movement through mudstone horizons via fractures (Aspinwall & Company, 1996) (Ref. 15.30).

15.5.48 As vertical groundwater movement is restricted by the lower permeability mudstones and shales, the aquifer is considered to be under semi-confined to confined conditions. As such, the aquifer has low storage coefficients ranging from 0.001 to 0.00008, which are reported to be typical of semi-confined to confined conditions (Aspinwall & Company, 1996) (Ref. 15.30).

15.5.49 The BGS Physical Properties of Minor Aquifers in England and Wales (Ref. 15.37) reports that six analyses from outcrop samples at Hinkley Point gave porosities ranging from 1.9% to 3.1%.

Aquifer Characteristics - Current Studies

Built Development Area West

15.5.50 **Table 15.6** shows permeability summaries from Lugeon (packer) Testing carried out in the BDAW by Structural Soils Ltd (SSL) on behalf of EDF Energy (Ref. 15.31)

Table 15.6: Indicative Permeabilities for Different Formations in BDAW from Lugeon Testing

Formation	Minimum (m/s)	Maximum (m/s)
Blue Lias 0-20m	$1.89x10^{-6}$	$1.61x10^{-5}$
Blue Lias 20-40m	$1.16x10^{-7}$	$1.25x10^{-5}$
Blue Lias >40m	$5.00x10^{-9}$	$7.15x10^{-7}$
Lilstock (Penarth Group)	$2.00x10^{-7}$	$4.50x10^{-7}$
Westbury (Penarth Group)	$4.19x10^{-7}$	$2.51x10^{-6}$
Blue Anchor Formation	$4.75x10^{-8}$	$6.11x10^{-6}$
Mercia Mudstone Group	$5.35x10^{-6}$	$8.59x10^{-6}$

15.5.51 A pumping test (PT1), with twelve piezometers arranged in a cruciform pattern, was conducted close to boreholes CBH13 and CBH16, at a discharge of 3l/s for four days in July 2010 (**Figure 15.11**). The tested section comprised about 14m of grey mudstone, belonging to the (weathered) Blue Lias and the top of the Lilstock Formation. In the first hour, drawdowns fell steadily in the pumping well and piezometers as expected for a confined aquifer, after which barrier boundary effects were observed, which probably correspond to the cone of depression intersecting one of the faults referred to earlier or the physical limit of the aquifer in the up-dip direction. After about a day of pumping, drawdown increased dramatically in the pumped well but not so much in the piezometers, suggesting that a major water producing fissure had been dewatered (about 5m below the top of the screen). As a consequence the discharge declined to only 2l/s by the end of the test. After pumping the well recovered to its pre-test level after about 10 days.

15.5.52 The transmissivity of the aquifer close to the well was estimated at about $80m^2/d$ ($9.3x10^{-4}m^2/s$), and permeability of $6.6x10^{-5}m/s$, and a storage coefficient of $2.0x10^{-4}$. The response was anisotropic and complex, with an apparent K (E-W):K (N-S) ratio of 1.3:1 indicating a slightly enhanced permeability perpendicular to the strata dip direction (i.e. along the strike) compared to that along the dip. Further details of the pumping test analysis are contained in **Appendix 15A**.

15.5.53 A second pumping test (PT2), also with twelve piezometers in a cruciform pattern, was conducted close to borehole CBH2_07, and about a hundred metres from the cliff line (**Figure 15.11**). The test was conducted at a discharge of 1.5l/s for four days. The tested section comprised about 13m of dark grey mudstone with about (at CBH2_07) a dozen interbedded limestone bands, of which none exceeded 0.5m, belonging to the Blue Lias Formation. For the first 12 hours, the response to pumping in the piezometers and pumping well approximated to the expected theoretical response of a confined aquifer, but later the rate of drawdown increased rapidly, displaying a classic barrier boundary response, suggesting the cone of depression had intersected a fault (faulting is not included in the numerical model explicitly because of uncertainty over its behaviour - barrier boundaries in the system are known to exist but their extent and their hydraulic properties are not known so the model has assumed (conservatively) their absence). The increase in drawdown in the pumping well is even greater because after about two hours the water level had fallen below the top of the screened section of the borehole. On the final day of the pumping test, the pumping water level dropped further, apparently due to dewatering of important fissures.

15.5.54 Interpretation of the results (see **Appendix 15A**) indicates an anisotropic confined aquifer with a transmissivity of about $40m^2/d$ ($4.6x10^{-4}$ m^2/s) and permeability of $3.6x10^{-5}$ m/s in the east-west direction, and about $20m^2/d$ (permeability of $1.8x10^{-5}$ m/s) in the north-south direction, indicating a more pronounced horizontal anisotropy than the test in the BDAW, at about 2:1. A storage coefficient of 1.0E-04 was inferred. It should be noted that the pumping test permeabilities are calculated from the length of the response zone, whereas flow will occur predominantly through the jointed limestones, and hence the actual permeability of the active aquifer horizons is probably about five to eight times higher.

15.5.55 In both of the four-day pumping tests described above, the recovery of water levels was incomplete, by the order of half a metre to a metre, after ten days of recovery. This behaviour is consistent with the hypothesis that the aquifer is divided into fault-bounded blocks with restricted flow between the blocks delaying the recharge of the aquifer in the vicinity of the pumping test.

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15.5.56 **Table 15.7** summarises the results of Lugeon Testing of permeability carried out in the BDAE by SSL on behalf of EDF Energy.

Table 15.7: Indicative Permeabilities for Different Formations in BDAE from Lugeon Testing

Formation	Minimum (m/s)	Maximum (m/s)
Blue Lias 0-20m	$1.13x10^{-6}$	$1.70x10^{-5}$
Blue Lias 20-40m	$5.16x10^{-7}$	$6.82x10^{-6}$
Blue Lias >40m	$3.43x10^{-7}$	$2.33x10^{-6}$
Lilstock (Penarth Group)	$2.00x10^{-7}$	$7.36x10^{-7}$
Westbury (Penarth Group)	$1.87x10^{-7}$	$1.26x10^{-6}$
Blue Anchor Formation	$2.78x10^{-7}$	$2.57x10^{-6}$
Mercia Mudstone Group	$3.00x10^{-7}$	$6.00x10^{-7}$

Southern Construction Phase Area

15.5.57 There are no specific data available for aquifer properties on the SCPA. Monitoring boreholes on the SCPA were not cored so no packer testing was carried out. However, the geological information presented in **Figure 15.4** shows that the underlying geology also comprises Lias Group (predominantly represented by the Blue Lias) strata and so it is anticipated that permeability and storage values will show a similar range to equivalent strata elsewhere on Hinkley Point.

Horizontal and Vertical Anisotropy

15.5.58 As mentioned above in respect of the pumping tests, there appears to be a difference between east-west horizontal permeability and north-south horizontal permeability. This was observed from the distance-drawdown characteristics from the variably aligned observation piezometers. The ratio between K E-W and K N-S has been estimated to be between 1.3:1 and 2:1. Higher permeabilities in the east-west direction are related to alignments of joint sets and extensional characteristics of fold and flexure structures. This will have the effect (during pumping) of a preferential flow contribution along the strike of the strata compared to up and down dip.

15.5.59 Vertical anisotropy is difficult to measure, but must be a key characteristic of the Blue Lias Formation, as can be inferred from the layering of mudstones and limestones, and the observed lack of continuity of joints between successive limestone horizons. Moreover, the matrix of the mudstone will be intrinsically anisotropic due to the compaction of clay minerals. An estimate of the vertical anisotropy can be obtained from the proportions of limestone to mudstone, and assuming that vertical permeability is approximated by the minimum Lugeon values where packer tests are conducted against mudstone horizons only. Using the equations in Anderson & Woessner (Ref. 15.38) the following Kh:Kv ratios for the various formations are estimated (more details are provided in **Appendix 15B**):

Table 15.8: Indicative Kh:Kv ratios

Formation	Kh:Kv ratio (vertical anisotropy)
Weathered Blue Lias	800
Fresh Blue Lias	120
Lilstock	5
Westbury	100
Blue Anchor	5

15.5.60 The value of 800 for Weathered Blue Lias is very high but is based upon the available permeability data and heterogeneity of the Blue Lias and in accordance with the equations used. However, it is not implausible given the lithology and structural fabric of the formation, and still leaves a vertical permeability about an order of magnitude higher than the vertical permeability in the Fresh Blue Lias.

15.5.61 Localised exceptions to this pattern of high vertical anisotropy will occur along open fault zones, such as encountered at CBH2_29 (**Figure 15.12**). Given that ultimately groundwater levels are controlled by discharge to sea, there must be physical mechanisms for this to occur, so such fault zones are also likely in the areas of groundwater discharge in the Bristol Channel (details unknown) to allow for upward flow from the deeper Blue Lias and lower formations.

Groundwater Levels and Flows

Built Development Area West

15.5.62 Groundwater levels, both strikes and static water levels, were recorded during the Structural Soils Limited investigation (Ref. 15.31) and piezometers (24 in total) have subsequently been monitored. Twenty of the 24 piezometers were installed with response zones to target the 'shallower' groundwater in the Blue Lias, Penarth Group and/or Mercia Mudstone. Four of the 24 piezometers were installed with response zones to target the deeper groundwater in the Blue Anchor and/or Blue Lias. For the purposes of this EIA 'shallow groundwater' is generally that groundwater (and predominantly within the Blue Lias Formation) which is present between 0 and 30mbgl. 'Deeper' groundwater is groundwater (predominantly in the Blue Anchor Formation) at depths >30mbgl. This does not necessarily mean that the groundwater is discontinuous between the two levels of 'shallow' and 'deep' (although it is stratified to some extent) but indicates the depth at which response zones were installed. **Table 15.9** below summarises the response zone depth, formation, and aquifer targeted. Dataloggers have been installed in selected boreholes (see **Table** 15.9) as part of the environmental studies undertaken by AMEC for EDF Energy. The locations of the 'shallow' piezometers are shown on **Figure 15.12** and **Figure 15.13**.

Table 15.9: Summary of BDAW Piezometer Response and Formation Zones

Piezometer	Formation/Aquifer Targeted	Ground Level (mAOD)	Response Zone Depth (m bgl)	Aquifer Targeted ('shallow or 'deep')
DBH04	Penarth Group	26.06	12.0 – 19.00	'Shallow'
DBH05	Penarth Group	22.24	14.00 – 19.00	'Shallow'
DBH06	Blue Lias	15.66	4.50 – 19.50	'Shallow'
DBH07	Blue Lias	13.28	5.00 – 12.00	'Shallow'
DBH08	Blue Lias	17.78	5.50 – 20.00	'Shallow'
DBH09	Blue Lias	17.22	6.00 –16.00	'Shallow'
DBH10	Blue Lias	19.94	6.50 –14.50	'Shallow'
DBH11	Blue Lias	16.1	7.00 – 17.00	'Shallow'
CBH09	Blue Anchor	13.16	39.00 – 45.00	'Deep'
CBH10	Blue Lias	18.01	5.00 – 13.00	'Shallow'

Piezometer	Formation/Aquifer Targeted	Ground Level (mAOD)	Response Zone Depth (m bgl)	Aquifer Targeted ('shallow or 'deep')
CBH11	Blue Lias	17.75	30.00 – 40.00	'Deep'
CBH16	Blue Anchor	11.05	41.50 – 48.50	'Deep'
CBH17	Blue Lias	15.86	5.00 – 15.50	'Shallow'
CBH18	Blue Lias	15.27	23.00 – 33.00	'Shallow'
CBH19	Blue Lias	9.86	7.50 –14.50	'Shallow'
CBH20	Blue Lias	10.93	5.00 – 17.50	'Shallow'
CBH21	Blue Lias	19.48	3.50 – 15.00	'Shallow'
CBH24	Blue Lias	17.81	3.50 –18.50	'Shallow'
CBH25	Blue Lias	21.05	4.00 –17.00	'Shallow'
CBH26	Blue Lias	15.67	20.50 – 31.00	'Shallow'
CBH27	Blue Lias	18.93	6.50 – 12.50	'Shallow'
CBH29	Blue Anchor	22.18	41.00 – 55.00	' Deep'
CBH33	Blue Lias	14.67	5.00 –11.00	'Shallow'
CBH35	Mercia Mudstone	13.17	7.50 –11.50	'Shallow'

15.5.63 Summaries of manual observations made during groundwater sampling and subsequently, and hydrographs for the available records for the datalogger-equipped 'shallow' Blue Lias boreholes up to November 2010 are contained in **Appendix 15C**. Minimum observed levels were usually reached as late as November in 2009 after the summer recession, but during July and August in 2010 which overall was a much drier year (see **Figure 15.16**). Maxima in 2009 tended to occur around the end of November after the very heavy November rain (see below), although levels in some boreholes continued to rise into January 2010. **Table 15.10** shows observed minimum and maximum shallow Blue Lias water levels. Nominal low and high water levels maps for the BDAW are contoured in **Figure 15.12** and **Figure 15.13** for 1 August 2010 and 1 December 2009 respectively. A site-wide groundwater level map covering the BDAW and areas beyond is also included as **Figure 15.15**.

15.5.64 Hydrographs from the shallower Blue Lias piezometers (**Appendix 15C**) can be interpreted in accordance with the rainfall hydrograph (**Figure 15.16**). Water tables rise in response to sustained winter rainfall and then fall away again as recharge declines. Rainfall periods in spring and summer do not show a groundwater response because available recharge is taken up by the increasing soil moisture deficit and does not reach the unsaturated zone or the water table. The soil moisture deficit is only reversed at the end of October when recharge can start again. In 2010, the recession continued to the end of the available hydrograph records.

15.5.65 The main groundwater flow regime within the BDAW is controlled by local rainfall recharge. In general, groundwater flow is from south to north, from outcrop recharge to discharge offshore, although the watercourse crossing the HPC site from west to east and then turning north to the shoreline (Hinkley Point C Drainage Ditch) clearly receives some groundwater baseflow and can be seen from **Figure 15.12** and **Figure 15.13** to exert some control on local groundwater levels. The valley topography of this watercourse drainage also results in a zone of artesian conditions (see **Figure 15.12** and **Figure 15.13**) where, at high groundwater levels during winter, heads in the shallow Blue Lias piezometers can be several metres above surface elevation. Boreholes exhibiting these characteristics include CBH16, CBH19, CBH20, CBH33 and DBH11. In summer, after groundwater recession, levels in these artesian boreholes recede to ground elevation or just below. It is the topographic ‘low’ due to the small valley that causes these artesian or sub-artesian conditions.

15.5.66 Average general gradient from the groundwater contours is around 0.02 (1 in 50) but varies in detail with the level condition and the location within the BDAW.

Table 15.10: 2009/2010 Minimum and Maximum BDAW ‘Shallow’ Borehole Groundwater Levels

Borehole	Ground level (mAOD)	Minimum groundwater levels (m AOD)	Maximum groundwater levels (m AOD)	Difference (m)
CBH10	18.01	9.01 (19/7/10)	16.87 (29/11/09)	7.86
CBH17	15.86	6.50 (18/7/10)	15.36 (3/12/09)	8.86
CBH19	9.86	9.01 (11/5/10)	11.83 (4/7/09)	2.82
CBH21	19.48	9.21 (9/8/10)	15.23 (29/11/09)	6.02
CBH24	17.81	8.63 (8/8/10)	15.29 (29/11/09)	6.66
CBH25	21.05	13.49 (5/11/10)	20.37 (22/1/10)	6.88
CBH26	15.67	9.72 (23/7/10)	14.41 (29/1/10)	4.69
CBH27	18.93	10.32 (15/8/10)	17.32 (29/11/10)	7.00
CBH33	14.67	10.02 (13/8/10)	16.38 (11/2/09)	6.36
DBH06	15.66	7.38 (19/7/10)	12.93 (29/11/09)	5.55
DBH07	13.28	8.90 (21/7/10)	13.00 (24/11/09)	4.10
DBH08	17.78	7.59 (19/7/10)	14.25 (28/11/09)	6.66
DBH09	17.22	7.78 (3/8/10)	16.35 (10/2/09)	8.57
DBH10	19.94	11.67 (21/8/10)	17.37 (29/11/09)	5.70
DBH11	16.1	10.40 (8/8/10)	16.39 (29/11/09)	5.99

15.5.67 CBH20 values are not clear from the hydrograph (**Appendix 15C**), possibly due to irregularities from sampling events (removal of loggers, recovery from sample pumping, etc).

15.5.68 Piezometer pairs exhibit apparent vertical head differences (and therefore potential vertical groundwater flow components). The differences in gradient can be in either upward (e.g. CBH18 to DBH06) or downward (DBH07 to CBH09). In other cases where the deeper borehole is highly saline the apparent head difference can be due to density effects where the saline water is heavier and results in a depressed groundwater level as a result (when the density effect is removed the revised equivalent fresh water head can be up to several metres higher than that observed; for example in the case of CBH16 which contains hypersaline water with a total dissolved solids content of up to 150,000mg/l the corrected freshwater head is some 5m higher). Vertical differences otherwise are likely to be due to local characteristics of recharge and groundwater flow.

15.5.69 With respect to vertical gradients where the deeper borehole contains highly saline water, e.g.CBH16, this reflects the isolation from the active groundwater regime of this deeper water and explains why the hypersalinity has been preserved (see also paragraph 15.5.122).

15.5.70 There is not enough groundwater data from boreholes in the Blue Anchor Formation and Mercia Mudstone Groups to form reliable contours. However, groundwater/piezometric levels are all substantially lower than the Blue Lias levels, typically by around 6-8m. Therefore there is no evidence of a tendency for any upward groundwater flow into the Blue Lias from deeper formations, and no apparent substantial hydraulic continuity between the Blue Lias and either the Blue Anchor or Mercia Mudstone Groups.

Built Development Area East

15.5.71 Groundwater levels for the BDAE were obtained during the latter half of 2010 from the onshore investigation programme to augment what had already been undertaken on the BDAW. **Table 15.11** summarises the piezometer information for boreholes within the BDAE, and the locations are shown on **Figure 15.14**. In accordance with the distinction between ‘shallow’ and ‘deep’ piezometers identified for the BDAW above in **Table 15.9**, the BDAE targets are generally ‘shallow’, although CBH2_18, CBH2_29 and DBH2_7 have response zones extending below 30m depth and could be regarded as transitional. Hydrographs for the available data are included in **Appendix 15C**. It should be noted that the BDAE data was only available to December 2010 prior to groundwater modelling commencing, whereas the hydrographs at **Appendix 15C** show more recent data.

Table 15.11: Summary of BDAE Piezometer Response and Formation Zones

Piezometer	Ground level (mAOD)	Formation/Aquifer Targeted	Response Zone Depth (m bgl)
CBH2_18	16.36	Blue Lias	23.5-36.3
CBH2_28	18.77	Blue Lias	8.5-12.5
CBH2_29	15.55	Blue Lias	25.5-37.5
CBH2_30	12.08	Blue Lias	3.2-13.6
CBH2_33	24.31	Blue Anchor	25.5-40.0
CBH2_49	25.33	Blue Lias	9.5-22.0
CBH2_53	15.57	Blue Anchor	42.0-54.5
CBH2_54	13.86	Blue Anchor	81.0-89.5
DBH2_7	15.42	Blue Lias	25.5-34.7
DBH2_8	15.47	Blue Lias	1.5-14.5
DBH2_9	17.73	Blue Lias	5.0-15.5
DBH2_10	15.61	Blue Lias	4.7-13.8
DBH2_11	20.26	Blue Lias	1.0-11.0
DBH2_12	6.33	Blue Lias	3.5-11.5
DBH2_17	16.67	Blue Lias	1.5-5.5
DBH2_26	10.93	Blue Lias	4.0-12.0
DBH2_19	24.51	Blue Lias	2.4-13.0

Piezometer	Ground level (mAOD)	Formation/Aquifer Targeted	Response Zone Depth (m bgl)
DBH2_20	15.88	Blue Lias	4.5-14.5
DBH2_21	1.65	Blue Lias	4.75-15.25
DBH2_22	14.24	Blue Lias	3.5-13.0
DBH2_23	17.18	Blue Lias	2.0-14.5
DBH2_24	13.61	Blue Lias	2.5-14.5
DBH2_27	11.28	Blue Lias	2.8-15.3

15.5.72 The groundwater flow regime indicated for the BDAE is consistent with that previously determined for the BDAW, with a general flow from south to north. A site wide piezometric map (**Figure 15.15**) has been developed which includes these data (along with all other contemporaneous data where possible) and this is described separately below.

Southern Construction Phase Area

15.5.73 Groundwater levels for the SCPA have been obtained during the latter half of 2010 from the onshore investigation programme. **Table 15.12** summarises the piezometer information for boreholes within the SCPA, and the locations are shown on **Figure 15.14**. The records are not long enough for groundwater level minima, maxima and ranges to be defined.

Table 15.12: Summary of SCPA Piezometer Response and Formation Zones

Piezometer	Formation/Aquifer Targeted	Response Zone Depth (m bgl)
DBH2_13	Blue Lias	3.5-13.5
DBH2_14	Blue Lias	3.5-13.5
DBH2_15	Blue Lias	1.0-13.5
DBH2_16	Blue Lias	1.0-11.5
DBH2_18	Blue Lias	3.5-13.5

15.5.74 The groundwater flow regime indicated for the SCPA is tentatively identified on the site wide piezometric map described separately below (**Figure 15.15**).

15.5.75 Hydrographs for boreholes within the SCPA are provided in **Appendix 15C**. There is, however, an insufficient duration of available records to date to enable meaningful maxima and minima to be stated, since the record starts after the likely minimum and does not yet show the winter recharge response.

Hinkley Point A

15.5.76 SERCO (2010) (Ref. 15.39) describes groundwater levels for January 2009 consistent in general with the flow regime on the HPC Development Site. The gradient under Hinkley Point A is around 0.03, falling from 12mAOD in the south of the Hinkley Point A site to 4mAOD in the north adjacent to the foreshore.

Overall Hinkley Groundwater Flow Regime

15.5.77 **Figure 15.15** is a site-wide groundwater level map based on observation data, where available, and extrapolation by professional judgement elsewhere. Observed data are taken from December 2010. The map integrates the different sub-catchment flow regimes known for the BDAW and BDAE and areas to the west. These are all to the north of the Blue Anchor and Mercia Mudstone faulted inlier which forms the ridge to the south of the HPC Development Site footprint to the north of Green Lane; and that for the Holford Stream in the SCPA and its downstream catchment towards the Bristol Channel to the east of Hinkley Point B.

15.5.78 The map contours are shown as solid for areas where there is directly observed data; long-dashed for areas where there is some limited but not directly contemporaneous data (Hinkley Point A) and short-dashed where it is inferred elsewhere on the basis of topography and conceptual assumptions.

15.5.79 Groundwater flow features shown by the map **(Figure 15.15**) include:

- The groundwater sub-catchment divides between the BDAW/BDAE and the SCPA. North of this divide, groundwater flows generally northwards to the shoreline from around 14mAOD or higher (some levels are essentially perched on higher mudstone horizons that are not marked by groundwater contours), whilst south of the divide groundwater contours drop quickly to 6mAOD and below (that are not marked by groundwater contours), controlled by the topographic elevation of the Holford Stream. Within the BDAW, the contours follow the drain course of the Hinkley Point C Drainage Ditch corresponding to the artesian zone so there are also localised reversals of the general groundwater flow direction.
- The upper Holford Stream sub-catchment. This is fed mostly by groundwater rainfall recharge on the Blue Lias outcrop to the south which extends as far as the faulted boundary of the Mercia Mudstones around Stogursey. The groundwater contours closely follow the general pattern of the ground surface and the likely presence of groundwater mounds and ridges between surface watercourses is shown by the 20m contour northwest of DBH2_16 between Holford Stream and Bum Brook.
- The lower Holford Stream sub-catchment across Wick Moor. Here, the Blue Lias is overlain by estuarine and marine alluvium, which is of unknown thickness but is assumed to be of low permeability and so groundwater heads will be confined and direct recharge will be limited. In contrast to the upper Holford Stream sub-catchment to the west, where the Blue Lias is at outcrop and groundwater contributes baseflow directly to the Holford Stream via springs and seepages, in the lower sub-catchment any major seepage from the Blue Lias to the Holford Stream across Wick Moor via the alluvium is unlikely.
- At Hinkley Point B, groundwater contours are assumed to swing round to join the northern 'limb' of the Holford Stream 'groundwater valley'. Similarly, contours extending eastwards from the BDAW will also swing round creating a groundwater ridge east of the end of the Mercia Mudstone/Blue Anchor inlier. The apparent steepness of the groundwater gradient southwards from this ridge is indicative of low permeability conditions even though actual groundwater fluxes from recharge in that area are likely to be limited. This may also indicate the barrier effect created by the Hinkley Point Fault in this area.

v. Rainfall Recharge and Meteorology

15.5.80 Rainfall recharge provides the principal input to the groundwater system. The annual amount of recharge depends on annual rainfall, run-off, evaporation, crop uptake and on the transmissivity and the vertical hydraulic conductivity of the drift deposits. Considering that the transmissivity and the vertical hydraulic conductivity of the drift deposits are relatively low at HPC, Royal Haskoning (2009) (Ref. 15.36) estimated the maximum recharge to the aquifer at outcrop at one third of mean annual rainfall.

15.5.81 The Royal Haskoning (2009) (Ref. 15.36) report points out that

> *"in areas where the site is underlain by clay and silty clay to a depth of around 5m, the effective recharge to the aquifer will be significantly lower than that of the outcrop area."*

15.5.82 The recharge in areas of drift deposits was estimated to be one tenth of the mean annual rainfall. Considering a mean annual rainfall of 947mm/year (from records from 1971 to 2000 at Currypool Farm), Royal Haskoning (2009) (Ref. 15.36) finally estimated that the maximum recharge is 315mm/year at outcrop, and 95mm/year where drift deposits occur.

15.5.83 It is noted that Aspinwall & Company (1996) (Ref. 15.30), estimated recharge at 50 to 200mm/year, depending on land use or the presence of drift deposits.

Meteorology

15.5.84 Rainfall data acquired from the Meteorological Office provide daily rainfall records from 1962 until 1996 at Brymore School, the nearest available station some 8km from the HPC Development Site. Monthly averages from these data are shown in **Table 15.13**, with an annual average of 759mm. Average annual rainfall from Met Office HM33 data (**Appendix 15D**) is marginally higher at 763mm. Both are lower than the 30 year annual mean quoted above of 947mm, although the figure will vary depending on the length and period of data concerned. Applying the Royal Haskoning calculation to the lower rainfall estimate of 759mm a year results in maximum recharge estimates of 253mm over outcrop and 76mm over drift.

15.5.85 Rainfall data from December 2008 are available from a weather station installed on the HPC Development Site by AMEC on behalf of EDF Energy. **Figure 15.16** shows the data from December 2008 to December 2010, with fill-in data obtained from the Met Office from radar analysis for January, March and April 2009, when the site station was experiencing technical problems. Highest daily rainfall recorded on site was 37.8mm on 3 November 2009. The annual total recorded on site in 2009 was 740mm (including some radar data fill-in). Monthly totals are also shown in **Table 15.13**, including data for 2010 up to November. 2010 was a much drier year than 2009, totalling 329.7mm (up to 17 December, there is also a gap in the record between 18 March and 1 April). Snow and freezing conditions prevailed in December 2010 which may also have impacted on the record.

Table 15.13: Monthly Rainfall (mm) for 1962-1995 and 2009/2010

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Brymore School 1962-1995 average	82	59	60	50	56	49	48	58	67	71	77	82	759
Hinkley Point C 2009	67.0	58.3	54.8	34.8	39.2	73.9	96.1	34.9	25.6	57.2	140.1	58.5	740.4
Hinkley Point C 2010	45.0	44.8	2.3*	19.2	8.0	26.3	28.8	55.7	11.4	38.5	46.4	3.3*	329.7*

* *Gap in record 18 March – 1 April, record ends 17 December*

15.5.86 Data from the Meteorological Office Surface Exchange System (MOSES) database for the period 1961-2001 provide for an analysis of rainfall, evaporation and soil moisture deficit through the year that can inform the likely temporal distribution of groundwater recharge. This is summarised in **Appendix 15D** and shown in **Figure 15.17** which illustrates:

- Potential Evapotranspiration (PE) and Actual Evapotranspiration (AE) monthly average values, derived using Penman-Monteith equations, for average rural land use surfaces;
- Soil Moisture Deficit (SMD) which increases through the late spring and summer and declines in early autumn;
- Effective Precipitation (EP) which is the part of precipitation that reaches stream channels as run-off; and
- actual rainfall monthly averages (for the period 1962-1995) for the Brymore School rain gauge.

15.5.87 Annual average totals are 452mm AE, 534mm PE and 759mm rainfall. SMD reaches a maximum of 77mm in July and August.

15.5.88 The seasonal distribution of rainfall, evaporation and soil moisture deficit restricts the periods during which direct rainfall recharge is likely to the late autumn and winter when the soils are at field capacity and a proportion of excess precipitation can percolate below the soil zone to the water table. In spring, the higher temperatures result in a build up of soil moisture deficit which lasts until at least early autumn. During this period direct recharge is unlikely unless there is enough persistent precipitation to remove the soil moisture deficit. Consequently, and as shown in the borehole hydrographs for 2008-2010 (**Appendix 15C**), the groundwater level hydrographs for 2009 exhibit a steady recession from March or April through to late October when the final removal of soil moisture deficit coincides with a period of intense rainfall (see **Figure 15.16**) and the groundwater levels show a sudden rise. Rainfall events during June, July and August, some of which are quite substantial, are not reflected in a rise in groundwater levels because of the prevailing high SMD.

15.5.89 shows that although the annual average rainfall for Brymore School for the period 1962-1995 (759mm) is similar to the total for 2009 (740mm), the summer months for

2009 were much wetter than the 1962-1995 average (see Figure 15.16). The wettest month in 2009 was November at 140.1mm, nearly twice the 1962-1995 average. From Figure 15.17 and the borehole hydrographs in Appendix 15C (CBH24 is overlain on Figure 15.17 as an example) it is clear that there was no substantial recharge between March/April and October, despite the high summer rainfall.

15.5.90 2010 was a much drier year, and the period from March to July 2010 was especially dry, and would have allowed a greater soil moisture deficit to build up; moreover, the autumn rain that coincided with groundwater level rises in 2009 did not occur. For 2010, rainfall until the middle of December totalled 330mm, less than half of the 2009 total or the long-term average.

15.5.91 **Figure 15.16** also includes an example borehole hydrograph (CBH24) to illustrate the relationship between rainfall and groundwater level (influenced by recharge). There is a long recession from spring to autumn in 2009, where soil moisture deficits have built up and summer rainfall events, some of which are substantial (two days in June over 20mm), do not produce any apparent recharge manifested in the hydrograph. However, substantial rain in late October and early November clearly bring the soil to field capacity since groundwater levels respond quickly and recharge results in a rapid rise of over 5m in the level in CBH24. After March 2010, levels recede and the dry months to August allow a substantial soil moisture deficit to build up, which remains unsatisfied by rain in August and any other rain until December 2010, at which time the winter recharge rise has still not commenced.

15.5.92 The apportionment of excess precipitation between run-off and recharge is uncertain. Although the hydrological analysis in **Chapter 16** concentrates on extreme rainfall events and floods, it is possible to derive an approximation for potential recharge by subtracting the SMD from the effective precipitation in the autumn and winter months when SMD is zero or low enough to be overcome by the rainfall. This gives a potential recharge of 217mm, and is likely to represent a lower bound on the total value of run-off and recharge. This value is similar to the estimation from Aspinwall & Company (1996) (Ref. 15.30).

15.5.93 An alternative calculation was also undertaken based on the MOSES EP of 383mm/yr by using the CEH/BGS Hydrometric Register. The Hydrometric Register gives a base flow index value for the Currypool Stream catchment (off the Quantock Hills north of Taunton, from Secondary A Devonian sandstone and Secondary B Mercia Mudstone) of 0.71. This suggests a recharge value of 272mm/yr which is considered to be a more likely value for recharge and compares more favourably with the Royal Haskoning (2009) (Ref. 15.36) estimate of 315mm/yr. Ultimately however, the recharge may be best estimated from the model calibration process since there is a direct relationship between permeability (for which there is considerable data) in order to maintain the observed groundwater head distribution.

Recharge

15.5.94 On the existing neighbouring HPA and HPB sites, a recharge value of 25mm/yr is considered appropriate to represent a low recharge situation where the ground surface is covered mainly by buildings, roads and hardstandings. To the south-east in the area of high alluvial content in shallow soils, a recharge value of 50mm has been applied in the assessment as discussed above.

15.5.95 It is acknowledged that there may be areas of lower recharge based on localised artesian conditions across certain areas of the HPC Development Site, and possibly elsewhere in areas of lower permeability superficial or mudstone-dominant Blue Lias cover where recharge could be reduced locally from the current nominal condition. However, this is likely to be patchy and sufficient data to fully conceptualise these effects does not exist. Moreover, substantial reduction in general recharge would require lower model permeabilities to support the observed groundwater heads, which would not compare well with measured permeability values.

15.5.96 The adoption of a recharge value that may be slightly overestimated is conservative from a dewatering perspective. Prior to any major construction dewatering the artesian cover and other superficial deposits will have been stripped and replaced with higher permeability engineered platforms at different elevations than the current surface topography. Within the area where all dewatering will occur, the development platform will be at 14mAOD.

15.5.97 The recharge value used for non-developed areas of the groundwater model is therefore fixed to 272mm/yr.

15.5.98 It is important to recognise that this estimate of potential recharge applies only to the amount of rainwater that might percolate through the soil zone (i.e. beyond the reach of plant roots) to reach the water table. The quantity that actually reaches the water table at particular locations will be substantially lower because of the following three factors. First, the area of the existing Hinkley Point Power Station Complex (and also HPC during the operational phase) will have a reduced recharge in view of the hardstanding and engineered drainage. Second, there will be reduced recharge in areas of clayey superficial deposits such as along the Holford Stream flood plain, south-east of Hinkley Point B. Third, where groundwater levels are artesian, such as in parts of the north-west of the development site, no recharge can occur.

vi. Groundwater Use

15.5.99 Within the area detailed in **Figure 15.9**, including the 2km search radius from the GroundSure Report (Ref. 15.33) and beyond, there are no potable water abstractions and no associated Source Protection Zones.

15.5.100 In the nominal 2km search area for the GroundSure Report (Ref. 15.33), 17 licensed groundwater abstractions have been identified. These are shown in **Table 15.14** with distances adjusted to show nominal distance and direction from the BDAW, BDAE and, where appropriate, the SCPA boundaries.

Table 15.14: Licensed Groundwater Abstractions

Groundsure Groundwater Abstraction ID	Grid Reference	Licence No. And Details Of Use	Nominal Distance (m) and Direction from BDAW/BDAE Boundary
16A	319400E 144600N	16/52/007/G/109 General farming and domestic, well, Stogursey	650m SW; 400m W of SCPA
17A	319400E 144600N	16/52/007/G/10 General farming and domestic, well, Stogursey	650m SW; 400m W of SCPA

Groundsure Groundwater Abstraction ID	Grid Reference	Licence No. And Details Of Use	Nominal Distance (m) and Direction from BDAW/BDAE Boundary
18	321300E 143480N	16/52/007/G/178 General farming and domestic, Farringdon Hill Farm	1950m SSE; 1175m SSE of SCPA
19B	323200E 145800N	16/52/007/G/109 General farming and domestic, borehole, Stogursey	2340m E
20B	323200E 145800N	16/52/007/G/109 General farming and domestic, borehole, Stogursey	2340m E
21C	323110E 145090N	16/52/007/G/105 General farming and domestic, well, Yearmoor Lane	2295m E
22C	323110E 145090N	16/52/007/G/105 General farming and domestic, well, Yearmoor Lane	2295m E
n/a	323600E 145400N	16/52/007/G/108 General farming and domestic, well, Stogursey	2735m E
n/a	323600E 145400N	16/52/007/G/108 General farming and domestic, well, Stogursey	2735m E
25	323000E 143500N	16/52/007/G/154 General farming and domestic, Stogursey	2920m SE
n/a	323800E 144300N	16/52/007/G/062 General farming and domestic, well, Stogursey	3200m ESE
n/a	323800E 144300N	16/52/007/G/062 General farming and domestic, well, Stogursey	3200m ESE
n/a	320300E 142300N	16/52/007/G/116 General farming and domestic, well, Stogursey	3200m S
n/a	320300E 142300N	16/52/007/G/116 General farming and domestic, well, Stogursey	3200m S
n/a	321000E 142300N	16/52/007/G/077 General farming and domestic, well, Stogursey	3200m S
n/a	321000E 142300N	16/52/007/G/077 General farming and domestic, well, Stogursey	3200m S
n/a	320940E 141960N	16/52/007/G/180 General farming and domestic, borehole, Higher Monkton Farm	3320m S

15.5.101 All these wells and boreholes are for general farming and domestic purposes. The nearest abstraction is 650m south-west of the BDAW/BDAE boundary and 400m west of the SCPA). All the others are over 2km distance from the BDAW.

vii. Groundwater Chemistry

15.5.102 Detailed descriptions of the existing non-radiological groundwater chemistry can be found in **Appendix 15E** and in **Appendix 15F** for radiological groundwater chemistry. A summary of the groundwater chemistry on site is provided below.

15.5.103 Five sampling campaigns for radiochemical and non-radiochemical analysis of groundwaters have been undertaken on BDAW (11 piezometers), four sampling campaigns on BDAE (1st campaign only 13 piezometers sampled, 21 piezometers in following campaigns), and three campaigns on SCPA (7 piezometers).

15.5.104 Non-radiochemical determinands were analysed by the range of methods detailed in **Appendix 15H**. The suite of baseline groundwater quality determinands was selected to include a wide range of determinands and quality indicators frequently tested for in preliminary UK groundwater quality assessments, as well as a wide range of potential contaminants that are commonly associated with current and historical contaminative activities. The suite includes basic indicators of potential pollution e.g. ammonia, electrical conductivity, chloride, and biochemical oxygen demand (BOD). Inorganic parameters such as nitrate, nitrite and phosphate have been included particularly given the current and historical agricultural use (i.e. to see if any impact to groundwater from the application of fertilisers may have occurred) and given that the area is within a Nitrate Vulnerable Zone. Electrical conductivity, chloride and sodium have also been included as these are key parameters which can help to evaluate the origins of more saline groundwaters. Other major anions and cations (e.g. sodium, chloride, calcium, magnesium, potassium, and sulphate) have been included as indicators of general groundwater quality but are also useful in helping to assess potential geological/geochemical impacts to groundwater (e.g. mineralisation/salinisation caused by mineral deposits in the bedrock).

15.5.105 Radiochemical samples were scheduled for laboratory analysis with the following radiochemical suite:

- High Resolution gamma spectrometry.
- Gross alpha, (calibrated with Am-241), and Gross beta, (calibrated with K-40).
- Tritium (as tritiated water).
- Carbon-14.

15.5.106 The suite was selected to provide a general screen for alpha, beta and gamma-emitters and to provide information with regard to soft beta-emitters (tritium and carbon-14). The inclusion of gross alpha, gross beta and tritium also meets the requirements for drinking water monitoring. The inclusion of gamma spectrometry provides quantitative data with regard to a range of natural and anthropogenic radionuclides.

c) Summary of Non-Radiological and Radiological Groundwater Quality

15.5.107 In general, the shallow groundwaters across the BDAW, BDAE and SCPA show very little evidence of any notable contamination by non-radiochemical or radiochemical contaminants, with the exception of very isolated and occasional occurrences of slightly elevated concentrations of certain inorganic salts, heavy metals, ammonia and nitrate. The exception to this is the shallow groundwater quality in a number of piezometers in the northern area of the BDAE (particularly the north-eastern area of the BDAE) which shows more consistent evidence of slightly elevated concentrations of inorganic salts, certain total and dissolved metals and metalloids and ammonium.

15.5.108 The source of the slightly elevated contaminant concentrations in several of the piezometers in the northern and north-eastern areas of the BDAE is believed to be historical leaching from:

- the large double-humped spoil mound in the centre of the BDAE which will be removed as part of the enabling works;
- other general Made Ground deposits and historical activities which are widespread across the northern and north-eastern areas of the BDAE (e.g. Area 4); and
- the former NDA temporary waste storage area (since removed) which was present on Area 5 for a period of two to three years (possible but less likely).

15.5.109 The concentrations (where elevated) are generally only 1-3 times the conservative Tier 1 screening criteria which have been applied and given their origin, planned removal of the spoil mounds during the enabling works, and known direction of groundwater flow are not considered to be significant or of concern (see **Chapter 14** Geology and Land Contamination for more details.)

15.5.110 Slightly elevated nitrate concentrations are occasionally present in the shallow groundwater on the BDAW, BDAE and SCPA (in one case (CBH35) this is more significantly elevated). The source of these nitrate concentrations is likely to be due to the application of nitrogenous fertilisers or ploughing of organic-rich soils. With the exception of CBH35, all of the slightly elevated concentrations were well below the nitrate drinking water and environmental screening concentration of 50mg/l. The Hinkley Point area is a designated Nitrate Vulnerable Zone, which means that from an environmental impact assessment point of view, the groundwaters and surface waters in the area are sensitive to activities during the construction and operation of the proposed development that could give rise to nitrate pollution.

15.5.111 Slightly elevated concentrations of tritium have been found in three piezometers (CBH2_56, CBH2_57 and DBH2_26) in the north-eastern area of the BDAE close to the boundary with the Hinkley Point A station. Whilst the concentrations are slightly above the adopted RIFE background value (< 4Bq/l) the activities are below the acceptable drinking water screening level of (100Bq/l) and as such are not significant or of concern.

15.5.112 With the possible exception of the slightly elevated tritium noted above, there is no evidence of any cross boundary migration of non-radiological or radiological contaminants onto the BDAE from the adjacent Hinkley Point A.

15.5.113 The deeper groundwater on the BDAE and BDAW has been found to contain very high concentrations of salts and minerals and also elevated concentrations of several heavy metals and metalloids and ammonium. The source of these elevated concentrations is considered to be related to the natural salt and mineral deposits in the surrounding bedrock and the natural geochemistry of the deep groundwater.

15.5.114 A review of the SERCO data (Ref. 15.39) has revealed that shallow groundwater in several locations across the adjacent HPA site is contaminated by hydrocarbon and radiological contaminants. The baseline description for HPA is discussed with the contaminant transport modelling section later in this chapter, together with its potential for this contamination to impact the HPC site.

15.5.115 In summary, the current environmental risks from existing non-radiological and/or radiological contamination in the shallow and/or deep groundwaters on the BDAW, BDAE and SCPA are considered to be low to very low.

15.5.116 The concentrations of several determinands, particularly suspended solids, have been regularly found to exceed freshwater and to a much lesser extent saline EQS standards. Assessment of the potential impacts from the discharge of potentially contaminated dewatered groundwater to surface waters is contained in **Volume 2, Chapter 16**.

d) Groundwater Conceptual Model

i. Previous conceptual models

15.5.117 The Aspinwall & Company (1996) (Ref. 15.30) and Allott Atkins Mouchel Power Consultants (1988) (Ref. 15.29) reports contain extensive sections on hydrogeology and conceptualisation which are relevant to this study.

15.5.118 The Environmental Statement (ES) for the formerly proposed Central Electricity Generating Board (CEGB) HPC Pressurised Water Reactor (PWR) Station (August 1987) (Ref. 15.40) includes as its **Figure 11.1** a conceptual model in the form of a block diagram which extends to cover an area to the west of the Hinkley Point A and B sites (i.e. BDAW and BDAE).

15.5.119 The Royal Haskoning (2009) (Ref. 15.36) report refers to previous conceptual models undertaken by Allott, Atkins and Mouchel (1988) (Ref. 15.29) and Rendel, Palmer and Tritton (1986) (Ref. 15.28) which are described in the report by Aspinwall & Co.(1996) (Ref. 15.30).

15.5.120 Both of these investigations produced hydrogeological models for the site. Allott, Atkins and Mouchel (Ref. 15.29) considered the aquifer properties beneath the site in five separate layers (made ground, sands and gravels, Angulata Zone, Lower Liasicus Zone and Penarth Group), whereas the Rendel, Palmer and Tritton (Ref. 15.28) model considered only two layers, an upper weathered zone and an unweathered zone. The permeabilities (or hydraulic conductivities, K) used in these models range from 1.0×10^{-9} to 1.0×10^{-3} m/s, but are on average (arithmetic) 1.0×10^{-5} m/s.

15.5.121 In general these previous models are consistent with the conceptual model developed for this EIA which is described below.

ii. Hydrogeological Basis of Current Conceptual Model

15.5.122 The spatial limits of the conceptual model developed for the EIA are taken to be from approximately easting 318000 in the west (where the Penarth Group intersects the shoreline) to 323000 in the east (where Holford Stream discharges to the Bristol Channel); and from the shoreline in the north to Stogursey in the south (i.e. the outcrop boundary between the Blue Lias and the Mercia Mudstones).

15.5.123 **Figure 15.6, Figure 15.7**, and **Figure 15.15** summarise the conceptual understanding of the local hydrogeological system that was described in detail above. The aquifer system is considered to extend down to the Blue Anchor Formation, although the base of the system is not well defined stratigraphically. Locally, in association with fault zones, the Mercia Mudstone can be fractured, and locally shallower layers contain hypersaline water that must have been isolated from active circulation over geological periods of time. These waters are found below the level of construction dewatering for HPC and do not take an active part in the baseline groundwater flow regime (if they did, they would have been already diluted by throughflow of fresher water). The most permeable units are the weathered Blue Lias and the Lilstock Formation. The Planorbis zone at the base of the Blue Lias can also exhibit higher permeabilities than the Blue Lias in general. Flow in the Blue Lias occurs extensively along joints in limestone horizons, and in a more concentrated fashion along fault zones, where these coincide with laterally persistent fracturing. Because the limestones are typically 0.5m thick, their lateral continuity will be readily disrupted by faults. The faults themselves will tend to act as barriers to flow normal to the fault plane, but may provide high permeability pathways along their length. The barrier-boundary responses seen in pumping tests thus support the interpretation that the aquifers behave as a series of compartments where faulting is present, with dimensions of the order of hundreds of metres and which have limited hydraulic continuity across faults between compartments.

15.5.124 At the regional scale (**Figure 15.7**) the Blue Lias aquifer is fed by rainfall recharge, either directly or, where present, through the sand and gravel and/or Made Ground. Groundwater flows approximately south to north from the area of Mercia Mudstone outcrop south of Stogursey (about northing 145300) to discharge directly into the Bristol Channel, or indirectly following baseflow discharge to the surface freshwater network. The Penarth Group/Mercia Mudstone forms the lower boundary to the system.

15.5.125 However, at the scale of the HPC Development Site (i.e. the BDAW and BDAE) (**Figure 15.6**), this general natural flow regime is intercepted by another upfaulted inlier of Mercia Mudstone on the southern margin of the BDAW (about northing 145600). The BDAW and the BDAE are therefore likely to be largely self-contained as a groundwater system, bounded by the Mercia Mudstone and Penarth Groups beneath, the faulted inlier to the south (about northing 145600), and the Bristol Channel to the north.

15.5.126 The groundwater flow system across the whole model domain as described above is illustrated in the site-wide piezometry map (**Figure 15.15**).

Streams and Wetlands

15.5.127 As noted earlier, Holford Stream originates in low lying land on the south of the Mercia Mudstone – Blue Anchor inlier, and runs approximately along its southern (faulted) contact before crossing the Hinkley Point Fault and entering the broader wetland area of Wick Moor. Although not measured directly, groundwater levels are inferred to rise to more than 20mAOD beneath the topographic high points of the ridge formed by the inlier (south of BDAW). This ridge represents a divide in the groundwater system, separating the Blue Lias aquifer in the SCPA from that in the BDAE/BDAW. North of the inlier, groundwater flows towards the coast.

15.5.128 South of the ridge, in the SCPA, the dominant flow direction is also to the north, but the low groundwater elevations at the southern margin of the ridge (4 – 6mAOD in CBH35 and DBH2_13) prove the geological inference (and the assumption for the EIA) that the two aquifers are hydraulically isolated. The low groundwater elevations suggest that the faulted contact of Blue Lias and Mercia Mudstone, in the north of the SCPA, is a spring line that supports flow in Holford Stream (otherwise, the area would either be permanently waterlogged or subject to strongly artesian conditions).

It follows that abstraction to the north of the inlier will not affect groundwater levels or flows in this section of Holford Stream.

15.5.129 Where the inlier terminates against the Hinkley Point Fault (on the eastern boundary of the BDAW), its topographic expression (i.e. the ridge) is less pronounced, and furthermore the Blue Lias is present at outcrop on both sides of the fault. However, this gross geological continuity is almost certainly not matched by hydraulic continuity of the aquifers. There are several lines of conceptual argument to support this. Firstly, permeable limestone horizons will likely not be in continuity, except where different limestones have fortuitously been brought into contact. Secondly, in many locations the fault surface will have been smeared by clayey fault gouge. So although fracturing may have produced a permeable zone along the fault, this should be distinguished from its effect on restricting flow perpendicular to the fault. Moreover, east of the Hinkley Point Fault, a NE-SW anticline will tend to introduce greater anisotropy, facilitating flow parallel to its axis, and further restricting flow in the NW-SE direction.

15.5.130 Thus, overall it is inferred that the BDAW/BDAE will have a substantially restricted hydraulic connection with the Blue Lias beneath Wick Moor, which, due to the low permeability alluvial cover described earlier, will have restricted continuity with overlying surface water bodies due to the presumed, but unproven, low vertical permeability of the alluvial deposits.

15.5.131 In order to provide confirmatory evidence on the conceptual assessment of potential impacts on Wick Moor, it is planned to install monitoring boreholes between the main construction dewatering areas and Wick Moor. This is likely to include boreholes in the south-east corner of the development areas, and also on the alluvium on Wick Moor itself. Piezometers will record groundwater levels in both the alluvium and underlying Blue Lias.

Flow to and from the Bristol Channel

15.5.132 In addition to discharge to streams and drains, and diffuse seepage to the land surface, the other major potential discharge mechanism is vertical leakage to the Bristol Channel. In addition, due to the northerly dip of strata, there is a narrow strip of land close to the coast which could discharge via a seepage face along the cliff line, although observation of the cliff suggests that any such flows are very small. Therefore the bulk of any coastal discharge must occur offshore by upward leakage from confined aquifers.

15.5.133 Under natural conditions, the net discharge, after averaging out tidal fluctuations in the estuary, will always be from the land to the sea. The Blue Lias aquifers identified onshore have no direct connection with the Bristol Channel. The strata dip more or less uniformly beneath the Bristol Channel at about 10 degrees, and the shallowest aquifers that are likely to be pumped are expected to have a cover of more than 10m of mudstones at the coastline. The aquifers could extend for several kilometres beneath the estuary, to its centre line, or more likely until disrupted by faulting. In either case there is no point of lateral discharge to the Bristol Channel. Moreover, with increasing distance from the shoreline, there is not only an increasing thickness of sediment but also, as the Blue Lias is succeeded by the Charmouth Mudstone Formation, the cover will have an increasingly low permeability. Because of the layering, and the lack of vertical continuity of joints between limestone beds, the overlying sediments will have an extremely low vertical permeability, dominated by that of the mudstone layers, and as noted earlier exhibiting strong vertical anisotropy. Hence, offshore, the aquifers can only discharge by vertical leakage through these strata. The measurement of minimal tidal fluctuations, a few centimetres only, in boreholes close to the coast support the notion of very poor hydraulic connection between the aquifers and the Bristol Channel. As a consequence, when pumped, little water will be drawn in from the offshore sections of the aquifers, with this mainly by release from artesian storage, and therefore there will be very limited potential for saline intrusion. The offshore sections of these aquifers are probably best viewed as closed bodies of almost stagnant groundwater.

15.5.134 It is noted here that although saline groundwater has been identified onshore, as described below, this probably originates from dissolution of evaporite minerals, and does not constitute evidence for ongoing saline intrusion (see also 15.5.122).

iii. Groundwater Numerical Model

15.5.135 A numerical groundwater model has been developed to represent as closely as possible the observed baseline groundwater regime in the vicinity of the HPC Development Site and to provide a basis for assessment of scenarios relevant to the construction phase of the proposed development. The principal objectives of the model simulations were:

- to predict the magnitude and lateral extent of drawdowns during construction dewatering; and
- to determine the effect of construction dewatering on groundwater flow from beneath the Hinkley Point A station, and hence provide the basis for assessing the possible mobilisation of contaminants from beneath that site.

15.5.136 The groundwater numerical model was designed primarily to investigate the effects of dewatering within the development area and under HPA, not to produce definitive results concerning the aquifer east of the Hinkley Point Fault and under Wick Moor. The model in its current form does not represent the discontinuities across the Hinkley Point Fault as described above, but rather presents a continuum in the Blue Lias aquifer up to the south-east boundary of the model. As such the numerical model is very conservative with respect to the estimation of effects on the lower reaches of Holford Stream and across Wick Moor. This will have the opposite effect on dewatering predictions as it will allow dewatering drawdown to extend over the Hinkley Point Fault towards the eastern part of the HPA site and to the south east towards Wick Moor. In reality the Hinkley Point Fault may act to prevent drawdown extending this far.

15.5.137 An important part of model development is calibration. Options for calibration of this model are constrained to:

- a pumping test carried out as part of the BDAW onshore investigation in August 2010, repeating one from December 2008;
- a second pumping test in the BDAW undertaken in July 2010; and
- the groundwater hydrographs from up to 24 months of data (between December 2008 and December 2010) collected from the transducers installed in some of the monitoring boreholes. The locations of the two pumping tests are shown on

Figure 15.11, and their detailed configurations are shown in **Figure 15.H.10** and **Figure 15.H.11**.

15.5.138 The calibration process is constrained by the interdependence of hydraulic conductivity and infiltration recharge in generating a water table surface. The former is estimated from permeability and pumping tests, whilst the latter is subject to temporal and spatial variability in a parameter that cannot be measured directly. Moreover, the multi-layered and faulted nature of the Blue Lias aquifer makes comparison of monitoring points difficult.

15.5.139 It has been possible to develop a calibrated model that is suitable to make construction phase development scenario projections which are considered valid for EIA purposes. The development of the model has been a progressive process, subject to the availability of data which has been made available as site investigations and monitoring works have progressed over time.

Model Geometry and Grid Definition

15.5.140 The model grid configuration is shown in **Figure 15.19**. A rectilinear finite difference grid is made up of 172 columns and 135 rows. These vary in resolution from 50m at the margins to 10m, both in the development area (which is the principal zone of main interest in relation to dewatering activities) and to the north and south where the topography and layers dip relatively steeply and a more closely spaced grid is required to ensure that sloping layers are sufficiently continuous from one row to the next.

15.5.141 The total model domain extends 4800m east-west and 1500m north-south. To place the model in geographical context, **Figure 15.19** also shows the grid overlaid on an outline map of the Hinkley Point area. Outside the BDAW, BDAE and part of the SCPA there is little or no validated site-specific data for the model and input data has been inferred from earlier reports and desk study information.

15.5.142 The model comprises five geological layers, two in the Blue Lias, and one each in the Lilstock, Westbury and Blue Anchor formations. The Planorbis zone is included in the lower of the Blue Lias layers (Layer 2) but hydrogeologically assigned to Layer 3 which is of higher permeability. The base of the model is defined by the top surface of the Mercia Mudstones aquiclude below the Blue Anchor formation. It should be noted that relatively few boreholes penetrated to this depth.

15.5.143 The model layer geometry has been developed as follows:

- Existing borehole information from the BDAW, BDAE and the former CEGB Hinkley Point C investigation were imported and gridded in the software package Surfer.
- For the base of the Blue Lias (base of Layer 2) the gridded data are replicated directly to the east (as far as the Hinkley Point Fault) and to the west to the edge of the model; extrapolated to north in accordance with the geological formation dips identified from a dip angle calculated from the gridded BDAW/BDAE data (calculated to be 11 degrees) and south, maintaining a minimum thickness of 5m below Layer 1 (see below).
- The base of Layer 1 was derived from the surface topography since the geotechnical interpretation of the on-shore investigation data (Ref. 15.31)

concluded that there was a change in the degree of weathering (and therefore permeability) related to depth below ground surface. The surface topography was derived from an EDF supplied topographical data set (UKE-2009-54521-FR.pdf) (**Figure 15.3**). Where the thickness of the Blue Lias formation exceeds 40 m, the base of Layer 1 was fixed to 40m below topography, thereby wedging out to the south on the west side of the Hinkley Point Fault. It is shown in plan form in **Figure 15.20** (the trend of the Hinkley Point Fault and the anticline to the east can be seen).

- East of the Hinkley Point Fault the base of the Blue Lias was modified according to downthrow and structural information in the British Geological Survey Sheet Memoir 10 to incorporate variable downthrows and an anticline with an axis running west-east. The Hinkley Point Fault is represented in the model as a shift in layers, the eastern side of the fault being the downthrown side. However no horizontal barrier (including the Horizontal Flow Barrier package) has been implemented. The dry cells occur to the south of the main Nuclear Island, to the north of the Blue Anchor outcrop in an area where the Blue Lias is very thin. It is therefore very likely that this part of the Blue Lias aquifer will actually dry out during dewatering and will hence form a flow barrier to the south/south east. Should the Hinkley Point Fault have been represented in the model as a horizontal flow barrier, this drying of cells would have been exacerbated due to the extra compartmentalising of the aquifer around the HPC site.
- Apart from the above, the faulting in the formations has not been explicitly modelled. Results of the impact assessment (see below) are of sufficient low significance to make their inclusion unnecessary as they are conceptually interpreted to present barriers to groundwater flow. Their inclusion in the model would therefore probably further reduce predicted impacts as a result of drawdowns in the Blue Lias aquifer. It is considered that the results of the impact assessment do not therefore warrant the inclusion of faults in the model.
- MODFLOW requires that all layers are in sequence throughout the model domain. Thus Layer 1 cannot be situated directly on Layer 3 where the ‘real’ Layer 2 is absent (total Blue Lias thickness less than 40 m). In order to preserve model functionality therefore, Layer 2 was extended across the whole model so that it remained at least 5m thick. The value of 5m was chosen so that cell-to-cell continuity would be maintained in the areas of steeper layer gradients. Layer 2 was allocated the same aquifer properties as Layer 1 in these areas.
- The average thicknesses of Layers 3 (Lilstock), 4 (Westbury) and 5 (Blue Anchor) were determined from evaluation of the BDAW and BDAE borehole logs, giving thicknesses of 5.0 m, 9.2m and 38.2m respectively. These thicknesses were subtracted from the base of Layer 2.

15.5.144 In MODFLOW, Layers 1 to 3 were assigned as convertible, such that transmissivity varies depending on saturated thickness, and the appropriate value of storage (specific yield or specific storage) is automatically assigned according to whether the water level is above or below the top of the cell at the beginning of each time step. Layers 4 and 5 were specified as confined.

15.5.145 The starting head values in the initial steady state models were set at a uniform 15mAOD – close to real values to enable the model to start efficiently. Note that this results in some Layer 1 cells being dry from the beginning, however the calibration has been repeated by setting the starting heads to at least 1m above the cell bottoms to confirm that this has no effect on the calibration achieved. Cell rewetting is enabled, so cells that dry out can refill if groundwater levels rise again rather than being switched off. The calibrated steady state heads were exported to form the first stress period for all the transient models (see below).

iv. Boundary Conditions

15.5.146 **Figure 15.19** indicates the type of boundary conditions used in the model.

15.5.147 Overall, there are very few surface water features in the model through which groundwater can discharge locally under baseline conditions. The drainage ditch on BDAW is the only such feature on or near the HPC site which may allow this to occur. Holford Stream is the only other surface water feature, forming the south east boundary condition of the model (the model domain does not include the upper part of the Holford Stream across the SCPA), but is several hundred metres from the main site. Hence the groundwater conceptualisation is for the majority of recharge to enter the Blue Lias aquifer, flow north towards the Bristol Channel, and exit the aquifer under the Bristol Channel at some point off-shore. There are no specific data to allow a full conceptualisation of these flows or discharges to be undertaken. Whilst flow in deeper layers such as the Lilstock may occur further out into the Bristol Channel this cannot be quantified. Hence a simple northern boundary in the model was implemented.

15.5.148 The natural discharge regime of groundwater to the Bristol Channel is represented by fixed heads along the north of the model domain at 0mAOD. The groundwater surface is still at an elevation of up to 10m at the cliff line, so it is assumed that the discharge of the natural groundwater flow regime into the Bristol Channel takes place several hundred metres off-shore. In the model, the fixed head cells are approximately 300m from the cliff line. This distance in the BDAW was estimated by extrapolating the groundwater gradient at the coast beyond the shoreline. It is a conceptual assumption since there are no off-shore data available. In this case, the boundary condition could be more complex, involving vertical leakage over an extended area. However, in the absence of evidence, it was considered prudent to apply a simple numerical condition.

15.5.149 The Holford Stream, and its associated surface drainage system in the south-east corner of the model, rests on (presumed) low permeability marine/estuarine alluvium which probably results in the Blue Lias being semi-confined or confined in this area. This means that the groundwater/surface water interactions are limited and, further that this lower permeability cover will also restrict aquifer recharge and discharge in this zone.

15.5.150 Holford Stream and its associated surface water drainage system are therefore not represented explicitly in the numerical model and a drain boundary was applied to the south-eastern limit of the model domain, with a stage set at the topographic surface elevation of the Holford Stream bed (6mAOD adjacent to the Hinkley Point Fault falling to 2mAOD at the eastern boundary of the model). As this limit is relatively far from the BDAW and BDAE, the type of boundary condition applied has a limited effect on the groundwater levels simulated within the development area where the main construction dewatering will take place. Again, a more complex condition could be applied, but given that Holford Stream is not in the main area of interest, a simple condition is considered appropriate. The drain bed was assigned the following parameters:

- Stage 6m in the west falling to 2m in the east – intermediate values interpolated by Groundwater Vistas.
- Width of 1m.
- Length, variable as assigned by Groundwater Vistas based on the cell dimensions in each case. In the west the cells are 20m wide, in the east 50m wide. Groundwater Vistas selects the largest of cell width or length for this parameter for a digitised polyline of cells used to specify a drain.
- Bed thickness, 1m.
- Hydraulic conductivity, 1000m/d (high value to provided unimpeded transfer).

15.5.151 The model was found to be relatively insensitive to these parameters and the resulting conductance values are considered to be an appropriate estimate.

15.5.152 The remainder of the southern boundary of the model, to the west, is represented by no-flow boundary (inactive) cells that follow the physical northern boundary of the faulted inlier of Mercia Mudstones (see **Figure 15.4** and **Figure 15.6**).

15.5.153 Across the Built Development Area (BDAW and BDAE) the existing drainage ditches (which locally control groundwater levels, see **Figure 15.12** and **Figure 15.13**) are represented in MODFLOW by internal boundary conditions in the form of drains (see **Figure 15.19**), with stage elevations between 10 and 16mAOD, derived from the surface topography. This includes a former drain channel now buried beneath Made Ground on the BDAE, which joins the existing drain where it alters course from east to north. In the absence of any other data, the drain beds were allocated hydraulic conductivity values of 1m/d (about twice the highest initial Blue Lias permeability in Layer 1), with an assumed thickness and width of 1m. From this the MODFLOW model calculates a drain conductance of 10m^2/d which is considered appropriate for these drains in the absence of field data.

v. Hydrodynamic Parameters and Recharge

15.5.154 **Table 15.15** summarises the final calibrated parameter values used for the model. Further details are contained in **Appendix 15G** and background baseline descriptions are contained above.

15.5.155 Kx (horizontal permeability) values are based on the results of the pumping tests and the various packer (Lugeon) tests where available. Horizontal anisotropy in the Blue Lias and Lilstock formations (Layers 1-3) are set at 2:1 (E-W:N-S) based on the observations of the distance-drawdown relationships in the pumping tests. The low permeability and low groundwater activity regimes in the Westbury and Blue Anchor formations (Layers 4 and 5) do not justify any horizontal anisotropy and there is a lack of data to calculate anisotropy for these layers.

15.5.156 Vertical anisotropy is a result of lithology and sedimentary structure, with vertical permeability being substantially lower. Horizontal permeability is facilitated by mineral alignments within the mudstones and the predominance of fractures and joint sets parallel with bedding planes. Vertical permeability reflects the resistance to groundwater flow across these structures. The estimation of vertical permeability uses the lower bound values of Lugeon tests, assumed to represent matrix or minimally fractured mudstone horizons, and the Kh:Kv ratio uses equations such as those contained in Anderson & Woessner (Ref. 15.38) and described in **Appendix 15B**.

Table 15.15: Final Calibrated Parameter Values in Groundwater Model

		Kx (east-west)		Ky (north-south)		Kx/Ky	Kz (vertical)		Kx/Kz	Sy	Ss	Layer type
		m/d	m/s	m/d	m/s		m/d	m/s		(-)	(-)	
Layer 1	Weathered Blue Lias	0.38	$4.40x10^{-6}$	0.19	$2.20x10^{-6}$	2	$4.74x10^{-4}$	$5.49x10^{-9}$	800	0.02	$3.00x10^{-5}$	Convertible
Layer 2	Fresh Blue Lias	0.0039	$4.51x10^{-8}$	0.0019	$2.20x10^{-8}$	2.1	$3.25x10^{-5}$	$3.76x10^{-10}$	120	0.02	$3.00x10^{-5}$	Convertible
Layer 3	Lilstock	4.41	$5.10x10^{-5}$	2.21	$2.56x10^{-5}$	2	0.882	$1.02x10^{-5}$	5	0.02	$3.00x10^{-5}$	Convertible
Layer 4	Westbury	0.25	$2.89x10^{-6}$	0.125	$1.45x10^{-6}$	2	$2.50x10^{-3}$	$2.89x10^{-8}$	100	0.01	$3.00x10^{-6}$	Confined
Layer 5	Blue Anchor	0.1	$1.16x10^{-6}$	0.05	$5.79x10^{-7}$	2	0.02	$2.31x10^{-7}$	5	0.01	$3.00x10^{-6}$	Confined

15.5.157 Estimated Kh:Kv values in the Blue Lias range from around 800 in the weathered Blue Lias of Layer 1 (strong horizontal fracturing and lithological fabric, minimal cross-cut fracturing through the weathered mudstones), to 120 in the fresh Blue Lias of Layer 2. The Lilstock (Layer 3) has a Kh:Kv of 5 influenced by its limited thickness and the limestone lithology of its active groundwater flow zone. Estimated (calculated) values for the Westbury and Blue Anchor are 100 and 5 respectively.

15.5.158 Specific yield in Layer 1 was initially set at 0.03 based on EDF fracture analyses and BGS outcrop values, reducing in Layers 2 and 3 to 0.02 due to compaction, and to 0.01 in Layers 4 and 5 due to compaction and lack of weathering. Final calibration resulted in Layer 1 specific yield also being set at 0.02.

15.5.159 Calibrated confined storage coefficients were set at $3x10^{-5}$ for Layers 1-3, and $3x10^{-6}$ for Layers 4 and 5.

15.5.160 Recharge and its relationship to rainfall records and soil moisture deficit etc is discussed above. Allocation of general values to the model is shown in **Figure 15.21**, taking account of the areas of reduced recharge due to hardstanding and surface drainage systems on Hinkley Point A and Hinkley Point B, the alluvium on Wick Moor, and the sea.

15.5.161 General recharge values are:

- Blue Lias outcrop 272mm/yr
- Hinkley Point A and B stations 25mm/yr
- Wick Moor alluvial plain 50mm/yr
- Sea 0mm/yr

15.5.162 The Blue Lias outcrop recharge is varied in the model during transient calibration against hydrographs in order to emulate the reduced and zero recharge in summer months when soil moisture deficit restricts or prevents effective recharge from taking place. The remaining values were derived from previous model calibrations.

vi. Calibration

15.5.163 An important part of groundwater model development is calibration which is detailed in **Appendix 15H** and summarised here. The overall calibration process was performed to achieve a representative groundwater model for the Built Development Area against the baseline conditions shown in **Figure 15.5**, and involved both steady state and transient regimes. The calibration process was undertaken in the following order (explained in more detail in the following sections):

15.5.164 A sensitivity analysis (**Appendix 15H**) was undertaken to assess horizontal and vertical permeability and recharge for all layers of the model. The results of this sensitivity analysis identified which parameters the model was more sensitive to, and hence formed the primary part of the calibration process. If the model was found to be insensitive to certain parameters, these parameters were fixed and not changed initially.

15.5.165 A steady state model was constructed in order to determine the general piezometric head pattern across the model.

15.5.166 The recharge associated with the alluvial flood plain in the east of the model was then modified in order to represent likely heads on the Hinkley Point B site.

15.5.167 A transient model was then constructed to represent the 2008 BDAW pumping test (**Appendix 15H**) by matching the maximum drawdowns in a selection of monitoring wells in the model to those observed in the field. This was achieved by varying model hydraulic conductivity values in all three principal axes (Kx, Ky and Kz) in Layer 3 (as detailed below).

15.5.168 A further transient model was constructed to represent the 2010 BDAW pumping test (**Appendix 15H**) following the same process as described above for assessing the 2008 pumping test.

15.5.169 It should be noted that the 2010 repeat test of the BDAW pumping well provided additional support information on horizontal permeability anisotropy – in general however, the pumping test calibrations provided little insight into the model behaviour compared with the hydrograph calibration. The pumping tests were more useful in determining the presence of barrier boundaries representing internal compartmentalisation in the aquifer.

15.5.170 A final transient model was then constructed using calibrated hydraulic conductivity values from the pumping test model. This model was designed to investigate the appropriate general recharge value assumed in the model, and its temporal distribution in 2009/2010 by attempting to match modelled heads in a selection of boreholes on the BDAW with observed field hydrographs. It is this final transient model that was used to assess environmental impacts.

vii. Modelled Development Scenarios

Preliminary Works Drainage

15.5.171 The ‘deep’ (9mAOD) spine drains proposed for the Preliminary Works drainage are not designed to collect water themselves, but rather to serve as discharge pipes for dewatering arisings and other surface drainage as required. As such they do not in themselves impact on the groundwater regime.

15.5.172 It is however proposed as part of the preliminary works to excavate the down to 3mAOD for Unit 1 and 6mAOD for Unit 2 (**Figure 15.18**). The steady state dewatering volume for this scenario is approximately 4l/s.

15.5.173 During construction dewatering the baseline groundwater conditions in the Blue Lias will be affected (**Figure 15.15**). During preliminary works when the site preparation works will be undertaken and the temporary jetty constructed the drawdown will be minor compared to main construction when dewatering levels are far deeper. However during both phases the hydraulic gradient under the HPA site will remain low. Under baseline conditions the hydraulic gradient under both the HPA and HPC sites is low and towards the north (Bristol Channel). During preliminary works dewatering this hydraulic gradient is largely maintained despite the minor drawdown. During main construction phase dewatering, the hydraulic gradient under the north-eastern HPC and north-western HPA site switches to a westerly direction (from northerly). However the magnitude of the hydraulic gradient is not greatly affected away from the area immediately surrounding the construction works.

Deep Dewatering

15.5.174 The planned deep dewatering to allow construction of the Nuclear Islands and other deep infrastructure, and in particular for the excavations for the cooling water pumping stations and Interim Spent Fuel Store (ISFS), have been simulated in the model. This was undertaken for environmental assessment purposes by introducing drain cells in Layers 1 and 2 at the locations of the cooling water pumping stations together with shallower drain cells in the remainder of the Nuclear Islands, based upon the planned deep excavation depths (based on finalised platform levels plus 3m extra to allow for a safety margin). The ISFS is to be dewatered to a level of -2mAOD, 3m below the base of the structure.

15.5.175 The main Nuclear Island drain cells were assigned the following parameters:

- stages: -4.2, -12.5 and -25m (to match each of the dewatering levels);
- width: 1m;
- length: 1m;
- bed thickness: 1m; and
- hydraulic conductivity: 5m/d (a suitable value for model stability).

15.5.176 The ISFS drain cells were assigned a stage of -12m, with all other properties being the same as stated above for the main Nuclear Island.

15.5.177 The model has an initial steady state period based upon the heads from the calibrated steady state model in order that the effects of dewatering over time from the baseline could be established. The following dewatering depths (drain stages) in **Table 15.16** were derived for modelling purposes:

Table 15.16: Modelled Deep Dewatering Depths

Deep pumping station excavations	Nuclear Island north	Nuclear Island south	Interim Spent Fuel Store
-25mAOD	-12.5mAOD	-4.2mAOD	-12mAOD

15.5.178 The deep dewatering simulation assumes (conservatively) no residual drawdown from any previous dewatering in the Preliminary Works, and lasts for eight years in total and is comprised of the following:

- Five years of main Nuclear Island dewatering. Five years is a conservative assumption and is one year longer than the design duration.
- Two and a half years of ISFS dewatering, immediately following the cessation of main Nuclear Island dewatering.
- Six months of recovery where no dewatering on the HPC site takes place.

15.5.179 Water level conditions for Layer 1 during dewatering are shown in **Figures 15.23 to 15.26**. **Figure 15.23** shows water levels in the second January of the simulation period (representative of a wet period). **Figure 15.24** (plan) and **Figure 15.25** (section) show water levels after five years which presents heads in a dry period (fifth October of the simulation period). **Figure 15.26** shows water levels after two and a half years of ISFS dewatering.

15.5.180 The influence of the dewatering can clearly be seen in the groundwater contours on the HPC Development Site. The flow direction under HPA is modified during dewatering such that flow to the west from this site and towards HPC is possible. However, it should be recognised that the hydraulic gradient under HPA is very shallow and the groundwater velocities are likely to be very slow and accelerating on the HPC site within a few tens of metres of the actual earthworks locations.

15.5.181 Changes to the groundwater regime from main Nuclear Island dewatering in terms of modification of gradients establishes quickly and the condition away from the immediate vicinity of the pumping does not change substantially after the first 30 days. It is assumed that the ISFS dewatering begins immediately after the five years of main Nuclear Island dewatering, and continues for a further two and a half years. During the ISFS dewatering period, groundwater under the western part of the main Nuclear Island begins to recover back towards the baseline condition (**Figure 15.15**), but will not fully achieve this state due to ISFS dewatering and operational drainage. Influent water quality is addressed in 15.5.122.

15.5.182 'Pumping rates' generated from the main Nuclear Island drain cells total around 12l/s on average after 5 years. The average ISFS dewatering rate is 4l/s. These dewatering rates were derived from the zone budget output of the model by specifying the drain cells used to simulate dewatering as a set of specific reaches in the model.

Operational Conditions

15.5.183 Modelling of operational conditions is not considered to be appropriate due to the intended construction of a peripheral drain around the site at 8mAOD. This drain will passively control groundwater levels within the site to this level, will be maintained for the operational life of the site and forms part of the safety case.

e) Contaminant Transport Assessment

15.5.184 Following the general groundwater modelling described above, the potential for mobile groundwater contaminants on the Hinkley Point A site to be mobilised by construction dewatering became apparent. The following section summarises the risk assessment which has been undertaken to inform the impact assessment. More details of the risk assessment for the main Nuclear Island dewatering can be found at **Appendix 15I**.

Main Nuclear Island Contaminant Assessment

15.5.185 The main Nuclear Island contaminant transport assessment followed current UK best practice by applying a tiered methodology whereby a number of contaminants were considered qualitatively at Tier 1 by both screening and conceptual argument, with only those failing this assessment being considered for further assessment at Tier 2 which may have included modelling.

15.5.186 A number of contaminants from 2004/5 data (Ref. 15.39) at a variety of locations on the HPA site were identified, including:

- Strontium-90 (Sr-90).
- Tritium (H-3).

- Diesel range organics (DRO).
- Hydrocarbons (unspeciated) both dissolved and free phase.
- Mercury (Hg).
- Other metallic compounds.
- PCBs.

15.5.187 At Tier 1, the various sources of the above contaminants were assessed both qualitatively (location on HPA site with respect to the main Nuclear Island dewatering zone of influence) and by simple numerical screening. To derive the main Nuclear Island dewatering zone of influence, a number of particle tracing models were used to derive a capture zone whereby any contamination outside of this zone would either remain largely uninfluenced or not be substantially drawn into the dewatering location over an assumed 5 year dewatering period. Those contaminants residing inside this capture zone were considered for further assessment, namely:

- Sr-90.
- H-3.
- Hg.
- Naphthalene (chosen as a mobile hydrocarbon analogue most suitable with respect to Total Petroleum Hydrocarbons).

15.5.188 Of these contaminants, H-3 was determined to be much more mobile than Sr-90, Hg or naphthalene. It was therefore decided to undertake Tier 2 modelling of H-3 to determine its significance to the dewatering location and HPC site (at the HPA/HPC site boundary) as discussed at **Appendix 15I**.

15.5.189 The results for H-3 show that over the assumed main Nuclear Island five year dewatering period, H-3 from the HPA site is not likely to be drawn on to the HPA site or into the extracted dewatering water at a significant concentration compared to the current UK drinking water standard of 100Bq/l.

15.5.190 Sr-90, Hg and naphthalene are all retarded contaminants and thus as such are even less likely to migrate a substantial distance during the period of dewatering. However, some sources of these contaminants are closer to the HPA/HPC site boundary than for H-3, so some confirmatory modelling was undertaken. The results of this modelling confirmed that these contaminants are highly unlikely to present a risk to the HPC site or the main Nuclear Island dewatering location during dewatering.

15.5.191 In summary, there is no known contamination on the HPA site which presents a risk to the HPC site or main Nuclear Island dewatering location under anticipated dewatering conditions.

15.5.192 In addition to the above modelling conclusions, it is also useful to consider the additional factor of dilution at the point of dewatering, since the potential contaminant flows only represent a fraction of the total inflow to the dewatering system. Based on MODFLOW calculations the flow over the site boundary from HPA to HPC in Layer 1, representing the H-3 plume (see Section 15.6 below), is approximately 26m^3/d or 0.3l/s. This is approximately 2.5% of the whole dewatering extracted volume (12l/s) during main construction dewatering. Therefore, the peak H-3 concentration from the aquifer adjacent to the main Nuclear Island (predicted value of 7.7Bq/l, Section 15.6) would be diluted down to 0.19Bq/l of H-3 within the discharged water, which is far below the standard limit of detection (5Bq/l). Please refer to Section 15.6 below for details of the contaminant transport assessment.

Interim Spent Fuel Store Contaminant Assessment

15.5.193 The ISFS is assumed to be constructed immediately after the main Nuclear Island dewatering has ceased. The ISFS dewatering is assumed to last for two and a half years and dewater to a level of –12mAOD.

15.5.194 During the period of ISFS dewatering, there are two potential sources of contamination that could be drawn into the excavations: H-3 contamination drawn onto the HPC site from HPA as a result of the preceding main Nuclear Island dewatering (see above) or contamination directly from the HPA site itself.

15.5.195 As detailed above for the main Nuclear Island dewatering contaminant risk assessment, predicted H-3 contamination is not significant, with peak H-3 concentrations falling below the current UK Drinking Water Standard of 100Bq/l by a substantial margin. Therefore this contamination will not present a significant risk to the ISFS excavations.

15.5.196 The second potential source of contamination is directly from the north-western part of the HPA site. As discussed in **Appendix 15I**, the geological layers underlying the HPA and HPC sites dip northwards at approximately 11 degrees. The groundwater monitoring boreholes on the HPA site are comparatively shallow and are not deep enough to penetrate to the potential depths where contamination from southerly HPA sources may reside as it is transported northwards to the Bristol Channel under baseline conditions. Thus the presence of deeper groundwater contamination in the north-western part of the HPA site is an uncertainty within this assessment.

15.5.197 It is possible, however, to address this uncertainty conceptually by calculating in reverse the H-3 concentration levels that would have to be present on the north-western part of the HPA site in order to breach the current UK Drinking Water Standard during ISFS dewatering. By applying the 100Bq/l H-3 limit to the eastern boundary of the ISFS excavations, it has been calculated that a H-3 concentration of up to 6,470Bq/l could be present 100m to the east of the ISFS excavations on the HPA site without breaching the adopted 100Bq/l limit in the ISFS excavations during dewatering. These calculations assumed dilution in groundwater, longitudinal and transverse dispersion and radioactive decay. As detailed above for the main Nuclear Island contaminant assessment, there are no known current or historical sources of H-3 groundwater contamination anywhere on the HPA site that breach 2,000Bq/l, less than one third of 6,470Bq/l.

15.5.198 In summary, there is no known contamination on the HPA site which will present a significant risk to the ISFS excavations during dewatering. Furthermore, H-3 contamination drawn onto the HPC site during main Nuclear Island dewatering has already been assessed as insignificant and will therefore not present an additional risk to the ISFS excavations.

f) Groundwater Receptors and Value

15.5.199 Groundwater receptors and their designated sensitivities are provided in **Table 15.2** and **Table 15.17** below.

Table 15.17: Summary of Groundwater Receptors and Their Value/Sensitivity Local to HPC

Receptor	Value/ Sensitivity	Comment
Blue Lias in proximity to coastal waters	Low	No abstractions and no Source Protection Zone designations, however, proximity to the foreshore and associated ecological receptors are taken into consideration.
Groundwater quality/aquifer properties	Low	Secondary A Aquifer. No significant local use at or adjacent to the site in or down-gradient of the likely area of influence. No Source Protection Zone designations.
Groundwater recharge/groundwater levels	Very low	Secondary A Aquifer tolerant of change.

15.5.200 **Table 15.17** is based upon Environment Agency groundwater vulnerability classifications, with Principal Aquifers being designated as High or Medium value, depending on the presence and location of water supply abstractions, and Secondary Aquifers being designated as Low or Very Low value. Low sensitivity sites are within the Catchment Source Protection Zone of a water supply abstraction.

15.5.201 As far as Hinkley Point is concerned, the Blue Lias is a Secondary A Aquifer, and the similar lithologies of the Lilstock Formation of the Penarth Group are also likely to be Secondary A. The Westbury, Blue Anchor and Mercia Mudstones are Secondary B Aquifers due to their yielding limited amounts of groundwater from minor fractures or thin permeable horizons.

15.5.202 River alluvium in the Holford Stream is designated as Secondary A, and the marine alluvium south and east of Hinkley Point A and Hinkley point B (North Moor, Wick Moor etc.) is designated as Secondary Undifferentiated, meaning it is not definitively attributable to either Secondary A or B.

15.5.203 On the basis of **Table 15.17** therefore, the whole of the HPC Development Site and its surroundings would be classified as Very Low groundwater value because all formations are Secondary A or poorer, and there are no water supply abstractions which invoke the need for Source Protection Zones.

15.5.204 Nevertheless, it is deemed prudent and conservative to limit the Very Low value only in respect of groundwater level change, and to use Low for groundwater quality aspects in view of the proximity of the HPC site to the shoreline and the presence of marine ecology receptors (**Table 15.17**).

15.6 Assessment of Impacts

15.6.1 This section provides an assessment of the key project elements which have the potential to impact on or be impacted by groundwater during the construction and operational phases of HPC (including dismantling and removal with respect to the temporary jetty).

a) Environmental Management and Protection Measures

15.6.2 The following impact assessment has been undertaken assuming legislative compliance and the adoption of standard good practice.

15.6.3 Environmental impacts arising from construction activities would be managed through specified mitigation and a range of control measures and monitoring procedures which are outlined in the **Environmental Management and Monitoring Plan (EMMP)** and the subject specific management plans (SSMPs) **(see Annex 3)**.

15.6.4 The SSMPs that are of relevance to groundwater include:

- Water Management Plan;
- Land Contamination Management Plan;
- Materials Management Plan; and
- Emergency Incident Control Plan.

15.6.5 The site will be regulated under an Environmental Permit and Radioactive Substances Authorisation. The Environment Agency has stipulated a series of indicative Best Available Techniques (BAT) within several of their recent guidance documents on environmental permitting for a variety of process industries and large installations such as nuclear power stations. Relevant selected examples of indicative BAT practices which represent standard control measures are provided below for illustrative purposes.

15.6.6 For subsurface structures, the indicative BAT requirements relevant to groundwater include:

- engineer systems to minimise leakages from pipes and ensure swift detection if they do occur, particularly where hazardous substances are involved; and
- provide secondary containment and/or leakage detection for subsurface pipework, sumps and storage vessels.
- for bunds the indicative BAT guidance requires that bunds should:
- be impermeable and resistant to the stored materials;
- have a capacity greater than 110 percent of the largest tank or 25 percent of the total tankage, whichever is the larger; and
- be fitted with a high-level probe and an alarm, where not frequently inspected.

b) Potential Impacts during both Construction and Operation

15.6.7 The following activities may take place during both construction and operation, therefore the impacts are only described once to avoid repetition.

Groundwater Impacts due to Accidental Spillages or Leakage from Mechanised Plant

15.6.8 Construction works and operation would require the use of mechanised plant and, therefore, have the potential to impact upon groundwater quality from the accidental spillage or leakage of contaminating liquids such as diesel fuel and hydraulic oil. Unmitigated, such spillages could seep through the unsaturated zone and contaminate the groundwater. It is, however, assumed that standard good practices would be observed, such as:

- maintenance of plant in good and clean condition;
- use of drip trays beneath hydraulic connections and sumps; and
- refuelling only in specified hardstanding areas protected by oil separators and with fuel stored in suitably bunded compounds.

15.6.9 Vehicle parking area drainage would include appropriately placed oil interceptors to remove contamination prior to release to the drainage system.

15.6.10 The scale of the impact is local since the potential impact is confined to the location of the plant activity and its immediate vicinity.

15.6.11 Minor contamination impacts result in a magnitude determination of low. On the basis of the low sensitivity (Secondary Aquifer with no abstractions in the vicinity and outside any SPZ) and low magnitude, the significance of the impact to groundwater is assessed as **minor adverse.**

Groundwater impacts due to Hardstanding Areas

15.6.12 Construction of hardstanding and road construction to groundwater is minimal. The only two factors that have any environmental relevance are:

- increase in hardstanding and impermeable surface areas which could reduce recharge to groundwater and increase run-off; and
- potential impact to groundwater quality from the accidental spillage or leakage of contaminating liquids such as road vehicle fuel and oil via road drainage and/or soakaways.

15.6.13 In hardstanding areas (car parks and metalled roads) there could be some minor but probably indiscernible impact on groundwater recharge and groundwater levels as recharge is reduced due to the diversion of run-off away from the hardstanding areas and into the surface water system.

15.6.14 The scale of this impact is local since the potential impact is confined to the location of the hardstanding and its immediate vicinity. It is likely that the impact would occur but any impact would be barely discernible.

15.6.15 Barely discernible impacts on a Secondary A Aquifer result in a magnitude determination of very low. On the basis of the very low sensitivity (Secondary Aquifer with no abstractions in the vicinity and outside any SPZ) and very low magnitude the impact significance is assessed as **negligible**.

Impacts on Humans (Site Workers) Relating to Groundwater Quality

15.6.16 Compliance with standard health and safety legislation and construction site practice is regarded as the baseline for the assessment and not considered as a separate specific mitigation. Hence, potential exposure to groundwater containing contaminants at the concentrations described above would not be considered to be an environmental impact. Any such 'impacts' are automatically mitigated by the adoption of exposure control measures including the wearing of appropriate Personal Protective Equipment (PPE) if required thus **no impacts** are anticipated.

c) Construction Impacts

15.6.17 Potential construction impacts include impacts that could occur during preliminary works (for the site preparation and temporary aggregates jetty) as well as during the main construction works. A number of impacts such as site clearance will be similar no matter what time in the process they occur so they are only discussed once. Where impacts are confined to a specific construction phase that phase is identified. The following construction impacts are addressed:

- site clearance (vegetation removal);
- ground preparation;
- site drainage;
- retaining wall (preliminary works);
- Holford Stream drainage;
- soil contamination;
- dewatering (main site construction);
- groundwater levels;
- groundwater quality;
- saline intrusion;
- other abstractions; and
- buildings and infrastructure.

i. Site Clearance (Vegetation Removal) – Impacts on Recharge and Groundwater Levels

15.6.18 Site clearance will involve the removal of vegetation including arable crops, grass, trees and hedgerows. Although trees and hedgerows have an enhanced potential for evapotranspiration compared with arable crops, grass or bare soil, this is not considered to be a major factor in the groundwater recharge regime in the study area overall, especially compared with the likely background seasonal variation in rainfall. Removal would increase groundwater recharge very slightly by reducing losses from evapotranspiration and consequently causing a slight increase in groundwater levels in aquifer outcrop areas.

15.6.19 In many cases site clearance will be followed by soil stripping and platform creation in the same areas, and so impacts in relation to site clearance would be incorporated within the subsequent activities. There would nevertheless be some areas where site clearance is the only activity.

15.6.20 Any impact upon groundwater recharge and levels arising from vegetation removal would be local (i.e. confined to the area of clearance) and likely to be indiscernible from, and lower in magnitude than, seasonal variation. The impact is reversible because re-vegetation of cleared areas would offset any potential change. As a result, the magnitude of impact is assessed as very low. On the basis of the very low sensitivity of the aquifer (Secondary Aquifer with no abstractions in the vicinity and outside any SPZ), the impact significance is therefore assessed as **negligible**.

ii. Ground Preparation (Topsoil Stripping and Materials Stockpiling) – Impacts to Recharge, Groundwater Levels and Aquifer Properties

15.6.21 Ground preparation activities have the potential to cause the following types of impacts:

- changes in recharge and groundwater levels in soil-stripped source areas;
- changes in recharge and levels in the stockpiled areas; and
- changes in aquifer properties in the stockpiled areas.

15.6.22 Removal of topsoil material would reduce the thickness of the unsaturated zone above the water table and could facilitate more rapid recharge locally. However, any enhanced local recharge and water table rise would be relatively quickly dispersed into the wider aquifer regime as water levels adjust to restore shallower gradients and smoother water table topography. These changes in water level (increases) would also be influenced by, and probably masked by, the impact of the new drainage works on groundwater levels (decreases).

Impact to Recharge and Groundwater Levels in Stripped Source Areas

15.6.23 Topsoil or subsoil removal is not likely to have a significant impact on groundwater recharge in the source areas. The absence of soil water retention properties (especially at times of soil moisture deficit) due to loss of topsoil may result in a slight and localised increase in groundwater recharge as recharge is enhanced due to the removal of soil moisture retention characteristics. This is, however, unlikely to be discernible in the context of normal seasonal variations in rainfall.

15.6.24 The scale of the impact is local since the potential impact is confined to the location of the subsoil and rock stripping and its immediate vicinity. It is certain that the impact would occur; however, the impact is reversible.

15.6.25 Such impacts result in a magnitude determination of very low to low. On the basis of the very low sensitivity (Secondary Aquifer with no abstractions in the vicinity and outside any SPZ see **Table 15.17**) and very low to low magnitude, the impact significance is assessed as **negligible**.

Impact to Recharge and Groundwater Levels in Stockpile and Aggregate Storage Areas

15.6.26 Stockpiling of soils and rock will principally take place within the SCPA. The water table in the Blue Lias in the SCPA reflects the surface topography and is controlled by the levels of Bum Brook and Holford Stream to which it discharges as baseflow (see **Figure 15.7** and **Figure 15.15**). Between the watercourses the natural water table is likely to be slightly higher than the surface drainage, the actual level being dependent on permeability, storage and recharge rate.

15.6.27 As for soil stripped areas, stockpile areas would affect local drainage and reduce or slow down groundwater recharge under their footprints. These effects would also be dissipated as the surrounding groundwater levels change to adjust to the new local recharge regime. These changes in water level would also be influenced by, and probably masked by, the impact of the new drainage works on groundwater levels.

15.6.28 Stockpiling may result in a reduction in direct recharge to the stockpile footprint in areas where the Lower Lias aquifer outcrops. This results from the enhanced run-off from the stockpile slope faces. However, this enhanced run-off could then recharge the aquifer away from the stockpile footprint if not carried directly to the surface water drainage, which in any event receives groundwater baseflow. The stockpile areas would form a small proportion of the total groundwater catchment.

15.6.29 The scale of this impact is local since the potential impact is confined to the location of the stockpiling and its immediate vicinity. It is likely that the impact would occur but only possible that any impact would be discernible. The impact is reversible because stockpile removal would offset any potential impact.

15.6.30 Barely discernible impacts on a Secondary A Aquifer result in a magnitude determination of very low. On the basis of the very low sensitivity (**Table 15.17**, Secondary Aquifer with no abstractions in the vicinity and outside any SPZ) and very low magnitude, the impact significance is assessed as **negligible**.

Impact to Aquifer Properties in Stockpile and Aggregate Storage Areas

15.6.31 Stockpile areas could change groundwater properties in the aquifer material beneath them. This would be due to the loading resulting in the squeezing of pore spaces and fractures and a consequent reduction in permeability and storage. For a given recharge condition this would result in a rise in shallow groundwater levels, which increases the groundwater gradient required to allow the throughflow of the same volume of groundwater.

15.6.32 The scale of the impact would be local, since the potential impact is confined to the location of the stockpiling and its immediate vicinity. It is very unlikely that the impact would occur given geological preconsolidation, and unlikely that any impact would be discernible. Any impact, however unlikely, would however be permanent because compression effects would remain after removal of the loading.

15.6.33 Barely discernible impacts would cause an effect of a very low magnitude to arise. On the basis of this and the very low sensitivity of the receptor (Secondary Aquifer with no abstractions in the vicinity and outside any SPZ), the impact significance is assessed as **negligible**.

iii. Retaining Wall (Preliminary Works) – Impacts to Groundwater Levels

15.6.34 Prior to the site levelling activities a soil retaining structure (retaining wall), would be constructed in the area where the proposed platform elevation at 14mAOD is greater than the existing ground level.

15.6.35 No dewatering is required for the retaining wall, so the only potential impacts are related to increased groundwater levels behind the wall.

15.6.36 There could be localised increases in groundwater level that are not collected by the drainage relief pipework incorporated in the retaining wall design.

15.6.37 The scale of the impact is local since the potential impact is confined to the location of the retaining wall and its immediate vicinity. The sensitivity with respect to groundwater is assessed as very low (Secondary Aquifer with no abstractions in the vicinity and outside any SPZ). It is possible that the impact would occur and possible that any impact would be discernible. The impact is likely to be temporary. The potential groundwater impacts result in a magnitude determination of very low; hence, the groundwater impact significance is assessed as **negligible**.

iv. Holford Stream Drainage and Interactions with Groundwater

15.6.38 The groundwater conceptual model suggests that the Holford Stream is partially fed by groundwater baseflow where the Blue Lias water table intercepts the surface in the western part of the Holford Stream catchment in the SCPA. This groundwater component augments the surface water run-off component.

15.6.39 The general catchment characteristics would not be altered during the site preparation works as the area would be used for the stockpiling of soils and rock until a substantial proportion of them can be reused in subsequent construction works and site restoration after the completion of construction. Culverted drainage would be installed below the stockpiles to ensure the upper surfaces of the soil are suitably drained, especially of water caused by the consolidation of the ground during loading by stockpiles.

15.6.40 The engineering design of the culverting would incorporate construction of sufficient permeability (as in a French drain, for example) to allow for continued flow of groundwater into the culverted section of the Holford Stream. Without such a design it is possible that groundwater heads would rise in the vicinity of the culverted section leading to localised temporary flooding and/or saturation of the lower parts of stockpiled materials.

15.6.41 Given appropriate design the impact on groundwater behaviour will be permanent and local in spatial scale, i.e. in the near vicinity of the culvert drainage system. The potential groundwater impacts result in a magnitude determination of very low; hence, the groundwater impact significance is assessed as **negligible**.

v. Existing Soil and Groundwater Contamination

15.6.42 Known contamination ‘hot spots’ from the spoil mounds or elsewhere in the BDAE would be removed for appropriate offsite disposal during the enabling works, and it is assumed that any other contamination identified subsequently during the site preparation works would be dealt with similarly. Any material remaining will be suitable for use (after treatment if necessary). Accordingly, there is no known potential for groundwater contamination arising from the topsoil or spoil stockpiles. These stockpiles are addressed in terms of potential soil impacts in **Chapter 14** of this volume.

15.6.43 Groundwater sampling campaigns undertaken within this area, (Ref. 15.41 and Ref 15.42) have not indicated the presence of significant contamination affecting the groundwater quality within the BDAE, apart from some exceedences of groundwater constituents in relation to screening values. Such exceedences in themselves do not indicate that the water is unsuitable for discharge to the marine environment and thus **no impacts** are anticipated in this context.

vi. Dewatering – Impacts to Groundwater Behaviour and Quality

15.6.44 Following the completion of the preliminary works, and specifically the site preparation works, the remaining earthworks and main construction phase works will be undertaken; these will include further deep excavations for Units 1 and 2; construction of the Nuclear Island and associated buildings and infrastructure; and construction of the sea wall.

15.6.45 Dewatering of deep excavations for buildings and other sub-surface structures is required to enable safe and efficient construction of foundations and the construction of any section of the building(s) below the baseline water table. Dewatering operations will start in advance of excavations so that the working areas are as dry as possible.

15.6.46 The assessment of dewatering effects has been carried out largely with the use of the groundwater numerical model and contaminant transport model described above in Section 15.5.

15.6.47 The extent of the main Nuclear Island deep excavations will cover an area of some 500 x 400m. This area extends to within about 50m of the shoreline. The deepest excavations are for the cooling water pumping stations, nearest to the shoreline, which will be excavated to around -22mAOD. The rest of the main Nuclear Island will be excavated to various depths but for dewatering purposes a depth of -9.5mAOD for the northern part of the area, and -1.2mAOD for the southern part are assumed. In order to be conservative for the assessment, modelled dewatering is to 3m below these levels (main Nuclear Island only). For the ISFS, dewatering to a level of -12mAOD is assumed.

15.6.48 The sea wall design includes passive drainage features (150mm drainage pipes coupled with an engineered drainage layer behind the wall) with invert levels of 4.5 to 5.5mAOD to prevent groundwater mounding behind the sea wall and hence the build up of hydrostatic pressure. These drainage pipes are designed to ensure that groundwater behind the wall (northern part of the HPC Development Site) will not exceed 6mAOD. As such it is assumed that the sea wall will effectively be ‘transparent’ with respect to groundwater flow and thus **no impact** on groundwater behaviour is anticipated.

15.6.49 Dewatering could result in:

- dewatering cones of depression creating new gradients which result in the flow of contaminated groundwater from adjacent areas into the abstraction point(s);
- dewatering cones of depression creating reversal of the baseline groundwater gradient to the Bristol Channel and intrusion of saline water to the Secondary A Aquifer; and
- dewatering cones of depression creating new gradients under buildings in adjacent areas, notably the Hinkley Point A and B power stations.

15.6.50 The assessment of dewatering impacts considers:

- the likely volumes and rates over time of water needing to be removed from the aquifer for effective dewatering (this will be a function of excavation depth, saturated aquifer characteristics, recharge and construction timescale);
- the estimated extent of the dewatering cones of depression using the numerical groundwater model; and
- from the gradients and the aquifer characteristics, estimates of the possible ranges of groundwater contaminant flow rate and travel distances from identified contaminated groundwater sources to the dewatering abstraction.

15.6.51 Comparison with groundwater level maps shows that the platform elevations are generally above existing groundwater levels, although existing natural groundwater levels under part of Unit 1 in the BDAE may be over 14mAOD. **Figure 15.12** and **Figure 15.13** show the nominal groundwater contours derived from water table levels in the shallow Lower Lias piezometers installed on the BDAW. The highest water levels are based on water table data from December 2009.

15.6.52 Without additional water management, the presence of high groundwater levels would make the cut and fill activities associated with the site preparation works in the low platform areas difficult and potentially unsafe. However, the surface water drainage component of the site preparation works would be augmented by spine drains running south-north which would receive groundwater pumped from the deeper excavations in these works. These drains are currently proposed to discharge to the upper shore via a single outfall at an invert level of 7.5mAOD. The spine drains proposed are not designed to collect water themselves, but rather to serve as discharge pipes for dewatering arisings and other surface drainage as required. As such they do not in themselves impact on the groundwater regime.

15.6.53 Deeper excavations for both units would be undertaken during the site preparation works to 3mAOD for and 6mAOD for Units 1 and 2 respectively. This excavation scenario has been modelled. **Figure 15.H.17** (in **Appendix 15H**) indicates that the resulting modelled drawdown cones do not extend outside the development areas. The steady state dewatering volume for this scenario is approximately 4l/s. The detailed earthworks design would also include an additional surface water and rainwater capacity component of the drainage as appropriate. Boreholes for future deep dewatering would also be installed by the dewatering contractor during the site preparation works phase. These will be subject to detailed method statements and risk assessments, although it is not anticipated that there will be any specific groundwater impact to be considered in relation to the borehole drilling; moreover, the boreholes are only temporary but will be retained throughout the period of subsequent construction for as long as dewatering is required.

15.6.54 From the above it is apparent that during the site preparation works drainage and excavation of the areas proposed for the two units would have a local impact confined to the BDAE and BDAW. In any other sensitive areas of the groundwater or surface water/groundwater regimes such as beneath the existing HPA or HPB or in relation to water levels beneath Wick Moor no impact is predicted (see Section 15.5 for further conceptual discussion on the hydrogeological isolation of Wick Moor from the construction dewatering at HPC). The overall magnitude of the impact during site preparation works is rated as low. On the basis of the very low sensitivity (Secondary Aquifer with no abstractions in the vicinity and outside any SPZ) and low magnitude, the impact significance is assessed as **negligible**.

15.6.55 Following the site preparation works, excavations for the building foundations and structures would progress. The planned deep dewatering for the two units and ISFS, and in particular for the excavations for the cooling water pumping stations, has been simulated in the groundwater model.

15.6.56 Most of the dewatering abstraction volume will arise from drainage of the fractures and larger pores in the saturated zone in its area of influence; some water will still be present in the unsaturated zone above the water table as transitional recharge water moving downwards or held in small pores and pore connections by capillary forces in the pre-dewatering saturated zone. The latter will be released into the excavation as the rock material is broken up and removed.

15.6.57 The depth of deep dewatering modelled is specified in **Table 15.16**. In the deepest part of the excavations, dewatering depth is to -25mAOD which is 39m below the level of the development platform at 14mAOD.

15.6.58 Water level conditions in the base case for Layer 1 in the model in the second January of the five year simulation period (representative of a wet period) are represented by **Figure 15.23**, and after five years by **Figure 15.24** (plan) and **Figure 15.25** (section) which present heads in a dry period (final October of five year simulation period). **Figure 15.26** shows Layer 1 water levels after two and a half years of ISFS dewatering.

15.6.59 The influence of the dewatering can clearly be seen in the groundwater contours on the HPC Development Site. The flow direction under Hinkley Point A is modified during dewatering such that flow to the west and towards HPC is possible. However, it should be recognised that the hydraulic gradient under Hinkley Point A is very shallow and the groundwater velocities within the HPA site are likely to be very slow.

15.6.60 Impact on the groundwater regime in terms of modification of gradients establishes quickly. For the main Nuclear Island dewatering, water levels away from the immediate vicinity of the pumping do not change substantially after the 30 day period. ‘Pumping rates’ for the main Nuclear Island dewatering are calculated by the model to be 12l/s (43.2m^3/hr). For ISFS dewatering (by which time main Nuclear Island dewatering has ceased) the average dewatering rate is calculated to be approximately 4l/s.

15.6.61 When considering groundwater impacts, it is very important to recognise the following in respect of the model results and their relation to actual conditions:

- The modelled behaviour is solely in response to the aquifer parameters adopted following calibration. Aquifer permeability, storage, recharge and horizontal/ vertical anisotropy are the principal factors in the response.
- In some areas, recharge may be less than that modelled due to presence of lower permeability made ground or Blue Lias mudstones at the surface. This is in addition to the low recharge zones already included for hardstanding areas on Hinkley Point A and B, and for the alluvium overlying the Blue Lias on Wick Moor. This issue is, however, less important for deep dewatering when any low permeability made ground or superficial deposits over the BDAW and BDAE will have been removed in production of the construction and development platforms and replaced with more permeable engineered backfill.

- The Blue Lias is present at outcrop on both sides of the Hinkley Point Fault. However, this gross geological continuity is almost certainly not matched by hydraulic continuity of the aquifers. Permeable limestone horizons will likely not be in continuity, except where different limestones have fortuitously been brought into contact. Also, in many locations the fault surface will have been smeared by clayey fault gouge. So although fracturing may have produced a permeable zone along the fault, this should be distinguished from its effect on restricting flow perpendicular to the fault. Moreover, east of the Hinkley Point Fault, a NE-SW anticline will tend to introduce greater anisotropy, facilitating flow parallel to its axis, and further restricting flow in the NW-SE direction.

15.6.62 With regard to the contaminant transport modelling, described in detail in **Appendix 15I**, identified sources of contamination at Hinkley Point A that might become environmental issues if mobilised and drawn during dewatering into the HPC site were first subjected to tiered risk assessment as per current UK best practice. This process eliminated sources that were already at concentrations below drinking water standards (DWS) or other appropriate EQSs, or were at a distance beyond the extent of the dewatering capture zone which reached partly into Hinkley Point A. Only four contaminants remained to be investigated after this initial screening, i.e. Sr-90, naphthalene, Hg and H-3.

15.6.63 The list of sources remaining was evaluated using a tiered assessment process, including the retardation of organic and metallic components. In the deterministic (best estimate) assessment, no failure of any contaminant (assessed as exceedences of relevant risk assessment screening criteria) was calculated at any of the receptors (i.e. the HPA/HPC site boundary or dewatering location).

15.6.64 For the more conservative Monte Carlo (statistical) assessments (**Appendix 15I**) it was concluded that:

- Sr-90, naphthalene and Hg do not present a risk of impact at any receptor location.
- H-3 due, to its unretarded nature, may present a potential risk at the HPA/HPC boundary from several of the Monte Carlo assessments.
- None of the contaminants (95th percentile) exceed the DWS or EQS at the dewatering location after four years (five years was also modelled to provide an additional conservative margin).
- No contaminants from Hinkley Point A would reach the dewatering abstraction during the dewatering period of up to five years, but there is a possibility that H-3 could cross the HPC boundary during that time, but only at the 95th percentile level of significance.
- Moreover, the above assessment, like the numerical groundwater model, assumes no additional conservative factors such as the presence of faults that in reality would reduce the propagation of the dewatering cone of depression and thereby also reduce the likelihood of movement of groundwater contaminants from Hinkley Point A which would also have to pass along the fault.

15.6.65 Following the initial contaminant transport modelling, the results of which were presented to the Environment Agency in July 2010, additional data became available and also subjected to review in case any further modelling was necessary. Three new potentially significant sources of contamination on Hinkley Point A were assessed:

- a source of hydrocarbon contamination from borehole G2B measured at 141 mg/l (on the basis of TPH banded solubilities, this could potentially be free phase hydrocarbon contamination);
- a source of free phase hydrocarbon contamination in borehole G40, i.e. not dissolved in the groundwater; and
- H-3 contamination in borehole G35 measured at 89.5Bq/l, which is below drinking the water standard.

15.6.66 The assessment concluded that on the basis of distance and/or concentration none of these additional sources altered the conclusions from the original assessment.

15.6.67 Contaminant transport modelling in GoldSim has shown that attenuation processes such as adsorption on clay minerals severely restrict the mobility of metals in the groundwater environment. Evaporite minerals are only found in low permeability formations, and their survival at all is a strong indication that they reside in a very low activity groundwater environment (see Section 15.5). Moreover, the discharge of salt mineral species into a marine environment is unlikely to be an environmental issue even if they were to be mobilised. In either case, these potential contaminants are not considered to present a significant source of concern.

15.6.68 The possibility of groundwater contamination in the BDAE which is as yet unidentified has been considered. If it occurs at all, it is likely to involve metals and/or hydrocarbons within Made Ground across the northern and north-eastern areas of the BDAE (see Section 15.5). Should any contamination be discovered, and not already removed with contaminated soil as part of managed removal operations, then the same retardation constraints on movement due to dewatering will prevail as discussed above. The management of any discharge of metals or hydrocarbons that potentially reach the dewatering abstraction points are addressed in **Chapter 16** of this volume. No radiological contamination of concern on BDAE has been identified. The concentration of H-3 near the Hinkley Point A boundary is lower than the limit set as the drinking water standard.

15.6.69 For the ISFS which is located closer to the HPC/HPA site boundary than the main Nuclear Island, it was determined in **Section 15.5** that it is highly unlikely that there are sources of groundwater contamination on the north-western part of the HPA site that would result in an exceedence of the adopted 100Bq/l limit with respect to tritium and thus pose a significant risk to human health during dewatering for this building.

15.6.70 It is possible to derive the following conclusions regarding environmental impacts, following the assessment methodology described in Section 15.4. These assessments are also summarised in **Table 15.18**.

Impacts to Controlled Waters (Groundwater Levels)

15.6.71 As described in **Section 15.5,** the dewatering activity will result in the drawdown of groundwater to create cones of depression. These drawdowns are assumed to reach a maximum of -25mAOD at the deep pumping station excavation abstraction points, and -12mAOD for the ISFS excavations which follow.

15.6.72 The cones of depression extend to the southern edge of the BDAW where further propagation is blocked by the upfaulted Mercia Mudstones inlier (as a result the Holford Stream in the SCPA is not affected), and partially across the area of Hinkley Point A. Neither Hinkley Point B nor Holford Stream across Wick Moor are affected – this is the case even without invoking the additional constraints on groundwater flow due to faulting as discussed in **Section 15.5** above where further conceptual discussion on the hydrogeological isolation of Wick Moor from the construction dewatering is presented. Holford Stream in Wick Moor is, moreover, assumed to be separated from the Blue Lias aquifer by low permeability marine and estuarine alluvium which provides a further 'barrier' to any impact on Holford Stream.

15.6.73 The impact on groundwater levels due to dewatering is both site-specific and local. The impact is adverse and direct because it occurs as a direct consequence of the dewatering activity.

15.6.74 The sensitivity of the groundwater environment is assessed as very low (**Table 15.17**). The groundwater body concerned is designated as a Secondary A Aquifer, and there is no current use of the resource at or adjacent to the HPC Development Site in the likely area of dewatering drawdown influence.

15.6.75 It is certain that the impact will occur in the Built Development Areas because the activity itself is the impact. It is likely that the dewatering cone of depression will extend beyond the Built Development Areas into adjacent land during the 4-5 year dewatering programme. The activity of dewatering is temporary but greater than two years. The impact is reversible because the drawdown recovers when abstraction stops.

15.6.76 Temporary and reversible impact on a Secondary A Aquifer results in a magnitude determination of low-medium. Groundwater levels may take more than two years to recover after the dewatering activity, but they are anticipated to recover without any additional action. On the basis of the very low sensitivity and low-medium magnitude the impact significance is assessed as **negligible** to **minor adverse** and no specific mitigation is considered to be necessary.

Impacts to Controlled Waters (Groundwater Quality)

15.6.77 The dewatering activity will cause the movement of groundwater in the cone of depression towards the abstraction point, i.e. the deep excavations. If the groundwater contains contaminants then the contaminants could also move.

15.6.78 The contaminant transport modelling (**Section 15.5**) indicates that contaminant movement into the BDAE or BDAW from Hinkley Point A will be minimal. Sources are either at concentrations below the DWS or EQS risk assessment criteria adopted, too distant, or metal and hydrocarbon contaminants are rapidly retarded by attenuation processes such that they do not migrate beyond the HPA/HPC boundary. It has been calculated using MODFLOW that the flow over the site boundary from HPA to HPC in layer 1 coincident with the extent of the H-3 plume is approximately $26m^3/d$ or 0.3l/s. This is approximately 2.5% of the whole dewatering extracted volume (12l/s) during main construction phase dewatering. Diluting the peak H-3 concentration from the aquifer adjacent to the main Nuclear Island from GoldSim of 7.7Bq/l down to 2.5% of the dewatered water gives a likely concentration of 0.19Bq/l of H-3 within discharged water, which is far below the standard limit of detection for laboratory analysis of 5Bq/l.

15.6.79 Potential for increase and/or mobilisation in existing baseline contaminants in the BDAE will be prevented by removal of the spoil mounds and any other soil "hot-spots" during the enabling works. Similarly, any new "hot-spots" which may be identified during the enabling works or subsequent site preparation works will also be removed. It is unlikely that any remaining groundwater contaminants (potentially metals or hydrocarbons) will be of sufficient concentration or mobility to arrive at the abstraction points at concentrations of concern. The assessment of this potential impact to controlled waters beyond the abstraction, i.e. at discharge to the Bristol Channel, is addressed in **Chapter 16** of this volume.

15.6.80 Whilst there is saline groundwater at depth beneath the HPC Development Site (different origin to saline water in the Bristol Channel), this is not considered sufficiently mobile, or if mobile, to be of environmental concern should it be encountered (see Section 15.5).

15.6.81 Sensitivity of the aquifer with respect to groundwater quality is assessed as low (**Table 15.17)**. The groundwater body concerned is designated as a Secondary A Aquifer, although there is no current use of the resource at or adjacent to the HPC Development Site in the likely area of dewatering drawdown influence.

15.6.82 It is possible that the impact will occur. The activity of dewatering is temporary but greater than two years; however the groundwater flow does not reverse when abstraction stops, it just reverts to its pre-abstraction condition. Therefore any mobile contaminants which have migrated towards the abstractions during dewatering (such as H-3) will revert to moving towards the coast. In both cases they will eventually discharge at some point offshore via vertical fractures through the Blue Lias aquifer beneath the bed of the Bristol Channel, which is the current baseline condition. However, H-3 concentrations on the HPC Development Site are unlikely to breach UK DWS during construction dewatering for either the main Nuclear Island or ISFS.

15.6.83 Permanent and irreversible impact could only occur if mobile contaminated groundwater is present initially on the HPC Development Site. This would potentially result in a magnitude assessment of low-medium. On the basis of the low sensitivity and low-medium magnitude the impact significance is assessed as **minor adverse**.

15.6.84 In any event, no contaminant concentrations are increased by dewatering, they can only migrate and be subjected to dilution and attenuation.

Impacts to Controlled Waters (Saline Intrusion)

15.6.85 Because the dewatering abstraction points are close to the shoreline, there is a potential for saline intrusion to occur during the dewatering programme.

15.6.86 The principal 'barriers' to saline intrusion are the lithological and structural characteristics of the Blue Lias aquifer. The Blue Lias is dipping northwards, so any movement of seawater from the north will have to pass through the formation across the 'grain' of its mudstone and limestone layering. In this direction, permeability is very low due to the predominance of mudstone over limestone and the absence of vertical persistent joints that would facilitate such flow. Vertical permeability has been estimated as being only 1/800th of horizontal permeability.

15.6.87 Sensitivity of the aquifer with respect to groundwater quality is assessed as low (**Table 15.17**). The groundwater body concerned is designated as a Secondary A

Aquifer, although there is no current use of the resource at or adjacent to the site in the likely area of dewatering drawdown influence.

15.6.88 It is possible that the impact will occur. The activity of dewatering is temporary, but greater than two years, however the groundwater flow will reverse to its baseline condition when abstraction stops. Therefore any saline intrusion will begin to reverse after dewatering. Furthermore, saline intrusion should not occur further south than the deep pumping station excavations, which are the closest part of the abstraction to the shoreline.

15.6.89 Any seawater component contributing to the dewatering abstraction will be discharged back to the sea, so no further impacts with respect to discharge to controlled waters need to be considered. In relation to Holford Stream and Wick Moor, further conceptual discussion on the hydrogeological isolation of Wick Moor from the construction dewatering at HPC is presented in Section 15.5. Any saline intrusion that does occur will be confined to the immediate vicinity of the EPR units. There is no dewatering activity that will invoke saline intrusion in Holford Stream or Wick Moor, nor is there any secondary risk from recharge of pumped water since the discharge will be to the sea.

15.6.90 Long-term impact could only occur if any saline intrusion is delayed from recovery after dewatering by the flow rate of the natural groundwater regime. This would potentially result in a magnitude assessment of low-medium, although the extent of aquifer so affected will be small, at most as far as the deep pumping station excavations. On the basis of the low sensitivity and low-medium magnitude the impact significance is assessed as **minor adverse**.

Impacts to controlled waters (other groundwater abstractions)

15.6.91 In theory dewatering could impact the water levels and yields of any abstractions in the cone of depression of the dewatering.

15.6.92 The only licensed abstractions in the study area are to the south of the BDAW/BDAE and outside the SCPA.

15.6.93 Sensitivity is assessed as very low. The nearest licensed abstractions are outside the likely dewatering cone of depression and any changes in groundwater level would be likely to be no more than the seasonal changes already experienced naturally.

15.6.94 The impact is assessed as very unlikely because the licensed abstractions are distant from the dewatering and separated hydrogeologically by the upfaulted impermeable Mercia Mudstones barrier between the BDAW/BDAE and the SCPA. The activity of dewatering is temporary but greater than two years, and the impact is also temporary if it occurs. The impact is also reversible because of the temporary nature of the dewatering activity and the reverting of the groundwater regime to its pre-dewatering configuration subsequently.

15.6.95 Magnitude is assessed as very low, since any changes are unlikely to be anything more than barely discernible (or none at all) over a short period. On the basis of the very low sensitivity and very low magnitude the impact significance is assessed as **negligible**.

Impacts to buildings and infrastructure

15.6.96 If groundwater gradients under a structure increase substantially it is possible that stresses can be generated due to the differential hydrostatic pressures under the structures and potentially cause damage to the foundations due to differential settlement.

15.6.97 The impact could affect buildings with foundations or subsurface structures under the Hinkley Point A site. This impact should it occur would be an indirect consequence of the proposed dewatering.

15.6.98 Sensitivity is assessed as low, because major structures will have deep foundations and will therefore be tolerant to any changes. Moreover, increase of settlement due to drawdown of groundwater is assumed to be low. Such differential stresses are not significant taking the ground conditions into account.

15.6.99 Modelling suggests that groundwater level changes under buildings on adjacent HPA land due to dewatering will not be substantially different to those which occur already in the current baseline groundwater regime. Likelihood is therefore assessed as unlikely. The activity of dewatering is temporary but greater than two years, but the impact could be permanent and irreversible if it occurs.

15.6.100 Magnitude is assessed as very low since barely discernible (or no) changes would occur over a short period. On the basis of the low sensitivity and very low magnitude the impact significance is assessed as **negligible**.

vii.Cumulative Construction Impacts

15.6.101 There are no cumulative construction impacts to groundwater. Each of the construction activities detailed above in **Section 15.6** is spatially or temporally discrete and will therefore not act together to form a set of cumulative impacts.

viii. Dismantling of Temporary Jetty

15.6.102 After the operational life of the temporary aggregates jetty (following main construction), it would be dismantled and the site restored. This would involve dismantling/removal of all added features such as fences, areas of hardstanding, temporary drainage and the service road to return to the baseline environment as far as practicable. The groundwater regime would return to its previous state passively.

15.6.103 These works would involve the use of similar machinery and plant to the construction phase. Accordingly, it is anticipated these actions would result in similar impacts with respect to groundwater levels and recharge to those described for jetty construction. This impact would therefore remain as **negligible**.

d) Operational Phase Impacts

15.6.104 Once the sub-water table buildings are in place and the site is operational the baseline groundwater regime will be altered. Portions of the baseline aquifer system will be replaced by effectively impermeable blocks which will possibly result in localised rises in the groundwater level on the upgradient side, drops in groundwater level on the downgradient side, and consequent changes to localised groundwater flow directions.

15.6.105 Permanent site drainage will include deep drains running south-north, at a level which would drain groundwater local to the sea wall to that level and intercept future groundwater flows. These drains are currently proposed to discharge to the upper shore at an invert level of 7.5mAOD. Also to be constructed is a passive peripheral drain at 8mAOD around the site to control groundwater levels during the operational phase of HPC. Groundwater collected will be discharged to sea via the cooling water outfall.

15.6.106 Operational impacts related to groundwater include:

- change in the groundwater flow regime due to placement of new building foundations, resulting in a rise in groundwater levels;
- change in local recharge to groundwater;
- change in the distribution of offsite contaminated groundwater due to the altered groundwater flow regime; and
- longer term intrusion of sea water due to the altered groundwater flow regime.

15.6.107 Post-construction, the HPC Development Site platform level will be at 14mAOD, overlying several metres of engineered fill which will have been used as backfill around deep foundations and sub-surface structures.

15.6.108 During construction, a major proportion of the shallow Blue Lias formation across the development platform will be removed, along with any confining layers which may have restricted groundwater movement.

15.6.109 During the construction phase a passive groundwater control system will be installed around the south and western edges of the main nuclear and conventional islands and cooling water infrastructure. The drainage system will have an invert level of approximately 8mAOD. This drainage system is designed to intercept shallow groundwater and limit groundwater levels within the main Nuclear Island, conventional Island and pumping station area, i.e. in the area surrounded by the drainage gallery, to a maximum of 8m to 9.5mAOD throughout the operational life of the power station. South of the gallery, the effect of the drainage gallery is anticipated to be less important. The system provides for the required degree of geotechnical safety. In particular, it has been designed to prevent the potential flotation of built structures due to upward groundwater pressure. This drainage system is critical to the safe operation of the HPC site and thus forms part of the required nuclear site safety case. As a result the drainage system will be inspected and maintained on a regular basis to ensure its integrity during power station operation.

15.6.110 Furthermore, during the operational phase there will be less groundwater recharge within the HPC Development Site due to presence of roads, buildings and hardstanding. Thus as the construction dewatering scenario shows no adverse impacts, it is extremely unlikely that the passive drainage system will cause any adverse impacts upon groundwater behaviour due to the higher groundwater levels that will be maintained.

15.6.111 The largest potential impact from the operational groundwater drainage system will be to exert control over the seasonal variation in groundwater levels (approximately 4m) by limiting the winter peak groundwater levels to 8mAOD. Groundwater levels in the summer under baseline conditions are of the order of 8mAOD and are unlikely to be significantly affected.

Impacts on Controlled Waters (Groundwater Levels)

15.6.112 New impermeable sub-water table structures could cause a rise in groundwater level on their up-gradient side. Groundwater levels are controlled at 8 mAOD by the passive groundwater control system as described above.

15.6.113 The scale is site specific (within the BDAW and BDAE only). The impact is direct because it occurs as a direct consequence of the proposed operational groundwater level control system.

15.6.114 Sensitivity is assessed as very low (**Table 15.17**), since the resource is a Secondary A Aquifer and will not be used in the Built Development Areas. The groundwater resource is not a major local feature and is tolerant to groundwater level changes. Any changes will be offset by reduced recharge (due to impermeable surface features such as roads, buildings and hardstanding) and ultimately managed by the groundwater control system.

15.6.115 Some change will occur because impermeable structures are replacing parts of the permeable aquifer. The placement of the structures below the water table and therefore the impact that results is permanent and irreversible. The likelihood is certain.

15.6.116 Magnitude is assessed as low, due to a noticeable but insignificant permanent change within the existing natural range of variation. On the basis of the very low sensitivity and low magnitude the impact significance is assessed as **negligible**.

Sea Water Intrusion

15.6.117 The likely overall continuity of an operational phase groundwater regime that is little changed from the baseline is not expected to result in any changes to the existing limited sea water intrusion. The principal 'barriers' to saline intrusion are the lithological and structural characteristics of the Blue Lias aquifer. As described in Section 15.5, the Blue Lias is dipping northwards, so any potential movement of sea water from the north will have to pass through the formation across the 'grain' of its mudstone and limestone layering. In this direction, permeability is very low due to the predominance of mudstone over limestone and the absence of vertical persistent joints that would facilitate such flow. Vertical permeability has been estimated as being only 1/800th of horizontal permeability.

15.6.118 Impact would be site-specific, confined to the BDAW and BDAE only. The impact would be direct as it occurs as a direct consequence of the proposed development. Changes in groundwater gradients and flow rates are not likely to be outside existing baseline ranges. Sensitivity is therefore assessed as low.

15.6.119 Likelihood is assessed as unlikely. Magnitude is assessed as very low, with barely discernible changes over a small area. On the basis of the low sensitivity and very low magnitude the impact significance is assessed as **negligible**.

Contaminated Groundwater

15.6.120 The operational phase groundwater regime is not expected to significantly change the baseline distribution of any contaminated groundwater. The risk of contamination from surface activities (leakages of fuel, hydraulic fluids, etc.) reaching groundwater will be managed by the EMMP protocols identified in the operational environmental permit and subject-specific management plans, surface water drainage systems and interceptors.

15.6.121 The scale would be local, within the BDAW and BDAE. It is assessed as direct because it occurs as a direct consequence of the proposed development.

15.6.122 Sensitivity is assessed as low. The groundwater body concerned is designated as a Secondary A Aquifer (**Table 15.17**), although there is no current or likely future use of the resource at or adjacent to the HPC Development Site.

15.6.123 Likelihood is assessed as possible. Some change may occur if contaminated groundwater is present because impermeable structures are replacing parts of the permeable aquifer.

15.6.124 Magnitude is assessed as low, with barely discernible changes over a small area. On the basis of the low sensitivity and low magnitude the impact significance is assessed as **minor adverse**.

i. Cumulative Operational Impacts

15.6.125 There are no cumulative operational phase impacts to groundwater as negligible impact significance has been predicted with respect to changes in groundwater levels and saline intrusion with only minor adverse significance applying to one potential source of impact (contaminated groundwater).

15.7 Mitigation of Impacts

15.7.1 There are no impacts assessed in this chapter that result in a significance other than negligible or minor adverse. Therefore, no specific mitigation measures are required. This applies to both the construction (including site preparation and temporary jetty) and operation of HPC.

15.7.2 Since most existing monitoring boreholes will be destroyed during construction, it is intended to install additional groundwater boreholes on the HPC/HPA boundary and to the south-east towards Wick Moor, in order to confirm that significant contaminant migration from HPA site does not occur during the construction phase dewatering. The monitoring will also provide data regarding the extent and magnitude of the dewatering drawdown and is intended to allow confirmation of the predicted impact upon groundwater behaviour particularly in the Wick Moor area.

15.8 Residual Impacts

15.8.1 As there has been no specific mitigation the residual impacts remain the same as the impacts already assessed.

15.9 Summary of Impacts

15.9.1 **Table 15.18** contains a summary of all potential groundwater impacts.

Table 15.18: Overall Summary of Impacts

Project Activity	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation/ Bes Practices	Residual Impact
Impacts during Preliminary Works, Main Construction Works and Operation								
All	Groundwater	Impact on groundwater quality due to accidental contamination from mechanised plant	Low	Local, indirect, adverse, possible, reversible, temporary	Low	Minor	No mitigation required	Minor
Hardstanding Areas	Groundwater	Impact on groundwater recharge and levels in hardstanding areas due to diversion of run-off into site drainage system	Very low	Local, direct, adverse, possible, reversible, temporary	Very low	Negligible	No mitigation required	Negligible
Impacts during Preliminary Works								
Site Clearance – vegetation removal	Groundwater	Impact on groundwater recharge and levels in hardstanding areas due to diversion of run-off into site drainage system The vegetation removal activity would cause a slight reduction in overall evapotranspiration and consequently a slight increase in groundwater recharge and hence groundwater levels in aquifer outcrop areas.	Very low	Local, direct, adverse, likely, reversible, temporary	Very low	Negligible	No mitigation required	Negligible

Project Activity	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation/ Bes Practices	Residual Impact
Ground Preparation – stripped areas	Groundwater	Impact on groundwater recharge and levels, source and platform areas In source areas where material is stripped there could be some minor but possibly indiscernible impact on groundwater recharge and levels as recharge is enhanced due to the removal of soil moisture retention characteristics or levels reduced by drainage in platform areas.	Very low to low	Local, direct, adverse, likely, reversible, temporary	Very low	Negligible	No mitigation required	Negligible
Ground Preparation – material stockpiling	Groundwater	Impact on groundwater recharge and levels, stockpile areas Stockpiling may result in a reduction in direct recharge to the stockpile footprint in areas where the Lower Lias aquifer outcrops. This results from the enhanced run-off from the stockpile slope faces.	Very low to low	Local, indirect, adverse, unlikely, reversible, temporary	Very low	Negligible	No mitigation required	Negligible
Ground Preparation – topsoil stripping and stockpiling	Groundwater	Impact on aquifer properties (reduced permeability and storage) due to compression exerted by the stockpile mass. Local modification of groundwater flow regime.	Very low	Local, direct, adverse, very unlikely, irreversible, permanent	Very low	Negligible	No mitigation required	Negligible

Project Activity	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation/ Bes Practices	Residual Impact
Site levelling/ terracing	Groundwater	Impact from stripped areas on groundwater levels. In some source areas where material would be stripped, notably in the Built Development Area West, the existing groundwater levels are higher than the final platform elevations. These levels would be reduced prior to excavation by the provision of drains to undertake shallow passive (gravity) dewatering, and so the existing groundwater regime would be impacted by having the water table lowered by up to 6m to the level of the drainage inverts at around 9-10m AOD.	Low	Local, direct, adverse, likely, reversible, temporary	Very low	Negligible	No mitigation required	Negligible
Site levelling/ terracing	Groundwater	Impact on groundwater recharge and levels, stockpile areas Topsoil stockpiling may result in a reduction in direct recharge to the stockpile footprint in areas where the Lower Lias aquifer outcrops. This results from the enhanced run-off from the stockpile slope faces.	Very low	Local, indirect, adverse, unlikely, reversible, temporary	Very low	Negligible	No mitigation required	Negligible
Stockpile and Aggregates storage areas	Groundwater	Impact on aquifer properties (reduced hydraulic conductivity and storage) due to the compression exerted by the materials mass locally modifying the subsequent groundwater flow regime.	Very Low	Local, indirect, adverse, very unlikely, irreversible, permanent	Very low	Negligible	N/A	Negligible

Project Activity	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation/ Bes Practices	Residual Impact
Drainage and dewatering	Groundwater	Impact on groundwater levels due to drainage and dewatering in UK EPR reactor unit areas	Low	Local, direct, adverse, certain, reversible, temporary	Very low	Negligible	No mitigation required but a groundwater monitoring programme will be instigated as part of the EMMP	Negligible
Retaining wall	Groundwater	Impact on groundwater levels	Very low	Local, direct, adverse, possible, reversible, temporary	Very low	Negligible	No mitigation required	Negligible

Project Activity	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation/ Bes Practices	Residual Impact
Impacts During Main Construction Phase (Including ISFS Construction)								
Construction dewatering	Groundwater	Impact on controlled waters (groundwater levels) The dewatering activity will cause the drawdown of groundwater to create cones of depression. For the main Nuclear Island, this drawdown is assumed to reach a maximum of 29m below platform level, i.e. to -15 to -19mAOD, assumed to represent about 30-40m total drawdown in practice. For the ISFS this drawdown is assumed to reach a level of -12mAOD.	Low-medium	Site specific/local, direct, adverse, certain, reversible, temporary	Very Low	Negligible-Minor	N/A	Negligible-Minor
Construction dewatering	Groundwater	Impact on controlled waters (groundwater quality) The dewatering activity will cause the movement of groundwater in the cones of depression towards the abstraction points, i.e. the deep excavations. If the groundwater contains contaminants then the contaminants will also move.	Low-medium	Site specific/local, direct, adverse, possible, irreversible, permanent	Low	Minor	N/A	Minor

Project Activity	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation/ Bes Practices	Residual Impact
Construction dewatering	Groundwater	Impact on controlled waters (saline intrusion). Dewatering activity could result in some saline intrusion as far as the deep pumping station excavations and ISFS, but limited by lithology and structure of Blue Lias.	Low-medium	Site specific, direct, adverse, possible, irreversible, permanent	Low	Minor	N/A	Minor
Construction dewatering	Groundwater	Impact on controlled waters (other groundwater abstractions) Dewatering could impact the water levels and yields of any licensed abstractions in the area of influence.	Very low	Local, direct, adverse, very unlikely, reversible, temporary	Very low	Negligible	N/A	Negligible
Construction dewatering	Groundwater	Impact on buildings and infrastructure If groundwater gradients under a structure increase significantly it is possible that stresses can be generated due to the differential hydrostatic pressures under the structures and potentially cause damage to the foundations due to differential settlement.	Very low	Local, indirect, adverse, unlikely, irreversible, permanent	low	Negligible	N/A	Negligible
Impacts during Jetty Dismantling and Restoration								
Removal of constructed features	Groundwater	Same impacts as described for construction phase.				Negligible to Minor		Negligible to Minor

Project Activity	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation/ Bes Practices	Residual Impact
Impacts during the Operational Phase								
Built sub-water table buildings and structures	Groundwater	Impact on controlled waters (groundwater levels) New impermeable sub-water table structures could potentially cause a rise in groundwater level on their up-gradient side. Offset by reduced recharge and surface drainage system, managed by passive groundwater control system.	Low	Site specific, direct, adverse, certain irreversible, permanent	Very low	Negligible	N/A	Negligible
Built sub-water table buildings and structures	Groundwater	Impact on controlled waters (sea water intrusion) If the baseline groundwater regime is significantly changed, or specifically if the groundwater flux is reduced so that sea water intrusion is facilitated, then sea water could potentially penetrate further inland than it does at present.	Very low	Site specific, direct, adverse, unlikely irreversible, permanent	Low	Negligible	N/A.	Negligible
Built sub-water table buildings and structures	Groundwater	Impact on controlled waters (groundwater quality) Change in the natural groundwater regime resulting in movement and redistribution of contaminated groundwater Possible leakage of contaminants from surface.	Low	Site specific, direct, adverse, possible, irreversible, permanent	Low	Minor	N/A	Minor

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CHAPTER 16: SURFACE WATER

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16. SURFACE WATER

16.1 Introduction

16.1.1 This chapter provides an assessment of the potential impacts to the terrestrial surface water environment associated with the construction, operational and land restoration phases of the Hinkley Point C (HPC) development site. Consideration of the current baseline conditions and the potential changes to the hydrological and drainage regime and the water quality status of watercourses within the locality of the HPC development site are presented. Impacts resulting from the potential changes to baseline conditions during the construction, operational and restoration phases identified. Where required, mitigation measures are identified to prevent, reduce and, where possible off-set any potential adverse impacts that are identified to be of significance.

16.1.2 This chapter also assesses the potential impacts that the HPC development will have on the flood regime at the HPC development site and in the surrounding area, during the construction and operational phases. The chapter draws on detailed information and data pertaining to the flood impacts associated with the development of HPC which are to be found in a separate **Flood Risk Assessment (FRA)**.

16.1.3 The **Flood Risk Assessment** has been prepared in accordance with Planning Policy Statement 25: Development and Flood Risk (PPS25) (Ref. 16.1). The **Flood Risk Assessment** considered a number of fluvial, tidal and combined fluvial/tidal/wave overtopping risk scenarios including the anticipated effects of climate changee and sea level rise over the construction and operational phases of the HPC development site. Potential impacts identified through the **Flood Risk Assessment** have been identified in this chapter.

16.2 Scope and Objectives

16.2.1 The scope of the surface water assessment has been determined through specific consultations with statutory consultees and through the Stage 1, Stage 2 and Stage 2 Update consultation processes located elsewhere in the ES.

16.2.2 The assessment of surface water impacts arising from the HPC development site have been undertaken adopting the methodologies described in Section 16.3 of this chapter. This assessment addresses only surface water issues associated with the HPC development. An assessment of potential groundwater impacts is presented in **Chapter 15** and for marine water quality impacts in **Chapter 18**.

16.2.3 The surface water assessment may be divided into two technical areas (hydrology and drainage, and surface water quality), which have merited separate yet complimentary studies. The scope of these two studies is discussed below.

a) Hydrology and Drainage Assessment Scope

16.2.4 The current baseline conditions and the potential changes to the hydrological and drainage regime in the vicinity of the HPC development site have been determined through site walkovers, channel surveys of the local surface water drainage system and through predictive modelling techniques. Baseline conditions and identified existing and future hydrology and drainage receptors are described in Section 16.5. The study area for the hydrology and drainage assessment, as illustrated in **Figure 16.1**, comprises all watercourses (and their associated catchments) that may be affected by the HPC development together with the intertidal area to the north of the HPC development site.

16.2.5 Section 16.6 assesses the potential changes to the baseline hydrology and drainage receptors, which include:

- downstream, on-site, and adjacent watercourses, such as, Hinkley Point C Drainage Ditch (HPC Drainage Ditch), Holford Stream, Bum Brook, West Brook and East Brook, Stogursey Brook, Bayley's Brook, and the watercourses feeding Wick Moor, which lie to the east of the C182, defined as Viewed Rhynes by the Somerset Drainage Board Consortium;
- the intertidal area adjacent to the HPC development site; and
- land adjacent to the HPC development site.

b) Water Quality Assessment Scope

16.2.6 Characterisation of current water quality conditions within the local terrestrial surface waters of relevance to the HPC development site was undertaken in order to establish a baseline against which future potential impacts may be assessed. To define the baseline conditions, a series of terrestrial water monitoring campaigns was undertaken in 2009. Baseline conditions and identified existing and future water quality receptors are described in **Section 16.5.97**. The study area for the water quality assessment includes those surface watercourses within, adjacent to and downstream of the proposed HPC development site, as illustrated in **Figure 16.1**. Section 16.6 assesses the potential changes to the baseline water quality receptors which include:

- HPC Drainage Ditch;
- Holford Stream; and
- Bum Brook.

16.2.7 There is a close relationship between the assessment presented within this chapter and **Chapter 18, Marine Water** and **Sediment Quality**. All potential marine water quality impacts are described and assessed within **Chapter 18**.

16.2.8 In addition to the studies identified above, a number of potential accidents and incidents that may result in surface water-related impacts are assessed.

c) Surface Water Assessment and Objectives

16.2.9 The objectives of this surface water assessment are:

- to identify all surface water receptors within the study area that may be affected by changes to terrestrial water quality or hydrology and drainage, during all phases of the HPC development;
- to characterise the baseline and future baseline surface water characteristics for the study area, including water quality status, watercourse hydraulic characteristics, surface water run-off characteristics and flood risk;

- to assess the impacts from all phases of the HPC development on the identified water quality and hydrology, drainage and flood risk receptors;
- to recommend mitigation measures, if determined necessary, to reduce the impacts on those surface water receptors; and
- to assess the residual impacts of all phases of the HPC development on those identified surface water receptors.

16.2.10 Appropriate mitigation measures aimed at preventing, reducing or off-setting any potential adverse impacts of the HPC development on surface waters that are identified to be of significance are presented in Section 16.7. The assessment of residual impacts following implementation of the mitigation measures is presented in Section 16.8. An assessment of cumulative impacts resulting from the HPC and other planned or reasonably foreseeable projects is provided in **Volume 11** of this ES.

16.3 Legislation, Policy and Guidance

16.3.1 This section identifies and describes legislation, policy and guidance of relevance to the assessment of impacts upon the surface water environment.

16.3.2 As stated in **Volume 1**, **Chapter 4**, the Overarching National Policy Statement (NPS) for Energy (NPS EN-1) when combined with the NPS for Nuclear Power Generation (NPS EN-6) provides the primary basis for decisions by the IPC on applications for nuclear power generation developments that fall within the scope of the NPSs.

16.3.3 Notwithstanding this, the IPC may consider other matters that are both important and relevant to its decision-making. This could include Planning Policy Statements (PPSs), Planning Policy Guidance Notes (PPGs), regional and local policy documents, although, if there is a conflict between these and the NPS, the NPS prevails for the purposes of IPC decision making.

16.3.4 Further, the Planning Act 2008 provides that the IPC must, in making its decision on an application, have regard to any Local Impact Report (LIR) prepared by relevant local authorities. It is anticipated that the LIRs will rely in part on PPSs, PPGs, regional and local policy to provide a context for their assessment. On this basis, regard has been given to these documents (where relevant to the technical assessment) since they are likely to inform the LIRs prepared by the relevant local authorities.

a) International

16.3.5 The scope of the assessment is not affected by international legislation beyond that within the European Union (EU).

16.3.6 Many of the standards and methodologies relating to surface waters are regulated at EU level through a range of environmental directives. The most relevant of these with respect to hydrology and drainage flood risk, and water quality and to the proposed development are the:

- Water Framework Directive (WFD) (2000/60/EC) (Ref. 16.2) (which largely supersedes the Dangerous Substances Directive ((76/464/EEC) (Ref. 16.3));

- Habitats Directive (92/43/EEC) (Ref. 16.4);
- Fish Directive (2006/44/EC) (Ref. 16.5); and
- Floods Directive (2007/60/EC) (Ref. 16.6).

i. Water Framework Directive (Ref. 16.8)

16.3.7 The WFD is a key piece of legislation relating to the protection of water quality and the ecological status of freshwaters and coastal waters.

16.3.8 The WFD provides a mechanism by which disparate regulatory controls on human activities that have the potential to impact on water quality may be managed effectively and consistently. In addition to a range of inland surface waters and groundwater, the WFD covers transitional waters (estuaries and lagoons) and coastal waters up to one nautical mile from mean low water (baseline from which territorial waters are measured). Existing regulations that will eventually be subsumed by the WFD include the Freshwater Fish Directive (78/659/EEC as consolidated in 2006) (Ref. 16.8 and Ref. 16.7) and the Dangerous Substances Directive (76/464/EEC) (Ref. 16.3). The WFD is implemented in England and Wales primarily through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (the Water Framework Regulations) (Ref. 16.8).

16.3.9 UK surface waters have been divided into a number of discrete units termed ‘water bodies’, with meaningful typologies that relate to their physical and ecological characteristics. Based upon ecology and water quality, these water bodies have been classified as falling into different status classes. The WFD requires that all inland and coastal waters must reach at least ‘good’ status by 2015 and that the status of all surface water bodies should not deteriorate. Individual water bodies that have been modified by man to the extent that it will not be possible for them to meet the WFD targets are categorised as Heavily Modified Water Bodies.

16.3.10 Implementation of the WFD is primarily achieved through a system of river basin management planning. The water bodies of England and Wales have been allocated to river basin areas depending on catchment areas and a management plan has been drawn up for each. The plans contain a programme of measures tailored to each catchment and designed to ensure the constituent water bodies achieve and maintain the appropriate status in accordance with the timelines set out in the WFD.

16.3.11 As part of the ongoing implementation of the WFD, the Environment Agency has recently been given the power to apply environmental standards to individually defined WFD water bodies via the ‘River Basin Districts Typology, Standards and Groundwater Threshold Values’ (Water Framework Directive) (England and Wales) Directions 2010 (Ref. 16.9), and the ‘River Basin Districts Surface Water and Groundwater Classification’ (Water Framework Directive) (England and Wales) Direction 2009) (Ref. 16.10).

ii. Dangerous Substances Directive (76/464/EEC) (Ref. 16.3)

16.3.12 The Dangerous Substances Directive (76/464/EEC) (Ref. 16.3) is implemented through the Surface Waters (Dangerous Substances) (Classification) Regulations 1997 (Ref. 16.11) and 1998 (Ref. 16.12). It sets Environmental Quality Standards (EQS) for a range of substances in water. The regulation of ‘Priority Substances’ under the WFD effectively supersedes many of these standards, although standards for some substances remain in force. The 2010 Directions referred to above complete the transposition of the Priority Substances Directive (Ref. 16.13).

16.3.13 The Dangerous Substances Directive and its 'daughter' directives are concerned with controlling the level of discharges that may contain dangerous substances and which may reach inland, coastal and territorial waters. List I substances – Black List, covers substances that are regarded as particularly toxic and persistent and which may accumulate in the environment. Pollution by these substances must be eliminated. List II substances – Grey List, cover substances whose effects are less serious but still toxic. Pollution by Grey List substances should be reduced wherever possible.

iii. Fish Directive (Ref. 16.5)

16.3.14 The Fish Directive (Ref. 16.5) is concerned with protecting and improving the quality of rivers and lakes to encourage self sustaining healthy fish populations. It sets out physical and chemical water quality objectives, and monitoring requirements for designated areas.

16.3.15 The Directive was originally adopted in 1978 and was consolidated in 2006. It will be repealed in 2013 by the WFD (Ref. 16.2).

iv. The Floods Directive 2007 (Ref. 16.6)

16.3.16 The Floods Directive (2007/60/EC) (Ref. 16.6) requires all Member States to determine if watercourses and coastlines are at flood risk, to map flood extent and assets and people at risk from flood, and to take appropriate measures to reduce the flood risk. Delivery of the Floods Directive is coordinated with the Water Framework Directive (Ref. 16.8) through flood risk management plans and river basin management plans. The Floods Directive is transposed into domestic law via the Flood Risk Regulations 2009 (Ref. 16.14).

b) National Legislation

16.3.17 The key pieces of national legislation relevant to the control and mitigation of risks to the surface water environment are:

- Environment Act 1995 (Ref. 16.15);
- Environmental Protection Act 1990 (Ref. 16.16);
- Environmental Permitting (England and Wales) Regulations 2010 (EPR) (Ref. 16.17);
- Water Resources Act 1991 (Ref. 16.18);
- Surface Waters (Dangerous Substances) (Classifications) Regulations 1997 (Ref. 16.11) and 1998 (Ref. 16.12);
- Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (the Water Framework Regulations) (Ref. 16.8);
- River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010 (Ref. 16.9);
- River Basin Districts Surface Water and Groundwater Classification (Water Framework Directive) (England and Wales) Direction 2009 (Ref. 16.10);

- Land Drainage Act 1991 (Ref. 16.19);
- Flood Risk Regulations 2009 (Ref. 16.14); and
- Flood and Water Management Act 2010 (Ref. 16.20).

i. **Environment Act 1995** (Ref. 16.15)

16.3.18 This Act established basic terms of reference for the Environment Agency. The Act provides the Environment Agency with a duty to take action as it considers necessary to conserve, enhance and secure the proper use of water resources in England and Wales. In respect of land drainage and flood defence functions, the Act places a duty on the Environment Agency with respect to the conservation of natural beauty and sustainable development.

ii. **Environmental Protection Act (EPA) 1990** (Ref. 16.16)

16.3.19 Part IIA of the Environmental Protection Act 1990 describes a regulatory role for Local Authorities in dealing with contaminated land, including assessment for any resulting pollution of controlled waters.

iii. **Environmental Permitting (England and Wales) Regulations 2010** (Ref. 16.17)

16.3.20 The Environmental Permitting Regulations 2010 (Ref 16.17) provide a consolidated system for environmental permits and exemptions for activities which include discharges to surface waters. It also sets out the powers, functions and duties of the regulators. The Environmental Permitting Regulations repeal parts of the Water Resources Act, 1991 (Ref. 16.18).

iv. **Water Resources Act 1991** (Ref. 16.18)

16.3.21 The Water Resources Act 1991 (Ref 16.18) (as amended by the Water Act, 2003 (Ref. 16.21) sets out the regulatory controls and restrictions that provide protection to the water environment through controls on abstraction, impounding and discharges as well as identifying water quality and drought provisions. This Act set the framework for surface water management over the past two decades in the UK, but elements of the Water Resources Act have now been superseded by the Environmental Permitting (England and Wales) Regulations 2010 (Ref. 16.17).

v. **Surface Waters (Dangerous Substances) (Classifications) Regulations 1997** (Ref. 16.11) **and 1998** (Ref. 16.12)

16.3.22 These Regulations prescribe a system for classifying the quality of inland freshwaters, coastal waters and relevant territorial waters with a view to reducing the pollution of those waters by dangerous substances (as defined by the Dangerous Substances Directive (Ref. 16.12). The Environment Agency is required by the Regulations to monitor the effect of discharges containing dangerous substances.

vi. **Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (the Water Framework Regulations)** (Ref. 16.8)

16.3.23 These Regulations make provision for the purpose of implementing the WFD (Ref. 16.8). The Environment Agency is required to carry out detailed monitoring and analysis in relation to each river basin district. The results of the Agency's technical work, the environmental objectives and proposals for programmes of measures are brought together in a River Basin Management Plan (RBMP) for each river basin district. The South West RBMP covers the study area for the surface water assessment (see paragraph 16.3.49 below).

vii. River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010 (Ref. 16.9)

16.3.24 These Directions detail the standards used to classify types of watercourses, stillwaters and presents the WFD Environmental Quality Standards (EQS) for surface and groundwaters in England and Wales.

viii. River Basin Districts Surface Water and Groundwater Classification (Water Framework Directive) (England and Wales) Direction 2009 (Ref. 16.10)

16.3.25 These Directions details the criteria that are used for the classification of surface and groundwaters in England and Wales for the purpose of the Water Framework Directive.

ix. Land Drainage Act 1991 (Ref. 16.19)

16.3.26 This Act consolidates enactments relating to Internal Drainage Boards and the functions of these boards and of Local Authorities in relation to land drainage. Internal Drainage Boards (IDB) exercise general supervision and perform powers relating to the drainage of land within their district.

16.3.27 Sections 23 – 27 of the Act address the requirements associated with obstructing flow in watercourses and culverting watercourses. Internal Drainage Board powers to serve notice on persons with respect to remedying the condition of watercourses are outlined in Section 25. Sections 28 to 31 are also of relevance to hydrology and drainage as they outline the requirements for the restoration and improvement of ditches.

x. Flood Risk Regulations (2009) (Ref. 16.14)

16.3.28 The Flood Risk Regulations 2009 (Ref. 16.14) transposes the EC Floods Directive (Ref. 16.6) into domestic law and implement its provisions. The Flood Risk Regulations (2009) do not impact on the private sector. The impact is on the public sector, in particular Local Authorities, and the Environment Agency, which are required to prepare preliminary **Flood Risk Assessment**s, maps and plans. The Environment Agency also has a duty to quality assure and coordinate the outputs and make them available to the EC. Although the outputs of the Flood Risk Regulations 2009 (Ref. 16.14) process are more strategic in nature, there is also a legislative obligation for relevant authorities to provide information where reasonable to fulfil the requirements of the regulations.

xi. Flood and Water Management Act 2010 (Ref 16.20)

16.3.29 The Flood and Water Management Act 2010 (Ref. 16. 20) sets out proposals for a new framework to help improve flood risk management, manage water more sustainably and improve water related services for the public in England and Wales. The Act received Royal Assent on 8 April 2010 and implementation of the first parts of the Act began on the 1 October 2010.

16.3.30 The Act prescribes a number of changes to the assessment and management of flood risk in England and Wales. These changes include defining new roles and responsibilities for flood risk management (including clarifying the Environment Agency's overview role on flood risk management); continuation of the Environment Agency's role in producing and maintaining the main river map; assignment of lead responsibility for local flood risk management to county and unitary local authorities; encouragement of national design and performance standards for Sustainable Drainage Systems (SuDS); and implementation of the Pitt Review (Ref. 16.22) recommendation to place a duty on relevant organisations to co-operate and share information.

c) National Planning Policy

i. Planning Policy Statement 1: Delivering Sustainable Development (PPS1) (2005) (Ref. 16.23)

16.3.31 PPS1 was published in 2005 and sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system.

16.3.32 Paragraph 22 of PPS1 advises that regional planning authorities and Local Authorities should promote, amongst other things, the sustainable use of water resources; and the use of sustainable drainage systems in the management of runoff.

ii. Planning Policy Statement: Planning and Climate Change – Supplement to PPS1 (2007) (Ref. 16.24)

16.3.33 The supplement to PPS1 sets out how planning should contribute to reducing emissions and stabilising climate change (mitigation) and take into account the unavoidable consequences which result from climate change (adaptation).

16.3.34 Paragraph 42 advises that planning authorities in their consideration of the environmental performance of proposed development, taking particular account of the climatic conditions the development is likely to experience over its lifetime, should expect new development to, amongst other things:

> *"…give priority to the use of sustainable drainage systems, paying attention to the potential contribution to be gained to water harvesting from impermeable surfaces and encourage layouts that accommodate waste water recycling…"*

iii. Planning Policy Statement 23: Planning and Pollution Control (PPS23) (2004) (Ref. 16.25)

16.3.35 PPS23 is intended to complement the pollution control framework under the Pollution Prevention and Control Act 1999 and the Pollution Prevention and Control Regulations 2000 (now replaced by the Environmental Permitting (England and Wales) Regulations 2010 (Ref. 16.17). The statement advises on the importance of the planning system in determining the location of development which may give rise to pollution, either directly or indirectly. The statement also ensures that other uses and developments are not, as far as possible, affected by major existing or potential sources of pollution.

16.3.36 PPS23 advises that, amongst other things, the following matters may be material in the consideration of individual planning applications where pollution considerations arise:

- *"…the possible adverse impacts on water quality and the impact of any possible discharge of effluent or leachates which may pose a threat to surface or underground water resources directly or indirectly through surrounding soils;*
- *the need to make suitable provision for the drainage of surface water;…"* (Page 12).

iv. Planning Policy Statement 25: Development and Flood Risk (PPS25) (2010) (Ref. 16.1)

16.3.37 PPS25 is the principal planning policy statement that regulates new developments with respect to flood risk. PPS25 sets out the Government's policies on development and flood risk. The aim of this PPS is to ensure that flood risk is taken into account at all stages in the planning process, to avoid inappropriate development in areas at risk of flooding. Where development is exceptionally necessary in areas of flood risk, this policy intends to make it safe without increasing flood risk elsewhere and where possible, reducing flood risk overall.

16.3.38 Paragraph 8 (Page 5) states:

"LPAs should in determining planning applications:

- *have regard to the policies in this PPS and, as relevant, in the RSS for their region, as material considerations which may supersede the policies in their existing development plan, when considering planning applications for developments in flood risk areas before that plan can be reviewed to reflect this PPS;*
- *ensure that planning applications are supported by site-specific flood risk assessments (FRAs) as appropriate;*
- *apply the sequential approach (see paras. 14–17) at a site level to minimise risk by directing the most vulnerable development to areas of lowest flood risk, matching vulnerability of land use to flood risk;*
- *give priority to the use of SUDs; and*
- *ensure that all new development in flood risk areas is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed."*

d) Regional Planning Policy

16.3.39 The Government's revocation of regional strategies was quashed in the High Court on 10 November 2010. However, on that same date the Government reiterated in a letter to Chief Planners its intention to revoke regional strategies through the Localism Bill. This letter was also challenged but, on 7 February 2011, the High Court held that the Government's advice to local authorities that the proposed revocation of regional strategies was to be regarded as a material consideration in their planning development control decisions should stand. The decision of the High Court was upheld by the Court of Appeal on 27 May 2011. Therefore, the regional strategies remain in place but in the case of development control decisions it is for planning decision makers to decide on the weight to attach to the strategies (see **Volume 1**, **Chapter 4** for a full summary of the position regarding the status of regional planning policy).

i. Regional Planning Guidance 10 for the South West 2001 – 2016 (RPG10) (2001) (Ref. 16.26)

16.3.40 RPG10 sets out the broad development strategy for the period to 2016 and beyond. Policy RE 1 (Water Resources and Water Quality) states that to achieve the long term sustainable use of water, water resources need to be used more efficiently. The policy also states that the quality of inland and coastal water environments must be conserved and enhanced.

16.3.41 Policy RE 2 (Flood Risk) states that:

"Local authorities, the Environment Agency, other agencies and developers should seek to:

- *protect land liable to river and coastal flooding from new development, by directing development away from river and coastal floodplains;*
- *promote, recognise and adopt the use of sustainable drainage systems for surface water drainage; and*
- *adopt a sequential approach to the allocation and development of sites, having regard to their flood risk potential in accordance with advice in PPG25 (Development and Flood Risk)."*

ii. The Draft Revised Regional Spatial Strategy for the South West Incorporating the Secretary of State's Proposed Changes 2008 – 2026 (July 2008) (Ref. 16.27)

16.3.42 Chapter 7 deals with Enhancing Distinctive Environments and Cultural Life. Policy F1 (Flood Risk) states that:

"Taking account of climate change and the increasing risk of coastal and river flooding, the priority is to:

- *Defend existing properties and, where possible, locate new development in places with little or no risk of flooding.*
- *Protect flood plains and land liable to tidal or coastal flooding from development.*
- *Follow a sequential approach to development in flood risk areas.*
- *Use development to reduce the risk of flooding through location, layout and design.*
- *Relocate existing development from areas of the coast at risk, which cannot be realistically defended.*
- *Identify areas of opportunity for managed realignment to reduce the risk of flooding and create new wildlife areas."*

16.3.43 Policy RE6 (Water Resources) states that:

"The region's network of ground, surface and coastal waters and associated ecosystems will be protected and enhanced, taking account of the Environment Agency's 'Regional Water Resources Strategy', catchment abstraction management strategies, groundwater vulnerability maps, groundwater source protection zone maps and river basin management plans. Surface and groundwater pollution risks must be minimised so that environmental quality standards are achieved and where possible exceeded. Local planning authorities, through their LDDs must ensure that rates of planned development do not exceed the capacity of existing water supply and wastewater treatment systems and do not proceed ahead of essential planned improvements to these systems."

iii. Somerset and Exmoor National Park Joint Structure Plan Review 1991-2011 (2000) (Policies 'saved' from 27 September 2007) (Ref. 16.28)

16.3.44 The Somerset and Exmoor National Park Joint Structure Plan was adopted in 2000 with relevant policies saved from 27 September 2007. The Plan provides a strategic base for all land use planning within the plan area for the period up to 2011.

16.3.45 Policy 15 (Coastal Development) states that provision for any development along the coast, including the Exmoor Heritage Coast, should be made within towns, rural centres and villages. Where development requires an undeveloped coastal location it should respect the natural beauty, biodiversity and geology of the coast and be essential in that location. New coastal developments should minimise the risk of flooding, erosion and landslip.

16.3.46 Policy 59 (Safeguarding Water Resources) states that protection will be afforded to all surface, underground and marine water resources from development which could harm their quality or quantity.

16.3.47 Policy 60 (Floodplain Protection) states that areas vulnerable to flooding should continue to be protected from development which would cause a net loss of flood storage area or interrupt the free flow of water or adversely affect their environmental or ecological value. In allocating land for development in local plans, consideration must be given to measures to mitigate the impact on the existing land drainage regime to avoid exacerbating flooding problems.

16.3.48 Policy 61 (Development in Areas Liable to Marine Flooding) states that provision should only be made for development in areas vulnerable to marine or tidal flooding where the development is needed in that location, no alternative location exists for the development, and adequate measures exist or can be readily provided to protect the development.

iv. River Basin Management Plan, South West River Basin District (2009) (Ref. 16.29)

16.3.49 The River Basin Management Plan (RBMP) has been prepared for the South West River Basin District's rivers and coastal areas under the requirements of the Water Framework Directive (Ref. 16.8). The plan describes the river basin district, and the pressures that the water environment faces. It shows what this means for the current state of the water environment, and what actions will be taken to address the pressures. It sets out what improvements are possible by 2015 and how the actions will make a difference to the local environment including the catchments, the estuaries, coasts and groundwater.

16.3.50 The plan sets out that development planning plays a key role in sustainable development and that the Environment Agency will continue to work closely with planning authorities to ensure that planners understand the objectives of the Water Framework Directive and are able to translate them into planning policy (page 29).

16.3.51 The plan presents current and future water body status objectives (Annex B) and thus site specific Environmental Quality Standards (EQS) can to be derived.

v. South West Regional Flood Risk Assessment (RFRA) (2007) (Ref. 16.34)

16.3.52 In accordance with PPS25 (Ref. 16.1), the South West Regional Assembly published their Regional Flood Risk Appraisal in February 2007 (Ref. 16.30). The document is a high level review of flood risk and strategy. In this document, concerns over the potential effects of climate change are identified across the South West region.

vi. Severn Estuary Flood Risk Management Strategy (2011) (Ref. 16.31)

16.3.53 The consultation sets out the Environment Agency's strategy to manage flood risk on the Severn Estuary.

16.3.54 Specifically in relation to the Hinkley Point C Project, the consultation explains that the Environment Agency's proposals may be amended to complement other projects planned for this area, including the proposed power station at Hinkley Point which would have some impact on flood defences.

e) Local Planning Policy and Local Strategy

i. West Somerset Local Plan (2006) (Policies 'saved' from 17 April 2009) (Ref. 16.32)

16.3.55 The West Somerset Local Plan forms part of the development plan for West Somerset. The Local Plan was adopted in April 2006 (with relevant policies 'saved' from 17 April 2009). The site is not subject to any specific surface water designations. The site lies outside of the defined Development Boundary.

16.3.56 The following saved policies are considered to be potentially relevant:

16.3.57 Policy W/1 (Waste Water Management, Sewage and Sewage Disposal) states:

> *"Development will only be permitted where adequate drainage, sewerage and sewage treatment facilities are available or where suitable arrangements are made for their provision. In sewered areas, new development will be expected to connect to main drainage. New sewers will be expected to be constructed to a standard adoptable by the appropriate water company."*

16.3.58 Policy W/2 (Surface Water Protection) states:

> *"Development which would adversely affect the quantitative and quality aspects of surface, underground or coastal waters will only be permitted*

where acceptable mitigating works are undertaken as an integral part of that development."

16.3.59 Policy W/3 (Groundwater Source Protection) states:

"Development which would adversely affect Groundwater Source Protection Areas will not be permitted if the risk to the quality and quantity of water in water courses or aquifers could result in the inability of a groundwater source to maintain public supply."

16.3.60 Policy W/5 (Surface Water Runoff Management) states:

"Development which would result in significant additional surface water runoff and result in contributing to an increase in the risk of flooding within the site and elsewhere, particularly in relation to areas liable to flooding will only be permitted where appropriate mitigating measures are taken as a part of the development."

16.3.61 Policy W/6 (Floodplain Protection) states:

"Development on floodplains or that which would result in increased flood risk of water courses, land and property, whether on the site or elsewhere will only be permitted where satisfactory environmentally acceptable measures are undertaken to mitigate these risks."

16.3.62 Policy W/7 (Protection of River Corridors) states:

"Development which would harm the landscape, nature conservation, fisheries or the recreational interest of water courses, wetlands and the surrounding landscape will only be permitted where suitable mitigation measures are undertaken to ensure that any damage is kept to a minimum and compensatory measures, including enhancement and habitat restoration, are secured."

ii. West Somerset District Local Development Framework (LDF) Core Strategy (Options Paper) (January 2010) (Ref. 16.33)

16.3.63 The Core Strategy is at a preliminary stage of preparation and the Options Paper does not include any specific policies relating to surface water impacts. The paper does however identify the types of policy that WSC considers could be included in the Core Strategy, including a requirement that new developments incorporate measures to mitigate against flood risk and manage surface water runoff through appropriate use of SuDS (sustainable drainage systems).

iii. Supplementary Planning Guidance

16.3.64 Sedgemoor District Council and West Somerset Council have jointly prepared draft supplementary planning guidance in relation to the Hinkley Point C Project. Public consultation on the Consultation version of the Draft Hinkley Point C Project Supplementary Planning Document (the draft HPC SPD) commenced on 1 March 2011 and concluded on 12 April 2011. EDF Energy has submitted representations which object to the draft supplementary planning guidance. See **Volume 1**,

Chapter 4 for a full summary of the position regarding the status of the draft HPC SPD.

16.3.65 In relation to climate change adaptation and flood risk, Box 3 in the document sets out the following approach:

> *"In accordance with PPS25, the location of development proposals should be justified through a sequential approach, in combination with relevant local policy relating to preferred locations for housing and employment development (where applicable)…*
>
> *...HPC project development should also be sited and designed to with consideration for other potential effects arising from climate change, such as more frequent summer 'heat waves' and generally warmer summers." (Page 12)*

16.3.66 Further planning policy context is provided in the Legislative Planning Policy Context chapter (**Volume 1**, **Chapter 4**) and the Introduction chapter (**Volume 2**, **Chapter 16**).

iv. West Somerset Council Level 2 Strategic Flood Risk Assessment (SFRA) (Ref 16.34)

16.3.67 The West Somerset Council Level 2 Strategic Flood Risk Assessment (SFRA) was published in October 2010, as a follow up to the Level 1 SFRA. The Level 2 SFRA considers three strategic development areas in West Somerset within the settlements of Minehead, Williton and Watchet. There are no specific requirements for the HPC development site.

v. West Somerset Catchment Flood Management Plan (Ref 16.35)

16.3.68 The HPC development site is within the area covered by the West Somerset Catchment Flood Management Plan, which was completed in December 2009. HPC is located in Sub Area 8, Hills and Cliffs, which has been assigned Policy Option 1: Monitor and Advise, for which no specific actions were identified.

vi. Parrett Catchment Flood Management Plan (Ref. 16.36)

16.3.69 The southern section of the HPC development site is located within the Holford Stream valley, which is within the area covered in the Parrett Catchment Flood Management Plan. Holford Stream valley and the upstream sections of Bum Brook, Bayley's Brook and Stogursey Brook are located within the 'Upper and North West Parrett' sub-area. The downstream sections of these watercourses, including Wick Moor, are located within the 'Shoreline' sub-area. Both of these sub-areas are covered by Policy 3:

> *"Areas of low to moderate flood risk where we are generally managing existing flood risk effectively – This policy will tend to be applied where the risks are currently appropriately managed and where the risk of flooding is not expected to increase significantly in the future. However, we keep our approach under review, looking for improvements and responding to new challenges or information as they emerge. We may review our approach to managing flood defences and other flood risk management actions, to*

ensure that we are managing efficiently and taking the best approach to managing flood risk in the longer term."

vii. Parrett Internal Drainage Board Byelaws (Ref. 16.37)

Byelaw 3 – Control of Introduction of Water and Increase in Flow or Volume of Water

"No person shall, without the previous consent of the Board, for any purpose, by means of any channel, siphon, pipeline or sluice or by any other means whatsoever, introduce any water into the District or, whether directly or indirectly, increase the flow or volume of water in any watercourse in the District."

Byelaw 10 – No Obstructions within 9 Metres of the Edge of the Watercourse

"No person without the previous consent of the Board shall erect any building or structure, whether temporary or permanent, or plant any tree, shrub, willow or other similar growth within 9 metres of the landward toe of the bank where there is an embankment or wall or within 9 metres of the top of the batter where there is no embankment or wall, or where the watercourse is enclosed within 9 metres of the enclosing structure."

f) Best Practice Guidance

16.3.70 A range of best practice guidance is of relevance to this assessment including the following (only those specifically referred to in the assessment of impacts are included in the reference list):

- Environment Agency Policy and Practice for the Protection of Groundwater (Ref. 16.38);
- Environment Agency Pollution Prevention Guidance Notes (PPG) (Ref. 16.39), including:
  - PPG 1 General guide to the prevention of water pollution.
  - PPG 2 Above ground oil storage tanks.
  - PPG 3 Use and design of oil separators in surface water drainage systems.
  - PPG 4 Disposal of sewage where no mains drainage is available.
  - PPG 5 Works in, near or liable to affect watercourses.
  - PPG 6 Working at construction and demolition sites.
  - PPG 8 Safe storage and disposal of used oils.
  - PPG 21 Pollution incident response planning.
- Construction Industry Research and Information Association (CIRIA) Report C532: Control of Water Pollution from Construction Sites (Ref. 16.40).
- CIRIA Report C650: Environmental Good Practice on Site (Ref. 16.41).
- CIRIA Culvert Design and Operation Guide (C689) (Ref. 16.42).
- CIRIA: The SuDS Manual (C697) (Ref. 16.43).

- BS6031:2009 Code of Practice for Earth Works (Ref. 16.44).
- Good Practice Guide for Handling Soils (MAFF, 2000); (Ref. 16.45).
- Designing for Exceedance in Urban Drainage – Good Practice, C635 (2006) (Ref. 16.46). This has been used in the determination of an appropriate drainage strategy for the HPC development site.

g) Regulatory compliance

16.3.71 In accordance with PPS25 (Ref. 16.1), surface water Runoff to controlled waters from a greenfield development site should be controlled to greenfield rates unless an alternative rate is agreed during consultation. However, the Environment Agency have stated in a Discharge Conditionality Report for HPC (Ref. 16.47) that, in terms of discharge rate to the foreshore and Bristol Channel, no constraints will be sought, subject to adequate demonstration that no adverse impacts to foreshore ecological habitats will be incurred (as discussed in the **Chapter 19 Marine Ecology**).

16.4 Methodology

16.4.1 The methodology adopted for assessing potential impacts to the surface water environment has been undertaken in accordance with the requirements for the environmental impact assessment of major projects in the UK (see **Volume 1, Chapter 7**). This approach was adopted across all technical study areas and consists of four clear stages:

- definition of the current baseline;
- impact assessment;
- proposed mitigation measures; and
- assessment of any residual impacts after implementation of mitigation.

16.4.2 The construction, operation and land restoration phases of the proposed HPC development are assessed.

a) Study Area

16.4.3 The geographical extent of the study area for this assessment comprises:

- the area within the HPC development site, together with the catchments of watercourses draining into and around the HPC development site; and
- in relation to the hydrology and drainage assessments only, the Hinkley Point intertidal area which will receive surface water discharges from the HPC development site. The water quality assessment for the intertidal area is addressed in **Chapter 18**.

16.4.4 The study area above is illustrated in **Figure 16.1.** In addition, there are eleven locations constituting the off-site highway, these are presented in the project description in **Volume 1, Chapter 2**.

b) Baseline Assessment

16.4.5 Baseline environmental characteristics for the study area were identified by utilising the following key data sources:

- Ordnance Survey (OS) (2005) Landranger Map 1:50,000 scale ‘Weston-super-Mare, Bridgwater and Wells’ Sheet 182 (Ref. 16.48).
- Ordnance Survey (OS) (2009) Landranger Map 1:50,000 scale ‘Minehead and Brendon Hills’ Sheet 181 (Ref. 16.49).
- Environment Agency “What’s In My Backyard” website in 2010 (Ref. 16.50);
- Aerial photography (Ref. 16.51).
- Walkover survey of the site (August 2009) (see photographs in **Appendix 16A**).
- Topographic channel survey of the downstream watercourses and defences (August 2009) (see **Appendix B of the Flood Risk Assessment** (Modelling Report and Figures).
- Consultation with appropriate Statutory Bodies (i.e. Environment Agency and Somerset Drainage Boards Consortium) (see below).
- The **Flood Risk Assessment** for the HPC site.
- Flood Estimation Handbook (FEH) and accompanying CD-ROM (Version 3.0) (Ref. 16.52).
- Extreme Precipitation Analysis at Hinkley Point – Final Report which was prepared for EDF by the Met Office in June 2010 (Ref. 16.53).
- Institute of Hydrology Report No. 124: Flood Estimation for Small Catchments (June, 1994) (Ref. 16.54).
- Terrestrial surface water quality monitoring campaigns carried out in 2009 (Ref. 16.65).

16.4.6 The assessment of the water quality status for surface watercourses in the vicinity of the HPC development site was undertaken using a combination of approaches. Historical water quality monitoring data were only available for Stogursey Brook, and these data were subject to collation and review. A summary of these data is presented in **Appendix 16B**. Of the surface watercourses within the study area, a WFD waterbody description is only available for Stogursey Brook (provided in **Appendix 16C**) and this was used as an indicative surrogate for the water quality status of Holford Stream and Bum Brook which form part of the same catchment. These data were supplemented with a programme of water sample collection and in-situ monitoring during 2009, to provide further information on the water quality conditions, in relation to WFD EQS (Ref 16.8), for watercourses in the HPC development site. The summary results of the water quality monitoring programme are provided in **Appendix 16D** (see also Ref. 16.65).

16.4.7 The desk-based assessments and walkover surveys listed above identified the need for survey data to carry out modelling studies on the extensive fluvial network surrounding the HPC development site and a tidal breach analysis, and analysis of the surface water quality data on the local watercourses.

16.4.8 As identified above a topographic survey of the local watercourses and defences was carried out by an appointed contractor for the **Flood Risk Assessment** and to aid the assessment of impacts to flood risk in this chapter. Details and drawings of which can be found in **Appendix B of the Flood Risk Assessment**.

16.4.9 A description of the proposed HPC development site and broad baseline conditions is provided in **Chapter 2**. Further details regarding the baseline surface water conditions are presented in Section 16.5**.**

c) Consultation

16.4.10 Extensive consultation has been undertaken throughout the EIA process. Meetings were held with the Environment Agency and West Somerset Council to discuss all stages of the assessment including specific aspects of the development. Details of these consultations are given below. Multiple consultations have been carried out in the preparation of the **Flood Risk Assessment** and these are detailed within the **Flood Risk Assessment** document.

i. Stage 1

16.4.11 A range of informal consultations were undertaken with stakeholders prior to publication of the Stage 1 consultation document and these have been detailed below and summarised in **Table 16.1**.

16.4.12 Prior to the commencement of the terrestrial water quality monitoring programme consultations were undertaken with local Environment Agency personnel in December 2008 to agree the sampling locations and analytical test parameters.

16.4.13 A number of other consultation meetings (in addition to the formal consultation reports produced) have taken place as part of the EIA process and these are summarised in **Table 16.1**.

16.4.14 Meetings were held with the Marine Authorities Liaison Group (MALG), as detailed in **Table 16.1**, to discuss various elements of the Hinkley Point C development, including the proposals for the Holford Stream culvert and the surface drainage strategy i.e. discussions were not limited to marine subjects.

16.4.15 MALG members include the Centre for Environment, Fisheries and Aquaculture Science (Cefas), the Countryside Council for Wales (CCW), Natural England (NE), the Environment Agency (EA), the Marine Management Organisation (MMO), Somerset County Council, the Royal Society for the Protection of Birds (RSPB), the Crown Estate, English Heritage (EH) and West Somerset Council (WSC).

Table 16.1: Summary of Surface Water Consultations

Date of consultation	Consultees attending	Issues discussed relating to surface water
15/12/2008	Environment Agency	Discussion and agreement of water quality monitoring strategy
11/5/2009	Environment Agency	Discussion of discharges and consenting
10/8/2009	Environment Agency and SDBC	Discussions surrounding the **Flood Risk Assessment** and drainage requirements
14/10/2009	Environment Agency	Meeting with the Environment Agency regarding construction activities in Holford Valley and associated drainage issues. Discussion of requirement for hydraulic structures such as bridges and culverts
24/6/2009	MALG	Discussion of application for discharge consents Presentation of terrestrial water quality

Date of consultation	Consultees attending	Issues discussed relating to surface water
		monitoring results Discussion of proposed discharge strategy
2/9/2009	MALG	Discussion of information required on discharge consents during construction Discussion of maintaining flows and water quality in Holford Stream
14/10/2009	Environment Agency	Discussion of drainage strategy and culverting of Holford Stream

Stage 1 Consultation Responses

16.4.16 Following issue of the Stage 1 consultation document a range of comments were received from consultees. The comments were taken account of in the scope of on-going studies for the HPC development site. Responses to these comments and how they were accounted for within the studies are provided in the consultation response document.

ii. Stage 2

16.4.17 Further consultation meetings detailed in **Table 16.2**, where terrestrial water quality was discussed, were carried out prior to issue of the Stage 2 consultation document which are detailed below and summarised in **Table 16.2**.

Table 16.2: Summary of Surface Water Consultations Carried Out at Stage 2.

Date of consultation	Consultees attending	Issues discussed relating to water quality
21/1/2010	Environment Agency	Discussion of Holford Stream culvert Discussion of drainage discharge strategy
14/4/2010	MALG	Discussion of drainage strategy in the area of Holford Stream and the importance of the maintenance quality during works was highlighted A discussion regarding drainage to the intertidal area was also held
24/5/2010	Environment Agency, ISDBC, and Natural England	Discussions of drainage strategy during site preparation including culverting of Holford Stream

16.4.18 During a meeting held in May 2010, it was agreed that the Environment Agency would provide a Discharge Conditionality Report (Ref. 16.47) in association with the HPC development site preliminary works which would stipulate requirements for discharges to the intertidal area. The document provided in 2010 by the Environment Agency and refers to the Site Preparation Works, however, this has been used as guidance for the entire HPC development construction phase.

16.4.19 It was agreed with the Environment Agency that EDF Energy would provide a Holford Stream culvert Justification Report. A Briefing Note was provided in July 2010 (Ref 16.55). Discussions were also held as to the requirement for EDF Energy to demonstrate that intertidal habitats would not be impacted as a result of the drainage outfall options under consideration at that time (see, **Chapter 19** – Marine Ecology).

16.4.20 It was agreed with the Environment Agency during consultation held in April 2010, that both the Institute of Hydrology Report No. 124 method (IH124) (Ref. 16.54) and the ReFH method (Ref. 16.56) would be used to calculate baseline peak discharges depending on catchment area (IH124 for areas less than 2 km^2 and ReFH for areas greater than 2km^2).

16.4.21 Additional meetings with the Environment Agency were held towards the end of 2010 to discuss mitigation options for any potential increase in flood risk to third party properties at Stolford.

Stage 2 Consultation Responses

16.4.22 Stage 2 consultation responses for Hinkley Point C relating to surface water considerations, were provided by the Environment Agency, WSC, all other key consultees and the general public between July and October 2010. These consultation responses have been reviewed and addressed in this chapter. Responses to these comments and how they were accounted for within the studies are provided in the Consultation Report.

iii. Stage 2 Update

16.4.23 A range of informal consultations were undertaken with stakeholders prior to publication of the Stage 2 Update consultation document (see below).

16.4.24 At the end of 2010 and beginning of 2011 meetings were held with the Environment Agency and WSC to discuss the approach to the assessment including the **Flood Risk Assessment** and associated modelling. A meeting was held with the Environment Agency in June 2011 to discuss Environmental Permit applications for the construction phase of works.

Stage 2 Update Consultation Responses

16.4.25 Stage 2 update consultation responses for HPC relating to surface water considerations, have been reviewed and addressed in this chapter. Responses to these comments and how they were accounted for within the studies are provided in the Consultation Report.

d) Assessment Methodology

16.4.26 The methodology adopted for assessing the potential environmental impacts to surface waters is outlined in **Volume 1**, **Chapter 7**. In addition, specific information is provided below on the determination of receptor value and sensitivity and of impact magnitudes for surface waters.

i. Value and Sensitivity

16.4.27 All of the surface water receptors that have the potential to be impacted by the proposed HPC development were assigned a level of importance in accordance with those definitions set out in **Volume 1**, **Chapter 7,** and with the surface water specific definitions given in **Table 16.3**.

16.4.28 Where a receptor could reasonably be placed within more than one value and sensitivity rating in **Table 16.3**, conservative professional judgement has been used to determine which rating would be applicable.

Table 16.3: Criteria Used to Determine the Value and Sensitivity of Surface Water Receptors

Importance and Sensitivity	Description
High	*Hydrology and drainage specific definition:* Controlled waters receptor located in area of significant social/community and economic value and considered of high amenity and economic value. Receptors shown on Environment Agency flood maps as being located in designated flood risk zones 2 and 3 and/or all designated Critical Ordinary watercourses. Controlled waters receptor identified is of significant UK or European value in terms of its hydrological status such that designated habitats and/or species are sensitive to change in hydrological regime. Receptor identified as having no capacity to adapt to, or recover from, proposed form of change, i.e. fluvial watercourse will not naturally realign and erode to optimise flow conveyance such that impact will persist. *Water quality specific definition:* Water quality of receptor supports or contributes towards the designation of a feature of national (or international) importance. Very low capacity to accommodate any change to current water quality status, compared to baseline conditions. Water quality of receptor waterbody classified under the WFD as high or good ecological status/potential. The receptor environment is likely to have natural ecosystems and make very good salmonid and cyprinid fisheries. The receptor may be used for any type of water abstraction including potable supply.
Medium	*Hydrology and drainage specific definition:* Controlled waters receptor located in area of moderate social/community and economic value and economic value and considered of medium amenity benefit and economic value. All watercourses defined as Main River. Receptors not located in designated Environment Agency flood risk zones 2 and 3 and are not designated Critical Ordinary watercourses. Controlled waters receptor identified is of moderate UK value or of moderate regional or local value in terms of its hydrological status such that selected designated habitats and/or species are potentially sensitive to change in hydrological regime. Receptor identified as having low capacity to accommodate proposed form of change i.e. fluvial watercourse will only partially reconfigure to optimise flow conveyance such that impact may persist or will be transposed to another location. *Water quality specific definition:* Water quality of receptor supports high biodiversity (not designated). Receptor has low capacity to accommodate change to water quality status. Water quality of receptor waterbody classified under WFD as good ecological status/potential. Receptor environment considered suitable for support of coarse fisheries.

Importance and Sensitivity	Description
Low	*Hydrology and drainage specific definition:* Controlled waters receptor located in area of no social/community and economic value and considered of low amenity benefit and economic value. All controlled waters and designated Ordinary Watercourses that are not designated Main Rivers. Receptors not located in designated Environment Agency flood risk zones 2 and 3 and are not designated Critical Ordinary watercourses. Controlled waters receptor is of only moderate local value in terms of its hydrological status. Receptor identified as having moderate capacity to accommodate proposed form of change i.e. fluvial watercourse will reconfigure to optimise flow conveyance such that change will, after time, return to approaching baseline conditions. *Water quality specific definition:* Baseline conditions define an environment that has a high capacity to accommodate proposed change to water quality status due, for example, to the large relative size of receiving water feature and effect of dilution. Baseline water quality status generally poor. Water quality of receptor could be expected to be classified under the WFD as moderate ecological status/potential. Receptor is likely to be capable of supporting only limited fish populations.
Very Low	*Hydrology and drainage specific definition:* Controlled waters receptor is of poor hydrological value with negligible amenity benefits and economic value. Receptor identified as being generally tolerant to the proposed change. *Water quality specific definition:* Specific water quality conditions of receptor water feature likely to be able to tolerate proposed change with very little or no impact upon the baseline conditions. Water quality of receptor waterbody could be expected to be classified under the WFD as poor or bad ecological status/potential. Poor or bad status waterbodies have severely restricted ecosystems and are very polluted.

ii. Magnitude

16.4.29 The assessment of magnitude of impact has been based on the effects that the HPC development would have upon the local surface water features and has been considered in terms of high, medium, low and very low magnitude ratings.

16.4.30 All of the surface water impacts identified as a result of the HPC development have been assigned a level of magnitude in accordance with those definitions set out in **Volume 1**, **Chapter 7**, and with the surface water specific definitions given in **Table 16.4** below. Potential impacts have been considered in terms of permanent or temporary, adverse (negative) or beneficial (positive) and cumulative.

16.4.31 The assessment of impact magnitude takes into account those elements which form part of the HPC development design, in particular the details of the drainage strategy.

16.4.32 Where a receptor could reasonably be placed within more than one magnitude rating in **Table 16.4**, conservative professional judgement has been used to determine which rating would be applicable.

Table 16.4: Criteria Used to Determine the Magnitude of Surface Water Receptors

Magnitude	Description
High	*Hydrology and drainage specific definition:* Very significant change to key hydrological/hydraulic characteristics of the receiving water feature to the extent that UK and European legislation is contravened. Chronic occurrence of change and/or changes are prolonged, lasting significantly longer than the duration of the hydrological event that initiated the change (i.e. normal period of time over which water levels in watercourse receptors would be expected to rise and fall). Changes are spatially extensive beyond the local area where the impact was incurred. Receptor waterbody impacted to the extent that permanent change in hydrological/hydraulic characteristics of the receptor waterbody significantly contravenes regulatory standards with respect to flood risk or low flow in accordance with statutory legislative requirements. *Water quality specific definition:* Very significant change to key characteristics of the water quality status of the receiving water feature. For example, water quality status degraded to the extent that a permanent change and inability to meet EQS is likely.
Medium	*Hydrology and drainage specific definition:* Significant changes to key run-off characteristics such that hydrological/hydraulic characteristics of the controlled water feature are impacted to the extent that UK and European legislation is contravened. Changes are limited in time to the duration of the hydrological event that initiated the change (i.e. normal period of time over which water levels in watercourse receptors would be expected to rise and fall). Changes are spatially extensive beyond the local area where the impact was incurred. Receptor waterbody impacted to the extent that permanent change in hydrological/hydraulic characteristics render receptor water body unable to meet regulatory standards with respect to flood risk and low flow in accordance with statutory legislative requirements. *Water quality specific definition:* Significant changes to key characteristics of the water quality status taking account of the receptor volume, mixing capacity, flow rate, etc. Water quality status likely to take considerable time to recover to baseline conditions. Changes are limited in time to the duration of the hydrological event that initiated the change (i.e. normal period of time over which water levels in watercourse receptors would be expected to rise and fall).
Low	*Hydrology and drainage specific definition:* Noticeable but insignificant changes to key run-off characteristics such that hydrological/hydraulic characteristics of receptor controlled water features would not contravene UK and European legislation. *Water quality specific definition:* Noticeable but not considered significant changes to water quality status of receptor water feature. Activity not likely to alter local status to the extent that water quality characteristics change considerably or EQS are compromised. Activities are likely to have an impact for a short time scale (e.g. relative to turnover of water feature) and baseline water quality conditions are maintained.

Magnitude	Description
Very low	*Hydrology and drainage specific definition:* Occasional but insignificant impact to key run-off characteristics with changes to hydrological/hydraulic characteristics of receptor controlled water features predicted to occur over a short period of time. Any change to hydrological/hydraulic characteristics will be quickly reversed once activity ceases. *Water quality specific definition:* Although there may be some impact upon water quality status, activities predicted to occur over a short period. Any change to water quality status will be quickly reversed once activity ceases.

iii. Significance of Impacts

16.4.33 The significance of the impact is judged on the relationship of the magnitude of impact to the assessed sensitivity and/or value of the receptor. The methodology for the assessment of the predicted significance of impacts, is outlined in **Volume 1, Chapter 7**.

iv. Cumulative Impacts

16.4.34 **Volume 1**, **Chapter 7** of this ES sets out the methodology used to assess cumulative impacts. Additive and interactive effects between site-specific impacts are considered within this chapter. The assessment of cumulative impacts with other elements of the HPC Project and other proposed and reasonably foreseeable projects are considered in **Volume 11** of this ES.

e) Limitations, Assumptions and Uncertainties

16.4.35 Limitations, assumptions and uncertainties identified and made for the assessments are listed below:

Limitations

- Annual mean and percentile concentration values calculated for water chemistry parameters have been derived from a limited number of sampling campaigns. The survey data are considered sufficient in order to undertake the impact assessment.
- The extent of flood risk has primarily been based on available historical data and hydrological and hydraulic modelling carried out for the **Flood Risk Assessment**. There is no available fluvial gauge data for the HPC development site. However, such data would not be expected given the relatively small size of catchment and the type of watercourses (ditches and rhynes) in the vicinity of the HPC development site.

Assumptions

- Consent for culverting Holford Stream and for any works within 9m of the watercourse will be sought from the Parrett Internal Drainage Board under the Land Drainage Act 1991 (Ref. 16.19).
- The impact assessment (specifically the determination of magnitude score) takes into account those elements of the HPC development site design relevant to surface water (e.g. provision of water management zones (WMZs)) before the

determination of impact significance is made (as project design is not considered to be a form of additional mitigation for the purposes of this assessment).

- It is assumed that no deterioration of the individual component elements of the water quality WFD waterbody designation is acceptable (e.g. a good current status for dissolved oxygen should be protected, even if the overall WFD waterbody status is moderate).
- Surface water discharge to Holford Stream will be managed so it does not exceed the predetermined greenfield run-off rates in accordance with PPS25 (Ref. 16.1).
- Suspended solid concentrations in water discharged into Holford Stream will be controlled as prescribed in the Environment Agency Hinkley Point C Site Preparation Drainage Design Discharge Conditionality Report (Ref. 16.47). Surface water and sediment discharge to the intertidal area and Bristol Channel will be at a rate and concentration as agreed with the Environment Agency and in line with the Hinkley Point C Site Preparation Drainage Design Discharge Conditionality Report (Ref. 16.47).
- Environmental Quality Standards (EQS) which are prescribed for downstream designated WFD waterbodies have been adopted for upstream watercourses for the purpose of the assessment.
- The construction surface water drainage system will be designed to the 3.33% Annual Exceedance Probability (AEP) event such that the system will not surcharge. The designs will ensure that surface run-off from the HPC development is controlled and managed for all events that exceed the design standard of the drainage system up to and including the 1% AEP event plus allowance for climate change.
- The operational drainage system will be designed to a 1% AEP storm event plus climate change allowances with no flooding with a 95% confidence limit (Jacobs, 2010 (Ref. 16.57)). The HPC development will also be designed to accommodate the 0.01% AEP storm event to ensure that the station operational safety is not compromised.
- The assessment assumes that all surface water discharges, during all phases of the development, will be subject to Environmental Permit, under the Environmental Permitting Regulations (Ref. 16.17). The Environment Permits will be applied individually to different waste streams i.e. surface water, groundwater and treated sanitary effluent.
- It has been assumed that consent for discharge to controlled waters will be required from the Environment Agency (and from Somerset Drainage Board Consortium where discharges could potentially be made to watercourses in any of their catchments) prior to constructing the temporary drainage system for the construction site and the permanent drainage system for the operational site. This is in accordance with legislation (including the Land Drainage Act 1991 (Ref. 16.19)) to ensure that the drainage methods, construction methods and proposed method of discharge to controlled waters would not result in adverse hydrological (including flooding), geomorphological and ecological impacts.

Uncertainties

- The current nutrient status of Holford Stream is unknown as this parameter was not included within the monitoring analytical suite that was agreed with the

Environment Agency. Historical phosphorus monitoring data is available for Storgursey Brook and it is assumed that Holford Stream will have a similar phosphorus status given that both watercourses are within the same catchment and have similar surrounding agricultural land use.

16.5 Baseline Environmental Characteristics

a) Introduction

16.5.1 This section describes the baseline environmental characteristics for the HPC development site and surrounding areas with specific reference to hydrology and drainage, including flood risk, and water quality. A definition of the baseline characteristics has allowed the potential effects of the HPC development to be determined and appropriate mitigation to be identified as necessary.

16.5.2 A brief overview of environmental conditions with respect to topography, soils, geology and hydrogeology is also presented in order to provide sufficient context for the specific surface water related baseline conditions.

b) Study Area Description

16.5.3 The HPC development site can be divided into two main drainage areas, north and south. The divide is delineated by a ridge (occupied by Green Lane) that runs east-to-west through the central part of the site (see **Figure 16.2)**.

16.5.4 The flood risk study area extends east of the HPC development site to include Wick Moor and residential properties in and around Stolford, the Steart to the south-east and contributing catchments upstream of the HPC development site which contribute to Bum Brook, Holford Stream and the HPC Drainage Ditch (see **Figure 16.3**).

16.5.5 Eleven off-site highway improvement schemes will be included in the HPC Project DCO application. They are described in **Volume 2**, **Chapter 2** of this ES. The schemes concern land that is presently within the highway, on highway land, verges, limited areas of hard surfacing and urban green space. Only schemes increasing the area of hardstanding compared to the baseline situation and/or in an area of flood risk have the potential to impact surface water. There are six such schemes which are discussed in Section 16.6. The study areas for each of these schemes comprise the land within the flow path of any surface run-off.

i. Environmental Overview

16.5.6 A general overview of the baseline setting for the study area is provided in the following sections. This provides background information relevant to the surface water assessment i.e. both water quality and hydrology and drainage/flood risk technical studies.

Topography

16.5.7 The following should be read in conjunction with the Light Detection and Ranging (LiDAR) data relief map presented in **Figure 16.2**.

16.5.8 The topography of the study area is characterised by undulating countryside, terminating at Bridgwater Bay to the north at a natural cliff line. An east-west trending ridge (occupied by Green Lane) which peaks at a maximum elevation of

35.3m AOD provides a topographical divide within the Hinkley Point C development site between the permanent development areas to the north and the SCPA to the south.

16.5.9 To the north of the ridge, ground levels generally range between 14m AOD and 31m AOD. An east-west depression associated with the valley of an unnamed watercourse (hereafter referred to as the HPC Drainage Ditch) passes through the centre of this area. The HPC Drainage Ditch flows west to east through the BDAW, before turning to the north (at an elevation of 8.6m AOD) at the boundary between the BDAW and BDAE and finally discharging to the Hinkley Point foreshore at an elevation of 8.5m AOD. Elevations along the top of the cliff range from 10.7m AOD to 16.6m AOD.

16.5.10 To the south of the ridge, ground levels range from approximately 14m AOD to 22m AOD. The gently undulating relief continues from the depression referred to above with the land gently rising to 5.8m AOD and then sloping more steeply to a maximum of between 21.1 and 24.8m AOD. The land then gently falls towards the southern boundary of the HPC development site where elevations typically range between 15m AOD and 16m AOD adjacent to Bum Brook. A small hillock is located towards the south-west corner of the site where the land crests at an elevation of 28.7m AOD.

Geology and Hydrogeology

16.5.11 The geology of the HPC development site and of the wider environment is presented within **Volume 2**, **Chapter 14** of the ES and within the Geological Survey and Mapping report (Ref. 16.58). A description of the hydrogeology of the HPC development site is presented in **Chapter 15** on Groundwater.

Soils

16.5.12 Soils throughout the HPC development site are identified as Soil Class 1 (Ref. 16.59) (soils of intermediate leaching potential) with the exception of an area comprising soils of high leaching potential, which extends along the site's southern boundary and corresponds to the extent of alluvial material shown on the GroundSure Superficial Deposits and Landslips map (Ref. 16.59).

16.5.13 Particle size distribution tests undertaken on samples of the superficial clay indicate a spread of classifications between slightly gravelly sandy silty clay and slightly gravelly sandy clayey silt. The main soil type on the HPC development site may be described as silty clay loam. Further details regarding the HPC development site soils are provided in **Volume 2**, **Chapter 13**.

16.5.14 The Standard Percentage Runoff derived using the Hydrology of Soil Types (SPRHOST) was obtained from the Flood Estimation Handbook (FEH) CD-ROM (Version 3.0) (Ref. 16.52) for the Holford Stream catchment, west of the upstream limit of the channel. This catchment was selected as the HPC Drainage Ditch is not covered by the FEH CD-ROM. The value varies slightly across the study area, however an average SPRHOST value of 53% was obtained for the site, indicating that approximately 53% of rainfall runs off as surface water in this catchment.

ii. Hydrological Baseline Overview

Greenfield Run-off

16.5.15 The greenfield run-off rate for the HPC development site is defined as the pre-development natural run-off rate, as given in the IH124 (Ref. 16.54). To clarify the impact assessment process, the HPC development site has been divided into seven zones as shown in **Figure 16.4** and described below:

- Zone 1: The area to the north of the Holford Stream catchment, draining to the HPC intertidal area. It should be noted that the majority of this area lies within HPC Drainage Ditch catchment which is marked on **Figure 16.4**.
- Zone 2: The area falling within the natural catchment area of Wick Moor.
- Zone 3: The area falling within the natural catchment area of Bum Brook.
- Zone 4: The area of the HPC Drainage Ditch to the west of the HPC development site boundary.
- Zone 5: The area of Holford Stream to the west of the HPC development site boundary.

16.5.16 The corresponding greenfield run-off rates for each zone have been calculated using the methodology given in IH124 (Ref. 16.54). The site-specific input parameters and output from the greenfield run-off analysis up to 2115 (as per PPS25 guidance) are presented in **Table 16.5**, as calculated using the IH124 method (Ref. 16.54). These rates are indicative of the HPC development site natural drainage areas. At present, estimates for climate change allowances are only available until 2100 (UKCP09) or 2115 (PPS25), however the uncertainty surrounding climate change predictions beyond 2100 is referred to several times in EN-6 and the need for additional safeguards is mentioned. Additional safeguards for the HPC development to withstand the potential impacts of climate change have been taken into account in the **Flood Risk Assessment** through a managed adaptive approach for the period beyond 2100. Zones 4 and 5 represent greenfield run-off upstream of the HPC development site boundary.

Table 16.5: Indicative Greenfield Run-off Rates for the Catchment Zones Identified in Figure 16.4

IH Parameters and output	Catchment Zones				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
AREA (ha)	73.77*	77.17	19.79	24.32	51.88
SAAR (mm)	753	753	753	753	753
SOIL (dimensionless)	0.530	0.530	0.530	0.53	0.530
Q_1 (m^3/s)	0.425*	0.442	0.119	0.146	0.310
Q_{BAR} (m^3/s)	0.482.*	0.502	0.135	0.166	0.353
Q_5 (m^3/s)	0.593*	0.618	0.166	0.204	0.434
Q_{10} (m^3/s)	0.719*	0.748	0.201	0.247	0.525
Q_{30} (m^3/s)	0.912*	0.949	0.255	0.314	0.667
Q_{50} (m^3/s)	1.023*	1.064	0.286	0.352	0.748

IH Parameters and output	Catchment Zones				
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5
Q_{100} (m^3/s)	1.167*	1.215	0.327	0.402	0.853
Q_{100} + 10% climate change up to 2025 (m^3/s)	1.284*	1.337	0.360	0.442	0.938
Q_{100} + 20% climate change from 2025 to 2115 (m^3/s)	1.400*	1.458	0.392	0.482	1.024

*The area of Zone 1 incorporates land that does not natural drainage to HPC Drainage Ditch catchment (see **Figure 16.4**)

Surface Watercourses

16.5.17 The definitions of controlled waters and other watercourse designations are given below, as taken from the Somerset Drainage Board Consortium's website (Ref 16.60) (August 2011):

- *"Main Rivers are normally the principle or arterial watercourses in an area and are designated as such on maps held by the Department for Environment, Food and Rural Affairs and the Environment Agency. The term also includes any structures in the bed or bank for controlling or regulating the flow of these watercourses".*
- *"Ordinary Watercourses comprise all watercourses that are not Main Rivers. These include all tributaries, streams, rhynes, ditches, and those watercourses that have been culverted or piped".*
- *"Viewed Rhynes are Ordinary Watercourses (either open or culverted) that provide a significant function in the drainage or irrigation of an area. Viewed Rhynes are maintained by the Board on a regular or infrequent basis as necessary. The Board undertakes its consenting and enforcement powers on all Viewed Rhynes. The term also includes any structures in the bed or banks for controlling or regulating the flow of these watercourses".*

16.5.18 Controlled waters include virtually all freshwaters, public supply reservoirs, underground waters, tidal waters, and coastal waters up to three nautical miles out to sea. Exceptions include small ponds and reservoirs that do not supply water to other watercourses.

16.5.19 There are a number of watercourses in the Hinkley Point study area which are both controlled waters and ordinary watercourses. These are illustrated in **Figure 16.1** and **Figure 16.3**. The controlled waters of interest to this assessment are sub-categorised as follows:

- an interconnected series of intermittently flowing (ephemeral) agricultural ditches that drain the northern area of the HPC development site: these watercourses ultimately discharge water to the intertidal area via the HPC Drainage Ditch; and
- perennial streams in and around the HPC development site and to the west of the C182, comprising Holford Stream, Bum Brook, Bayley's Brook and Stogursey Brook.

16.5.20 The watercourses feeding Wick Moor, which lie to the east of the C182, are defined as Viewed Rhynes by the Somerset Drainage Board Consortium (see definitions above). The levels and flows within these watercourses are controlled by the Parrett Internal Drainage Board by a series of sluices.

16.5.21 To the east of the C182, Holford Stream continues to flow to the east through Wick Moor and converges with West Brook at Sharpham Sluice. West Brook converges with East Brook immediately upstream of Great Arch Sluice, through which the watercourse discharges via an 80m long culvert to the intertidal area.

16.5.22 Stogursey Brook converges with Bum Brook and then Bum Brook diverges into West Brook and East Brook which are within the Parrett Internal Drainage Board boundary.

16.5.23 Each watercourse of interest to this assessment is described in the following paragraphs. The catchment areas that correspond to each of the watercourses discussed are highlighted in **Figure 16.1** and **Figure 16.4.**

Hinkley Point C Drainage Ditch

16.5.24 The HPC Drainage Ditch flows through the centre of the northern part of the HPC development site (see **Figure 16.1** and **Appendix 16A**, **Plates 16.1** and **16.2**). Its contributing catchment is undulating with generally shallow slopes. It runs from west to east with its source at 14.5m AOD. At NGR 320310, 145840, the HPC Drainage Ditch changes route to the north where it discharges onto the intertidal area at NGR 320290, 146150. The maximum elevation of the catchment is 37.4m AOD and the lowest point where it discharges to the intertidal area is at an elevation of 8.3m AOD.

16.5.25 **Table 16.6** displays the catchment and flow parameters for the HPC Drainage Ditch's existing catchment: this shows the predicted greenfield run-off rates for events of various AEPs, as calculated using the IH124 method (Ref. 16.54).

Table 16.6: Catchment and Flow Parameters for the HPC Drainage Ditch's Catchment (Catchment ID1, see Figure 16.3) Using IH124 Method (Ref. 16.54)

ID1 HPC Drainage Ditch	
AREA (km^2)	0.783
SAAR (mm)	753
SOIL (dimensionless)	0.530
Q_{1yr}	0.448m^3/s
Q_{BAR}	0.509m^3/s
Q_{5yr}	0.626m^3/s
Q_{10yr}	0.758m^3/s
Q_{30yr}	0.961m^3/s
Q_{50yr}	1.078m^3/s
Q_{100yr}	1.231m^3/s
Q_{100yr} (including 20% for climate change)	1.477m^3/s

Holford Stream

16.5.26 The source of Holford Stream is to the west of the HPC development site (see **Figure 16.1**). The stream's flow path is from west to east across the northern part of the SCPA to where it is culverted under the C182. Flow parameters for the watercourse at this location are given in **Table 16.7**. Downstream of the C182 culvert, the stream flows for a further 10m prior to entering a culvert under a track.

16.5.27 To the east of the C182 the catchment is characterised by an interconnected series of rhynes. Holford Stream flows through Wick Moor and converges with West Brook (note: flow parameters at this location are given in **Table 16.7**). An old sluice is located at the confluence of Holford Stream with West Brook (see **Appendix 16A, Plates 16.3** and **16.4**).

16.5.28 To the west of the C182 the catchment slopes are steeper, while to the east the catchment is characterised by low lying flat pasture land (see **Figure 16.1** and **Figure 16.2**). At present, land use for the catchment is rural with no urbanisation. In general, the riparian vegetation is dense, comprising long grasses, thistles and reeds (see **Appendix 16A, Plates 16.5 and 16.6**).

Bayley's Brook

16.5.29 Bayley's Brook flows from south-west to north-east through the village of Shurton and converges with Bum Brook at NGR 320320, 144530 to the south of the HPC development site.

Bum Brook

16.5.30 Bum Brook flows from west to east along the majority of the southern boundary of the HPC development site prior to flowing under the C182 to the south-east of the site (see **Figure 16.1**). Flow parameters at the C182 Bum Brook crossing are presented in **Table 16.7**. Bum Brook has two tributaries: Bayley's Brook and Stogursey Brook, which are described below. To the east of the village of Wick, Bum Brook bifurcates into East Brook and West Brook. The stream has several hydraulic structures along its course, including bridges, culverts, a weir and a ford. Bum Brook, at a location immediately downstream of its confluence with Bayley's Brook, is shown in **Appendix 16A**, **Plates 16.7** and **16.8**.

16.5.31 Between the confluence with Bayley's Brook and the C182, Bum Brook flows through farmland and gardens. The watercourse is culverted under the C182 and under the lane to and from Wick. Downstream of this lane the river is forded twice, primarily for use by agricultural vehicles. **Appendix 16A**, **Plates 16.7** and **16.8** show the first ford and the C182 crossing at NGR 321600, 144440.

16.5.32 The photographs presented in **Appendix 16A** were taken in August 2009 and thus the vegetation was denser than would be expected during the winter months. The riparian vegetation along the course of Bum Brook upstream of the C182 is characterised by grasses, wheat and reeds (see **Appendix 16A**, **Plates 16.9** and **16.10**). Downstream of the C182, the riparian vegetation comprises long grasses, nettles, hawthorn and brambles.

Stogursey Brook

16.5.33 Stogursey Brook flows south-west to north-east through the settlement of Stogursey, then through farmland, the hamlet of Newnham and then once again through farmland (see **Figure 16.1**). The stream then turns to the east at NGR 320760, 144540 and passes under the C182 before changing direction to the north-east where it converges with Bum Brook 130m downstream of the C182 at NGR 320910, 144590. Flow parameters are given in **Table 16.7**.

16.5.34 At the time of observation (August, 2009) the vegetation along Stogursey Brook was dense. **Appendix 16A**, **Plates 16.11** and **16.12** shows the vegetation upstream of the C182. The dense vegetation continues downstream of the road until it turns north-east where the riparian zone is more sparsely vegetated with trees and brambles.

East Brook and West Brook

16.5.35 To the east of Wick, Bum Brook (having converged with Stogursey Brook to the west) bifurcates into East Brook and West Brook at NGR 321687 144515 (see **Figure 16.1** and **Appendix 16A**, **Plates 16.13** and **16.14** for views downstream of West Brook from this location). East Brook and West Brook then flow parallel with each other for 1.52km before converging immediately upstream of Great Arch Sluice (see **Appendix 16A**, **Plates 16.13** and **16.14**). East Brook and West Brook flow through flat, low-lying farmland used primarily as pasture. **Appendix 16A**, **Plates 16.15** and **16.16** illustrate the riparian vegetation upstream of Sharpham Sluice. The channel banks are overgrown with grasses, reeds and thistles. The flow parameters for the fluvial network upstream of Sharpham Sluice and upstream of Great Arch Sluice are given in **Table 16.7**.

Table 16.7: Summary of Flow Characteristics at Key Points of Interest throughout the Study Area (for ID Locations see Figure 16.3).

ID	Catchment	Catchment descriptions	Design flow (m³/s)		
		Area (km²)	Q_{BAR} (m³/s)	Q_{30yr} (m³/s)	Q_{100yr} (m³/s)
			ReFH	ReFH	ReFH
2	Holford Stream (west of start of channel)	0.52	0.23	0.80	1.08
3	Holford Stream (upstream of the C182)	1.32	0.54	1.38	1.82
4	Holford Stream upstream of Sharpham Sluice	2.90	1.08	2.39	2.61
5	Bum Brook (upstream of the C182)	13.36	3.28	7.05	9.03
6	Stogursey Brook (upstream of the C182)	11.42	3.40	7.29	9.34
7	Fluvial network upstream of West/East Brook confluence (excluding Holford Stream	26.54	7.86	14.90	19.02
8	Fluvial network upstream of Great Arch Sluice	29.46	8.57	16.20	20.75

Note: for ID1 see **Table 16.6**

Surface Water Outfalls

16.5.36 With the exclusion of HPC Drainage Ditch, which discharges to the Hinkley Point intertidal area, the fluvial network in the area is served by two outfalls, both of which are illustrated on **Figure 16.1**. The largest outfall is Great Arch Sluice, which is located immediately downstream of East Brook and West Brook and includes the Holford Stream catchment, with a collective catchment area in excess of approximately 30km². A secondary outfall known as Cole Lane Sluice is located to the immediate east of the Hinkley Point B power station. Both of these are described in more detail in the following paragraphs.

Great Arch Sluice

16.5.37 Great Arch Sluice is located at NGR 322717, 145947 (see **Figure 16.1**). **Appendix 16A, Plates 16.17** and **16.18** show the upstream face of the sluice where a trash screen is evident. The water flows through a culvert under the flood embankment and under the crest of the embankment enters a large inspection chamber (see **Appendix 16A**, **Plates 16.19** and **16.20**). This chamber contains the flap that prevents tidal flow upstream. **Appendix 16A**, **Plates 16.19** and **16.20** show the chamber during both low and high tides.

Cole Lane Sluice

16.5.38 Cole Lane Sluice is located at NGR 312781, 141607 (see **Figure 16.1**) and **Appendix 16A**, **Plates 16.21** and **16.22**). Here the stream flows under the flood defence embankment and into the Bristol Channel, draining the series of rhynes located to the south of the existing Hinkley Point Power Station Complex. Rhyne East is a ditch that flows around an area of farmland to the west of the Hinkley Point sewage treatment works and connects to West Brook at Sharpham Sluice. **Appendix 16A**, **Plates 16.21** and **16.22** illustrate Rhyne East with the flood defence embankment in the distance, together with a close-up view of Cole Lane Sluice.

Bristol Channel Tidal Levels

16.5.39 The Bristol Channel has one of the highest tidal ranges in the world, with a maximum predicted tidal range of over 13m at Hinkley Point between 2005 and 2025 (Ref. 16.61). Water levels can rise by more than 2m above predicted levels during adverse weather conditions. **Table 16.8** and **Table 16.9** show the design event still water levels for Hinkley Point and Stolford based on extreme tide levels provided by the Environment Agency (Ref. 16.62) and adjusted to 2017, 2100 and 2115 as per Defra 2006 prediction in PPS25 (Ref. 16.1). Estimates for climate change allowances are only available until 2115 in PPS25, as beyond this date there is much uncertainty surrounding climate change predictions, Tidal modelling has been carried out for the **Flood Risk Assessment** using these values for the 2100 baseline scenario.

Table 16.8: Environment Agency Extreme Still Water Levels for the Bristol Channel at HPC with Defra 2006 Climate Change Allowances (m AOD)

AEP %	Peak still water level (mAOD)			
	Baseline Environment Agency extreme water levels*	2017	2100	2115
1	7.74	7.77	8.60	8.82
0.5	7.84	7.87	8.70	8.92
0.1	8.09	8.12	8.95	9.17

*EA 2008 data relates to chainage location 326, off the coast of HPC.

Table 16.9: Environment Agency Extreme Still Water Levels for the Bristol Channel at Stolford with Defra 2006 Climate Change Allowances (m AOD)

AEP %	Peak still water level (mAOD)			
	Baseline Environment Agency extreme water levels*	2017	2100	2115
1	7.78	7.81	8.64	8.86
0.5	7.89	7.92	8.75	8.97
0.1	8.14	8.17	9.00	9.22

*EA 2008 data relates to chainage location 328, off the coast of the Stolford defences

Evapotranspiration

16.5.40 Evapotranspiration was determined from the Met Office Surface Exchange System (MOSES) database (Ref. 16.63). Potential and Actual Evapotranspiration, Effective Precipitation and Soil Moisture Deficit are calculated for grass and averaged land use categories for a 40km cell. The cell used for this study is centred on NGR 320000 140000, approximately 6km due south of the HPC development site. Parameters were calculated using meteorological data observed between 1961 and 2001. Over this period, the average annual Actual Evapotranspiration was 460.5mm/yr for the averaged land use class compared with an average annual Potential Evapotranspiration of 545.5mm/yr.

Rainfall

16.5.41 Average annual rainfall in the HPC development site area has been derived from a number of sources. It is generally accepted throughout the UK that, in the absence of long-term rainfall records, the catchment information provided by the Flood Estimation Handbook (FEH) CD-ROM Version 3.0 (Ref. 16.52) provides the most current information with respect to mean annual rainfall, however, this is for the period 1960 to 1990.

16.5.42 The FEH CD-ROM (Ref. 16.52) gives values for the annual average rainfall (also known as ‘Standard-period Average Annual Rainfall – SAAR) for the period 1960 to 1990 and these data are shown in **Table 16.10** for the surface water catchments illustrated in **Figure 16.3**.

16.5.43 It is shown in **Table 16.10** that annual average rainfall generally increases with distance inland, the likely result of increasing topography and associated orographic effects. A SAAR value in the range 747 – 753 mm/yr is considered to be the most applicable for the HPC development site.

Table 16.10: Standard-period Average Annual Rainfall (SAAR) for all the Catchments of Interest in the Hinkley Point Area (Based on FEH DDF Model)

Catchment Name	Catchment ID	SAAR (mm)
HPC Drainage Ditch	1	753*
Holford Stream west of the start of the channel	2	753
Holford Stream upstream of C182	3	752
Holford Stream upstream of Sharpham Sluice	4	748
Bum Brook upstream of C182	5	812
Stogursey Brook upstream of C182	6	854
Fluvial network upstream of Sharpham Sluice (with exception of Holford Stream and rhynes to south of Hinkley Point A and B)	7	825
Fluvial network upstream of Great Arch Sluice	8	817

**This catchment is not identifiable on the FEH CD-ROM and SAAR is assumed to be the same as that for Holford Stream catchment upstream of source*

16.5.44 A study into extreme precipitation events in the Hinkley Point area has been prepared for EDF Energy by the Meteorological Office in June 2010 (Ref 16.53) (see **Table 16.11**). This study provides both current day and climate change extreme rainfall estimates at Hinkley Point using a combination of observed and modelled rainfall amounts. The Met Office study sourced the current day extreme rainfall estimates from the FEH CD-ROM DDF rainfall model (Ref.16.52); these are reproduced in **Table 16.10**.

Table 16.11: Current day (2010) Extreme Rainfall Estimates at Hinkley Point (mm) for Different Storm Durations

% AEP	Duration		
	15 minute	1 hour	Daily
20	12.8	18.6	50.4
10	15.7	23	58.4
1	33.3	44.6	92.6
0.01	145.1	163.7	228.8

16.5.45 **Table 16.12** displays the rainfall depths for different storm durations for the HPC development site. These were derived from the FEH CD-ROM DDF rainfall model and were multiplied by 1.30 for the upper limit of confidence interval of 95% and then by 1.33 for climate change for winter 2070-2099 (Jacobs, 2010 (Ref. 16.57). These data were sourced from the report prepared for EDF Energy by the Met Office (Ref. 16.53).

Table 16.12: Rainfall Depths (mm) for Different Storm Durations for Hinkley Point C for 2070-2099 with a 95% Confidence Limit

% AEP plus climate change	Duration		
	15 minute	1 hour	Daily
20	22.1	32.2	87.1
10	27.1	39.8	101.0
1	57.6	77.1	160.1
0.01	250.9	283.0	395.6

16.5.46 It is also important to consider rainfall characteristics at a larger scale, such as those storm durations that influence flood events. A range of rainfall depths for storms of varying magnitude was derived from the FEH CD-ROM DDF rainfall model (Ref. 16.52). This is the recommended method for determining rainfall depth in the UK and has largely superseded the Flood Studies Report (FSR) method although the FSR (Ref. 16.64) is still widely used, not least because it is able to provide rainfall depths for event magnitudes with a 0.01% AEP whereas the DDF model is not recommended for events with an AEP less than 0.1% AEP.

Groundwater Recharge

16.5.47 Rainfall recharge provides the driving mechanism for groundwater flow at certain areas across the HPC development site. Groundwater springs out at outcrops of lower permeability strata and also provides baseflow to surface watercourses. It is likely that the watercourses are structurally controlled, with those flowing west to east following the trends of the strike faults and fold axes, and those flowing south-west to north-east following structures parallel to the Hinkley Point Fault (as well as following the topography to the Bristol Channel).

16.5.48 Given the topography and likely groundwater flow regime it is considered that the surface watercourses are, at least, in partial hydraulic continuity with the groundwater, probably with significant groundwater contributions to baseflow and possible groundwater recharge in places. However, in broad terms, in the north of the HPC development site and across Wick Moor conceptual modelling (described in detail in **Chapter 15**) shows that there is no significant hydraulic connectivity between surface waters and groundwater due to the presence of low permeability alluvium. Further details are provided within the groundwater discussions in **Chapter 15**.

iii. Flood Risk Overview

16.5.49 There are areas of the HPC development site that are located within Environment Agency Flood Risk Map Zones 2 and 3. Flood Zone 3 is characterised as having greater than a 1% AEP of river flooding or greater than a 0.5% AEP of tidally influenced river flooding or flooding directly from the sea. Flood Zone 2 is characterised as having greater than a 0.1% AEP of river flooding or tidal flooding. The Environment Agency tidal, fluvial and combined tidal and fluvial Flood Zones are illustrated in **Figures 16.5**, **16.6** and **16.7**.

Tidal Flood Risk

16.5.50 The Environment Agency flood zone map shows a section of the Holford Stream Valley in the Southern Construction Phase Area (SCPA) as lying within Flood Zone 3 based on the 0.5% AEP tide inundating the land to the west of the HPC development site, assuming no flood defences to be present. However, the area benefits from a flood defence embankment located between Hinkley Point and Stolford Point which provides protection to the valley from coastal flooding. A topographical survey carried out for the purposes of the **Flood Risk Assessment** found a minimum effective crest level of 8.23m AOD on the western section of the defence near to Hinkley Point, while higher levels, up to a maximum crest level of 9.39m AOD, were found near Stolford on the eastern end of the defence.

16.5.51 Modelling of the baseline 2017 and 2100 overtopping and breach events was carried out for the **Flood Risk Assessment**, the results of which are presented in **Figures 25**, **27**, **30** and **33** of the **Flood Risk Assessment**. The results indicate that flooding of Wick Moor, a cluster of houses near Fisheries Cottage and Chapel Cottages would occur during the overtopping of the coastal defences (**Figure 25** of the **Flood Risk Assessment**), with increased flood depths and extents should a breach of the defences occur (**Figure 27** of the **Flood Risk Assessment**). The modelling also indicates flooding at or near Little Dowden's Farm, Swallowcliffe, Fisherman's Cottage, Stolford Farm and some properties north of Croft Farm. The predicted depths and extents increase further during the 2100 events, affecting a further third party property in Stolford (Seaview), the C182 and the existing Sewage Treatment Works and national grid towers (pylons).

Fluvial Flood Risk

16.5.52 The **Flood Risk Assessment** provides a detailed assessment of the fluvial flood risk for the study area. The Environment Agency fluvial Flood Zone Map (**Figure 16.6**) shows there to be a small area of fluvial floodplain within Flood Zone 3 along the very southern boundary of the HPC development site, bordering Bum Brook.

16.5.53 The Environment Agency fluvial Flood Zone Maps only indicate flood risk for catchments greater than 3km^2. Therefore, this information cannot be relied upon to give a complete view of the baseline fluvial flood risk. As part of the **Flood Risk Assessment** modelling of the fluvial network of the local watercourses has been undertaken to establish the baseline flood risk zoning. The modelling carried out for the **Flood Risk Assessment** used 2017 as the baseline year.

16.5.54 The **Flood Risk Assessment** modelling indicates that some areas of the Holford Stream floodplain within the HPC development site area would be categorised as functional floodplain (Flood Zone 3b). The **Flood Risk Assessment** modelling also indicates a small area of flooding under the 5% AEP event near to the proposed Bum Brook emergency access road bridge that would be categorised as Flood Zone 3b.

16.5.55 The modelling showed that some off-site residential properties at Stolford (near Little Dowden's Farm) may have their gardens flooded to shallow depths for the 0.1% AEP event in 2017, defined as Flood Zone 2, see **Figure 50** of the **Flood Risk Assessment** which is a close match to the Environment Agency Flood Zone map (see **Figure 16.6**).

Groundwater Flood Risk

16.5.56 Groundwater flooding occurs when groundwater levels rise above surface elevations. This is most likely to occur in low-lying areas, such as the Holford Stream Valley at an elevation of 4 to 5m AOD and alongside the HPC Drainage Ditch at an elevation of 8 to 9m AOD. Modelling carried out for **Chapter 15** has shown that the groundwater bodies in the northern (BDAW and BDAE) and southern (SCPA) areas of the site are not linked. Impacts relating to groundwater have been assessed in **Chapter 15** and are not consider further in this chapter.

Surface Water (Pluvial) Flood Risk

16.5.57 Surface water (pluvial) flooding arises from intense rainfall that is unable to soak into the ground or exceeds the capacity of drainage systems, therefore running quickly off the land and resulting in localised flooding. The acceptance potential of the soil affects the run-off rates, which are displayed in **Table 16.5**. The aforementioned paragraph and **Table 16.5** show that the soils on the HPC development site have a very low rainfall acceptance which in turn results in high run-off rates.

Sewer Flood Risk

16.5.58 Localised flash flooding from blocked or overloaded sewer systems can occur at times of heavy rainfall. At present, there is only a small amount of drainage infrastructure on site and the potential to flood the HPC development site would be very limited.

Flood Risk from Reservoirs and Other Artificial Sources

16.5.59 Flooding from artificial sources includes reservoirs, canals and lakes where water is retained above the natural ground level. There are no existing artificial sources in the vicinity of the study area.

iv. Water Quality Baseline Overview

16.5.60 The surface watercourses that drain the proposed HPC development site which have been examined for the purpose of freshwater quality assessment are:

- The series of interconnected agricultural ditches that drain the BDAW and which ultimately discharge to the Hinkley intertidal area through HPC Drainage Ditch.
- Holford Stream that flows in an easterly direction across the Southern Construction Phase Area (SCPA).
- Bum Brook that flows in an easterly direction along the southern perimeter of the SCPA.
- Stogursey Brook which forms part of a catchment that includes Holford Stream and Bum Brook.

16.5.61 The locations of the surface watercourses on the HPC development site are presented in **Figure 16.1**.

16.5.62 There are no historical water quality data available for the surface watercourses draining any part of the HPC development site. The most relevant surface water quality data which is available is Environment Agency data for Stogursey Brook which is located to the south of the site. Stogursey Brook forms a confluence with

Bum Brook, which itself flows along the southern perimeter of the SCPA. Given that both watercourses and Holford Stream are within the same catchment with similar surrounding agricultural land use, their water quality characteristics may be expected to be similar. Data were sourced from the Environment Agency website (www.environment-agency.gov.uk) for the period 2002 to 2007 for a 4.4km reach of the Stogursey Brook with a grid reference for the upstream limit of the reach at NGR 317800, 142400. A summary of this limited data set is presented in **Appendix 16C**. Bum Brook and Holford Stream discharge into the WFD waterbody named as ‘Stogursey Brook’ (see **Appendix 16D** for the WFD waterbody table for Stogursey Brook, taken from Annex B of the South West River Basin District Management Plan (Ref 16.29)). The Stogursey Brook waterbody is currently at overall ‘Poor’ WFD standard with the objective of reaching ‘Good Ecological Status’ by 2015. A number of water chemistry elements are specifically listed in the Stogursey Brook waterbody table as supporting elements to the status description (where data has allowed specific characterisation). The existing ‘Poor’ WFD status is a result of elevated phosphorus conditions which is detailed as a supporting element that is very certain and is recorded in the historical EA dataset.

16.5.63 To augment the limited baseline data, a terrestrial surface water quality monitoring programme was carried out for EDF Energy in 2009, following consultations with the Environment Agency. Full details of the sampling programme and methodologies may be found within the ‘Summary of Terrestrial Surface Water Quality Non-Radiochemical Analysis Results (Campaigns 1-6 including WFD)’ (Ref 16.65). A summary of the monitoring programme is provided below.

16.5.64 Terrestrial surface water quality monitoring was undertaken on surface freshwater features (field ditches and streams) on the area proposed for the Built Development (BDAW and BDAE) between January and July 2009. Following campaign 3 (of the water quality monitoring programme) in April 2009, the geographical scope of the monitoring area was increased, to cover the SCPA. In order to gather a sufficiently comprehensive baseline of the water quality conditions on the SCPA, three additional sample locations were added during campaigns four, five and six. The locations of the freshwater surface monitoring points are shown in **Figure 16.8**. The additional monitoring points within the Southern Construction Phase Area are identified as SWA (Bum Brook), SWB (Holford Stream) and SWC (unnamed watercourse).

16.5.65 Water sample collection and recording of *in-situ* water quality parameters such as pH, dissolved oxygen and temperature was undertaken on an approximate monthly basis; six campaigns were undertaken in total, as discussed with the Environment Agency during the December 2008 consultation meeting. *In-situ* measurements were recorded using pre-calibrated field meters. The sample collection methodology and handling of samples was undertaken according to the methods described in the British Standard for Water Quality Sampling (BS EN ISO 5667: 2006) (Ref 16.66). Prior to collection, water samples were subject to *in-situ* radiological screening to identify any potential hazards for sampling staff and the testing laboratories receiving the samples. No samples were found to be above the threshold values for alpha and beta particles and gamma emissions throughout the sampling programme.

16.5.66 The main anticipated discharges to freshwater surface features during the construction phase are suspended solids, BOD and petroleum hydrocarbons. The expected BOD discharges are associated with grey and black waste water generated from contractor facilities. The baseline monitoring campaigns of the existing surface watercourses employed a wider range of chemical parameters to assist in assessing their water quality status. The suite of chemical analysis testing for terrestrial surface water samples, which was agreed in consultation with the Environment Agency included:

- suspended solids;
- Biochemical Oxygen Demand (BOD);
- Total Petroleum Hydrocarbons (TPH);
- total zinc;
- dissolved and total boron;
- chloride;
- ammoniacal nitrogen;
- nitrate; and
- total hardness.

Freshwater Environmental Quality Standards

16.5.67 The water quality guidance values that have been used to access the data from the terrestrial surface water monitoring campaign are detailed in **Table 16.13** and are based on freshwater Environmental Quality Standards (EQS) values and Drinking Water Standards (DWS). Directions have recently been issued (Ref. 16.9) by the UK Government to the Environment Agency which allow revised water quality environmental standards developed by UKTAG (United Kingdom Technical Advisory Group) for the WFD (Ref. 16.8) and Priority Substances Directive (Ref. 16.13) to be implemented. The WFD EQS values are presented in **Table 16.13** alongside previous standards. The references for the range of water quality standards used to examine the data are provided as notes to **Table 16.13.**

16.5.68 A number of water chemistry parameters are specifically listed in the Stogursey Brook WFD waterbody classification table as supporting elements to the status description (where data has allowed specific characterisation) and these have been used, together with the target status of 'Good' to define appropriate EQSs (see **Appendix 16D** and **Table 16.13**). In each case, the highest available status score has been chosen, given that the WFD (Ref. 16.8) dictates no deterioration of any component water quality parameter should occur. Thus the EQS most likely to be used as a regulatory threshold (by the Environment Agency) has been selected for monitoring data assessment purposes. For this assessment all surface watercourses have been compared to the Stogursey Brook WFD EQS standards (see **Appendix 16D**) because in some cases this is the relevant WFD freshwater waterbody downstream of the HPC development site and for the case of the agricultural ditches in the northern part of the HPC development site, it is the closest freshwater WFD waterbody. The locations of WFD designated waterbodies in the locality of the HPC development site are presented in **Figure 16.9**.

16.5.69 The determination of WFD EQSs for total ammonia, Biochemical Oxygen Demand (BOD) and Dissolved Oxygen (DO) are linked to the alkalinity status of a watercourse. In order to allow comparison with the WFD standards alkalinity has been retrospectively calculated as it has not been determined by sample analysis during the monitoring programme. It should also be noted that many of the EQS values listed relate to annual mean values or percentile values. Comparison of the freshwater monitoring data collected during 2009 with EQS values has been performed using calculated annual mean and percentile concentrations that have been derived from a limited number of sampling campaigns.

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Table 16.13 Guideline Freshwater Quality Standards used to Assess the Water Quality of Terrestrial Surface Water Features at Hinkley Point.

Determinand	Units	Minimum Reporting Value	Screening Value				
			Pre-WFD		WFD		
			DWS	Fresh-water EQS	WFD Type	Water-body and Status	WFD Standard
Total Zinc	(µg/l)	5	5,000[5]	75-500[2 AT9] (300-2000)[P]	Hardness related	Stogursey Brook – High[CPr] Note only 'good' standard presented in WFD directions.	125 [AT9]
Total Boron	(µg/l)	5	1,000[1 T]	2,000[2 AT]	-	-	-
Dissolved Boron	(µg/l)	5	1,000[1 T12]	2,000[2 AT12]	-	-	-
Sodium	(mg/l)	0.1	200[1]	170 [A11]	-	-	-
Ammonium, NH_4	(mg/l)	0.01	0.5[1]	1[12]	-	-	-
Total Ammonia as N	(mg/l)	0.1	-	1.3[4]	Alkalinity related	Stogursey Brook – Good[CPrP]	0.6[10]
Un-ionised Ammonia as NH_3	(mg/l)	-	-	0.025[7I]	-	-	-
Un-ionised Ammonia as N	(mg/l)	-	-	-	('Specific Pollutant' – Annex 8)	Stogursey Brook – Good[CPrA]	n/a
BOD	(mg/l)	2	-	6 [4]	Alkalinity related	Stogursey Brook – Good[PrP]	5 (90%)[10]
Chloride	(mg/l)	1	250[18]	250[3 A]	-	-	-
Nitrate	(mg/l)	1	50[1]	-	-	-	-
Suspended Solids	(mg/l)	5	-	25[7]	-	-	-
Total Hardness	(mg/l as $CaCO_3$)	10	-	-	-	-	-
Total Petroleum Hydrocarbons (C_8-C_{35})	(µg/l)	10	10[5]	50[6]	-	-	-
pH	pH units	0 (*In-situ*)	6.5-10[1]	6-9[I]	n/a	Stogursey Brook – High[CPrP]	6 (5%) 9 (95%)
Temperature	°C	n/a	-	-	Cyprinid	Stogursey Brook – High[CPrP A]	25 (98%)
Dissolved Oxygen	% saturation	0 (*In-situ*)	-	-	Alkalinity related	Stogursey Brook – High[CPrP]	70 (10%)[10]
Dissolved Oxygen	mg/l	0 (*In-situ*)	-	50%>8[G7] 100%>5[G7] 50%>7[I7]	-	-	-

Table notes:

- Derived Ammonia values are based upon calculations as presented in: Canadian Council of Ministers of the Environment (2010) (Ref. 16.67).
- WFD Standards are derived from 'The River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive)(England and Wales) Directions 2010 (Ref. 16.9).
- Drinking Water Standards (DWS) are not used as environmental thresholds where other EQS values are available.

A Annual Average

T Total

P 90% of results

I Imperative value

G Guideline Value

C Current WFD status;

Pr- Predicted WFD status by 2015;

\- Analysis not undertaken or not relevant;

1 The Water Supply (Water Quality) Regulations 2000 (Ref. 16.68).

2 National Environmental Quality Standards (EQS) – For List II substances. Source DoE Circular 7/89 (Ref. 16.69).

3 Environment Agency Non-Statutory (Operational) Environmental Quality Standards – source Table B11 (Ref.16.70).

4 River Ecosystem Classification (RE3) – (90^{th} percentile) (Ref. 16.71).

5 The Water Supply (Water Quality) Regulations 1989 (Ref. 16.72). N.B. These Regulations were superseded by the 2000 regulations therefore there is currently no UK DWS for zinc and/or Total Petroleum Hydrocarbons.

6 The Surface Waters (Abstraction) for Drinking Water (Classification) Regulations 1996 (Ref. 16.73). DW1 treatment (i.e. simple physical treatment and disinfection) limit.

7 2006/44/ EC Fish Directive, Cyprinid Fish Guideline. (Ref. 16.5).

8 Point of Monitoring/Compliance may be at samples leaving treatment works or at other supply point, e.g. consumer's taps.

9 Hardness related (Zinc toxicity is influenced by hardness. Specific EQS values (mg/l zinc) are given for different hardness ranges within the legislation. By comparing to the hardness value, the appropriate EQS concentration has been selected).

10 Alkalinity related. By comparing to the alkalinity value, the appropriate EQS concentration has been determined. Note that alkalinity has been calculated for the purposes of this report.

11 Non statutory/proposed EQS, but EQS never adopted in UK. Therefore value quoted is for guidance only.

12 No statutory EQS for dissolved Boron – adopted Total Boron value

16.5.70 All test parameters have corresponding EQS values, with the exception of nitrate for which comparison could only be made to the Drinking Water Standard. It should be noted that although reference is made to Drinking Water Standards (DWS) in **Table 16.13,** the watercourses located within the vicinity of the HPC development site, and which therefore may potentially receive discharges during the construction and operational phases, are not used for potable water abstraction.

2009 Freshwater Quality Monitoring Results

16.5.71 A summary of the findings of the terrestrial water quality monitoring campaigns has been reported in 'Summary of Terrestrial Surface Water Quality Non-Radiochemical Analysis Results August 2010' (Ref. 16.65). The summary report is presented in **Appendix 16E**. The conclusions from the monitoring programme are as follows:

- The water quality results are representative of what would be expected for shallow, turbid slow flowing watercourses and ditches draining agricultural land that typically show wide variation in water quality and flow characteristics which may depend, for example, on rainfall intensity and associated surface drainage from surrounding fields.
- The drainage ditches in the BDAW are ephemeral in nature and a number of sites were found to be dry on different sampling visits. The drainage ditches, Holford Stream and Bum Brook are not described as WFD waterbody units and therefore WFD EQS standards' are not applicable and are used for information purposes only.
- The threshold level exceedences with respect to adopted water quality assessment criteria that have been found for various parameters are considered typical for the type of watercourse present in these areas of the HPC development site (i.e. small agricultural drainage ditches).
- Baseline dissolved oxygen concentrations are low within both Holford Stream and Bum Brook, the only two watercourses that are considered to be able to support fish populations (due to the ephemeral nature of the other drainage ditches on the Built Development Area land).
- Elevated concentrations of BOD and suspended solids were a regular occurrence across the monitoring programme. Elevated concentrations of these parameters commonly occur in shallow, heavily sedimented surface waters, particularly in field drainage ditches associated with agricultural land. Temporal variation in BOD, in watercourses of this type may be attributable to a range of factors including prevailing weather conditions (e.g. rainfall) and inputs of organic matter (e.g. cut vegetation). Temporal variation in suspended solids concentrations may be attributable to re-suspension of fine bed sediments.

16.5.72 **Appendix 16B** presents a graphical summary of the terrestrial surface water data (and a comparison to relevant environmental thresholds) for:

- suspended solids;
- ammonia; and
- BOD.

In-Situ Water Quality Monitoring Results

16.5.73 The pH results across all sampling campaigns ranged from 6.8 to 8.3 pH units, which represented a range of conditions from close to neutral to slightly alkaline (basic). All pH readings across the HPC development site fall within a relatively restricted range and are typical of lowland freshwater watercourses. EQS values recently introduced for pH and temperature under the WFD have allowed the *in situ* results to be compared against revised statutory limits. The pH and temperature values at all monitoring sites were found to fall within the normal range specified under the WFD EQS.

16.5.74 A wide range of dissolved oxygen concentrations, ranging from 21.2% saturation (2.4mg/l at 11.3^{o}C) to 96.3% saturation (11.3mg/l at 8.5^{o}C) was recorded across the six campaigns. This is to be expected in shallow, slow flowing, freshwater watercourses. The drainage watercourses within the BDAW are not considered suitable to support fish populations due to the ephemeral nature of the flows within them and comparisons to dissolved oxygen environmental quality standards for the protection of fish are therefore not considered to be appropriate.

16.5.75 The concentration of dissolved oxygen from all locations was found to be below the EQS values set by the WFD (Ref 16.8). A comparison of the dissolved oxygen data from Holford Stream and Bum Brook with the WFD EQS is presented in **Table 16.14**. Comparison of dissolved oxygen monitoring results with EQS percentile values (WFD EQS is a 10 percentile value) should be made with caution, given that the results for Holford Stream and Bum Brook are based on a limited data set i.e. only three *in situ* measurements. The comparison with the WFD EQS values, which is consistent with the discussions above, suggests that baseline dissolved oxygen concentrations are low within both Holford Stream and Bum Brook. Dissolved oxygen concentrations within all other watercourses that were not monitored may be expected to be similarly low, given the shallow depths and the ephemeral nature of flows within this surface agricultural drainage system.

Table 16.14: Comparison of *in-situ* Dissolved Oxygen (DO) Concentrations for Holford Stream and Bum Brook with Standards Specified in the Water Framework Directive.

DO EQS (% saturation)	Holford Stream (% saturation)	Bum Brook (% saturation)
70[1]	36 [1,2]	51.4 [1,2]

Table notes:

1 10 percentile value.

2 Based upon 3 in situ measurements.

c) Potential Receptor Value and Sensitivity

i. Hydrology and Drainage Receptors

16.5.76 The hydrology and drainage receptors include the HPC Drainage Ditch, (plus a network of smaller agricultural ditches), the Hinkley Point intertidal area, Holford Stream, Bum Brook and Wick Moor. The value and sensitivity rating for the hydrological conditions of the Bristol Channel is considered to be negligible as the Bristol Channel has a very high assimilative capacity for additional discharges at the volumes which would be generated from the HPC development site areas.

Therefore, the Bristol Channel is not considered further as a receptor in this assessment.

16.5.77 The flood risk receptors include the HPC development site, areas of agricultural land to the west of the HPC development site, Wick Moor and third party properties (such as those in Stolford and the existing sewage treatment works south of the HPA and B complex). The value and sensitivity of the receptors are based on the information given in **Table 16.3** and are discussed in more detail in the sections that follow.

Hinkley Point C Drainage Ditch

16.5.78 HPC Drainage Ditch has a low value and sensitivity rating as it is a controlled water of moderate hydrological status with a moderate capacity to accommodate the proposed form of change. It has no social/community and economic value and is not a main river.

16.5.79 Its hydrological status is only of low value as it does not contribute to a licensed water abstraction point, a surface water reservoir, any hydropower scheme or any other water reliant industry such as a mill, a power station or a fish farm, and does not comprise an upstream catchment that contributes to an area served by a strategic flood alleviation scheme.

Hinkley Point Intertidal Area

16.5.80 Run-off draining from the northern part of the HPC development site discharges to the intertidal area. Any increase in surface water run-off rates would result in elevated volumes of water flowing across the intertidal area before entering the Bristol Channel, except during very high tides, when it would discharge directly into the sea water which reaches the base of the cliff under such tidal conditions. The run-off is therefore discharging either directly onto the intertidal area or into the sea.

16.5.81 The value and sensitivity of the receptors is assessed to be very low as neither receptor would be adversely impacted hydrologically by the discharge (as detailed in **Chapter 17**) and both would be tolerant to the proposed change.

Holford Stream

16.5.82 Holford Stream has a high value and sensitivity rating as it is a controlled, ordinary watercourse with a high local value in terms of its hydrological status such that selected designated habitats and/or species are potentially sensitive to change in hydrological regime.

16.5.83 Holford Stream discharges to Wick Moor which is part of the designated Bridgwater Bay SSSI, and forms part of a network of rhynes that are maintained and controlled by the Parrett Internal Drainage Board, which forms part of the SDBC. As such, Holford Stream is classified as a Viewed Rhyne.

16.5.84 It should be noted that this chapter is only concerned with the hydrological impacts on Holford Stream within Wick Moor and the impact on water quality. Any potential impacts on the ecological features of Wick Moor as a result of changes to the hydrology and water quality condition are considered in **Chapter 20** on **Terrestrial Ecology & Ornithology**.

Bum Brook

16.5.85 Bum Brook has a high value and sensitivity rating as it is a controlled, ordinary watercourse with a high local value in terms of its hydrological status such that selected designated habitats and/or species are potentially sensitive to change in hydrological regime.

16.5.86 Bum Brook bifurcates into West and East Brook which flow through Wick Moor, which is part of the designated Bridgwater Bay SSSI.

Wick Moor

16.5.87 Wick Moor comprises part of the designated Bridgwater Bay SSSI and Severn Estuary SPA and Ramsar site and is within the area controlled by the Somerset Drainage Board Consortium (SDBC). It should be noted that the ecological value of Wick Moor is high for terrestrial ecological receptors. Indirect impacts on marine or terrestrial ecological receptors are addressed in **Chapters 19** and **20**, respectively.

16.5.88 During low flows Wick Moor requires enough water throughout the year to maintain a high water table level to support its nature conservation interests, therefore it is sensitive to the low flow regime and the value and sensitivity of Wick Moor is assessed to be high.

16.5.89 During high flows Wick Moor lies within Flood Zone 2 and 3. During high flows or a flood event the area is moderately tolerant to changes in water levels and is classed as a 'less vulnerable' receptor in PPS25 (Ref. 16.1). Therefore it has been given a value and sensitivity rating of medium during these events.

Agricultural Land Off-site to the West of the HPC development site and Holford Stream

16.5.90 This area of land is located within Flood Zone 2 with a small section in Flood Zone 3 and is classified as a 'less vulnerable' receptor in PPS25 (Ref. 16.1). The Environment Agency Flood Zone maps do not take the presence of flood defences into account, therefore the flood risk is only residual as it would only occur as a result of a breach of the coastal defences (see **Figure 16.5**). Therefore, the hydrology and drainage value and sensitivity is assessed to be medium.

Agricultural Land Off-site to the West of the HPC development site and Hinkley Point C Drainage Ditch

16.5.91 The value and sensitivity of land in this area is determined by its hydrological status. This land is within Flood Zone 1 (see **Figure 16.5**) and is classified as a 'less vulnerable' receptor in PPS25 (Ref. 16.1), and thus is assessed as being of low hydrological value and sensitivity.

Land Off-Site Adjacent to Bum Brook

16.5.92 This land is located in the fluvial Flood Zones 2 and 3 and is classified as a 'less vulnerable' receptor in PPS25 (Ref. 16.1). Therefore the hydrology and drainage value and sensitivity is assessed to be medium as (see **Figure 16.6**).

Third Party Properties

16.5.93 There are a number of third party properties in the study area. There are several residential properties in the Stolford and Wick Moor area; in addition the existing HPB Sewage Treatment Works (STW) is located in Wick Moor as are several national grid towers (pylons). These receptors are potentially affected by the displacement of flood storage resulting from the placement of materials arising from excavations for the HPC construction works to provide platforms upon which construction activities will occur within the Holford Stream Valley.

Residential Third Party Properties

16.5.94 The third party residential properties have a high value/sensitivity due to their social and economic value and also because of their location in Flood Zones 2 and 3 (see **Figure 16.7**) and their 'more vulnerable' classification in PPS25 (Ref. 16.1).

16.5.95 The off-site highway improvement works may also result in an impact to third party residential properties and/or land. Six of the schemes are located in Flood Zone 2 and/or 3. These third party properties also have a high value/sensitivity due to their social and economic value and their 'more vulnerable' classification in PPS25 (Ref. 16.1).

Non Residential Third Party Properties

16.5.96 The non-residential third party receptors will have a medium value and sensitivity as the STW are classed as 'less vulnerable' and towers (pylons) as 'essential infrastructure' in PPS25 (Ref. 16.1).

ii. Water Quality Receptors

16.5.97 The terrestrial surface water quality receptors are the HPC Drainage Ditch (which is the principle receiving watercourse for the field drainage network in the BDAW), Holford Stream and Bum Brook. Wick Moor is not considered as a receptor for water quality impacts as any potential effects will be negated by affording protection to water quality in Holford Stream and Bum Brook which form part of the upstream catchment. Freshwater discharges to the intertidal area and marine environment are not examined within this chapter and have been assessed within **Chapter 18** on **Marine Water and Sediment Quality**. A summary of the value and sensitivity of freshwater quality receptors is presented in **Table 16.15**.

Hinkley Point C Drainage Ditch

16.5.98 The proposed HPC construction works may impact upon the water quality conditions in the series of interconnecting agricultural drainage ditches that drain the Built Development Area West. These ditches discharge into the HPC Drainage Ditch that ultimately discharges to the Hinkley Point intertidal area. These watercourses are supplied with water from surface drainage running off surrounding agricultural land. The water quality status is characterised by highly variable water quality conditions, including elevated concentrations of suspended solids. The watercourses are ephemeral in nature, drying out during prolonged periods without rainfall. Given the current baseline conditions, the value and sensitivity of these watercourses has been assigned as low.

Holford Stream and Bum Brook

16.5.99 The freshwater watercourses that drain the Southern Construction Phase Area, (Holford Stream and Bum Brook) may be described as having a moderate water quality status, based on the available water quality monitoring data and historical information for Stogursey Brook which forms part of the same catchment.

16.5.100 Bum Brook, and in particular Holford Stream, are important water supply streams to the Bridgwater Bay SSSI which lies downstream and to the east of the HPC development site. The designation of the Bridgwater Bay SSSI relates to the mosaic of habitats present, such as coastal grazing marsh, saltmarsh and mudflat that are intersected by a network of brackish and freshwater ditches. The communities of plants and invertebrates that are associated with this complex water dependent ecosystem are listed within the SSSI citation. Due to the water dependent nature of this SSSI, Holford Stream and Bum Brook are considered to be sensitive to any potential water quality or flow changes and have therefore been assigned a high sensitivity and value.

Summary of Receptor Value and Sensitivity

16.5.101 The value and sensitivity of the various receptors is summarised in **Table 16.15**. **Table 16.3** should also be read in conjunction with this section.

Table 16.15: Summary of Receptor Water Quality and Hydrological Value and Sensitivity

Receptor	Value and Sensitivity	
	Rating	Summary Explanation
HPC Drainage Ditch	Low	*Hydrology* The land adjacent to the ditch is located in Flood Zone 1, therefore is not sensitive to flooding impacts Not Main River No social or economic dependents
	Low	*Water Quality* Highly variable water quality conditions with elevated suspended solids Open agricultural surface drainage system Ephemeral nature
Hinkley Point intertidal area	Very Low	*Hydrology* Receptor identified as being tolerant to the proposed change
	Not applicable	*Water Quality* Not assessed within **Chapter 16** (see **Chapter 18**)
Holford Stream	High	*Hydrology* The land adjacent to the stream is located in Flood Zone 2 and 3, therefore is sensitive to flooding impacts Somerset Drainage Board Consortium Viewed Rhyne
	High	*Water Quality* Moderate water quality status Important water supply to freshwater wetland habitats of Wick Moor and Bridgwater Bay SSSI

Receptor	Value and Sensitivity	
	Rating	Summary Explanation
Bum Brook	High	*Hydrology* The land adjacent to the stream is located in Flood Zones 2 and 3, therefore is sensitive to flooding impacts
	High	*Water Quality* Moderate water quality status Important water supply to freshwater wetland habitats of Wick Moor and Bridgwater Bay SSSI
Wick Moor	High	*Hydrology- During low flows* High sensitivity to low flows due to the sensitivity of the water table Located in SDBC area
	Medium	*Hydrology- During high flows* Some tolerance to high flows and flood events. Classed as a ‘less vulnerable’ receptor in PPS25 (Ref. 16.1) Located in SDBC area
	Not applicable	*Water Quality* Not assessed as protection provided to water quality in upstream catchment
Agricultural land off-site of the HPC development site west of Holford Stream	Medium	*Hydrology* Located in residual tidal Flood Zone 2 and 3 Classed as a ‘less vulnerable’ receptor in PPS25 (Ref. 16.1)
	Not applicable	*Water Quality* Not applicable
Agricultural land off-site from the HPC development site west of HPC Drainage Ditch	Low	*Hydrology* Located in Flood Zone 1 Classed as a ‘less vulnerable’ receptor in PPS25 (Ref. 16.1)
	Not applicable	*Water Quality* Not applicable
Land off-site adjacent to Bum Brook	Medium	*Hydrology* Located in fluvial Flood Zones 2 and 3 Classed as a ‘less vulnerable’ receptor in PPS25 (Ref. 16.1)
	Not applicable	*Water Quality* Not applicable
Residential third party properties	High	*Hydrology* High social value Classed as a ‘more vulnerable’ receptor in PPS25 (Ref. 16.1) Located in Flood Zones 2 and 3
	Not applicable	*Water Quality* Not applicable

Receptor	Value and Sensitivity	
	Rating	Summary Explanation
Non residential third party properties	Medium	*Hydrology* Classed as a 'less vulnerable' or 'essential infrastructure' receptor in PPS25 (Ref. 16.1) Located in Flood Zones 2 and 3
	Not applicable	*Water Quality* Not applicable

d) Statutory Constraints

16.5.102 There are no statutory constraints which have restricted the collection of baseline data, analysis and interpretation of information or the assessment of impacts within the environmental impact assessment of the HPC development with regards to surface water quality or quantity.

16.5.103 Statutory constraints in terms of flood risk are discussed within the **Flood Risk Assessment**.

16.6 Assessment of Impacts

16.6.1 This section of the chapter assesses the identified potential impacts on surface drainage and water quality receptors both within the HPC development site and for any off-site associated receptors that may be affected from changes to the hydrology or water quality status of local watercourses. An outline description is provided of the proposed surface and foul water drainage strategy to demonstrate how these systems will evolve and be managed through all phases of the development. The description of the drainage system provides identification of the discharge locations for surface drainage and waste water from the site during site preparation, construction, operation and restoration phases.

16.6.2 The key design feature of the drainage system is the provision of Water Management Zones (WMZs) to treat to a suitable quality and attenuate, where necessary, water requiring discharge from the HPC development site into the local surface water features. A full assessment of all identified potential impacts in terms of hydrology, flooding and water quality are provided in this chapter. This includes an assessment of risks from accidents and incidents and the approach that has been adopted to minimise their probability of occurrence and incident management. Cumulative impacts are also assessed for interactive impacts that may occur as a result of the different activities taking place on the site simultaneously.

16.6.3 Legislative compliance dictates that an Environmental Permit (which includes discharge consents) will be required by the site operator for water discharges to be released. By definition of compliance with a consent to discharge (under the Environmental Permitting Regulations 2010 (Ref. 16.17)), a legal discharge will not significantly adversely affect the receiving environment. The drainage system incorporates design features such as WMZs that have been developed to ensure compliance with the requirements of Environmental Permits in terms of discharge water quality and rate. The assessment of impact magnitude takes into account this range of design measures, which have been developed to reduce the potential for hydrological and surface water quality impacts to occur (and are therefore not considered to be additional mitigation measures for the purposes of this assessment).

a) Surface Water Drainage System

16.6.4 A summary description of the Surface Water Drainage Strategy through all phases of the HPC development is outlined below and is presented in **Chapters 2** and **3** of this volume. The assessment of the potential water quality, hydrology and drainage impacts has taken into account the evolution of the drainage systems throughout the lifetime of HPC.

16.6.5 In terms of the drainage strategy, the site is divided into two areas which are the combined area of the BDAW (Build Development Area West) and BDAE (Build Development Area East) and the SCPA (Southern Construction Phase Area) which is considered separately. The proposed earthworks will result in infilling of the existing agricultural drainage ditch system in the BDAW and BDAE areas including the HPC Drainage Ditch.

16.6.6 The construction drainage system will be fully compliant with applicable current legislation, regulations and guidance, ensuring that water is discharged to the identified receptors at rates and of a chemical quality that ensure that discharge conditions are met. Discharges to Holford Stream and Bum Brook will be at controlled greenfield rates to minimise downstream impacts.

16.6.7 A site-specific **Water Management Plan** will provide details of the manner in which the preliminary works and main construction works phases should be undertaken (by earthworks contractors for example) to ensure Environmental Permit requirements in relation to protection of the local surface water features, are met.

i. Drainage Strategy Phases

16.6.8 There are five main phases of the drainage system strategy:

- Phase 1: site preparation;
- Phase 2: construction;
- Phase 3: transition from construction to operational phase drainage system;
- Phase 4: landscaping and restoration works (only on SCPA);
- Phase 5: operation; and
- Phase 6: BDAE and BDAW decommissioning.

Phase 1: Site Preparation Drainage System Strategy

16.6.9 During the site preparation works phase, surface drainage collected in the BDAE and BDAW will initially be directed towards the HPC Drainage Ditch having been routed through a WMZ. The HPC Drainage Ditch will initially retain its existing discharge to the Hinkley Point intertidal area at the northern boundary of the site. The discharge point will move to the new Foreshore Construction Outfall structure once it is constructed and commissioned. As the site preparation works progress the agricultural drainage ditches including the HPC Drainage Ditch will be backfilled and the surface drainage system for the main construction phase installed. It will be necessary through all drainage phases to provide a connection for draining the part of the HPC Drainage Ditch which is located outside and to the west of the BDAW, through the drainage system in the northern part of the site. This construction phase system for drainage of the northern part of the HPC development site will discharge via a single new outfall to the upper foreshore area. Additional WMZs will be developed to manage discharges into the installed construction phase drainage system within the BDAW and BDAE.

16.6.10 The spine drains, which will form the principal drainage pathways during the construction phase (see below) will be constructed during the site preparation phase.

16.6.11 During this phase the Holford Stream culvert will be constructed. There will be two surface water discharge points established into Holford Stream at the eastern and western ends of the culvert. A temporary surface drainage system will be developed for the stockpiling and platform areas in the SCPA that will collect run-off and direct it to WMZs for management and treatment prior to discharge into Holford Stream.

Phase 2: Construction Drainage System Strategy

16.6.12 The main elements of the construction drainage system will already have been installed during the site preparation works. Within the BDAE and BDAW surface drainage and dewatering discharges will continue to be directed to one of three WMZs. The WMZs will provide treatment of discharges to ensure that quality conditions of Environmental Permits are met. There are no greenfield run-off attenuation requirements since all surface water, groundwater and treated effluent will discharge via the Foreshore Construction Outfall.

16.6.13 WMZs will be located in the north, east, west and south of the site to control the discharge of water from run-off and dewatering activities. This phase will also see the ongoing operation of Holford Stream culvert. During this phase of works surface drainage and other wastewaters from the BDAW and BDAE areas will discharge through the construction phase drainage system to the Foreshore Construction Outfall.

16.6.14 Surface drainage from the SCPA will continue to be directed through WMZ to two discharge points into Holford Stream. The WMZs will provide treatment of surface drainage to ensure that quality conditions of Environmental Permits are met and that discharges are made at greenfield run-off rates.

16.6.15 The construction drainage systems will be designed such that no flooding to third party receptors will result from rainfall events up to the 1% AEP event plus allowance for climate change.

Phase 3: Transition from Construction to Operational Phase Drainage System

16.6.16 During the construction phase there will be a periodic evolution from the construction phase drainage system described above to the operational phase permanent drainage system as elements of the permanent infrastructure are progressively installed. In some areas, the permanent systems may use parts of the construction drainage infrastructure. In these cases, the connections will be arranged to ensure that the drainage is managed throughout the transition from temporary to permanent systems. It may be that some elements of the construction phase drainage will form part of the permanent drainage system. Parts of the temporary drainage systems within the permanent power station site will be in use until relatively late in the construction works when the cooling water outfall tunnel has been commissioned.

16.6.17 The part of the construction phase drainage system, not incorporated into the permanent operational system to the north of Green Lane within the permanent development area will be made redundant. Some elements of the construction phase drainage system may be left in position for the operational phase but will effectively be redundant.

Phase 4: Landscaping and Restoration Works in SCPA

16.6.18 During and following the landscaping works on surrounding areas the gradual removal of elements of construction phase drainage system will be undertaken. This will include elements of the WMZs, SuDS features including ditches and swales, and outfall structures. The Holford Stream culvert will be retained together with all the associated features, such as energy dissipation measures and the adjacent drains. Further details on the Holford Stream culvert are provided below.

16.6.19 During the landscape restoration activities, the WMZs will be retained and are likely to be resized appropriately to accommodate the expected lower surface water run-off during this phase and thereafter. An additional WMZ will be developed for works associated with early landscaping of southern areas of the SCPA to manage surface drainage within this area, prior to a discharge into Bum Brook. In addition a network of ditches throughout the SCPA area is also proposed; these ditches will provide some attenuation of surface water flows and encourage biodiversity.

Phase 5: Operational Drainage System Strategy

16.6.20 The permanent drainage system will be designed to cope with rainfall events up to the 1% AEP standard without surface flooding due to overloading of the drainage network. The drainage system in combination with the final restored landscape and sea wall design, will also be designed to discharge any wave overtopping of the sea wall up to a rate of 10 litres/ linear m/s. This is far in excess of the estimated peak overtopping discharge of approximately 1.5 litres/linear m/s during the 0.01% AEP event (Ref. 16.74). Additionally, the operational drainage design will ensure that surface water flooding that might arise during events that exceed the design standard will be effectively managed such that the consequences will be minimised up to the 0.01% AEP event.

16.6.21 The permanent drainage will include a groundwater drainage system, designed to maintain groundwater levels to no higher than about six metres below the power station platform level (which will be at 14m AOD), in order to limit the flotation forces which might otherwise be caused by groundwater pressure on deep building foundations and sub-surface structures.

16.6.22 As described in **Chapter 2** of this volume, the surface and groundwater drainage systems will be routed into the attenuation pond before being discharged to the Severn Estuary via the cooling water outfall tunnel.

Phase 6: Decommissioning Operational Drainage System Strategy

16.6.23 Following secession of generation the use of the cooling water outfall tunnel will no longer be available. It will be necessary to disconnect the outfall pipe, which passes all surface water flows, from the attenuation pond and provide an alternative outfall.

16.6.24 The existing surface water drainage network will be abandoned in a staged process as demolition of buildings and structures proceeds.

16.6.25 At the appropriate stage, a ditch will be provided to link the existing HPC Drainage Ditch through the site to the Foreshore Construction Outfall. This will provide for continuity of discharge and a facility for draining the BDAE and BDAW when restored to a greenfield site.

ii. Foul Water Drainage Systems

Phase 1: Site Preparation Phase

16.6.26 During the site preparation works phase, grey and black water generated by contractors facilities will either be sent to sealed underground tanks for off-site disposal. Package wastewater treatment works will be installed during this phase of works but will not be operated until the main site construction phase commences in 2013.

Phase 2: Main Site Construction Phase

16.6.27 Grey water (e.g. from wash basins) and black water (e.g. from toilets) arising during this phase will be collected by a temporary foul drainage network and directed towards the three package treatments plants located in the BDAW and BDAE. Treated waste water effluent from package treatment works, will discharge to the intertidal area via the spine drain system and the Foreshore Construction Outfall (see **Chapter 18**).

16.6.28 Grey and black water generated from the accommodation campus will be discharged via temporary foulwater drains to a dedicated temporary package sewage treatment plant. Treated final effluent will towards a WMZ associated with the discharge into Holford Stream at the eastern end of the culverted reach. This is the only treated effluent that will be directed towards a terrestrial surface watercourse and the discharge will be subject to volume and quality controls under an Environmental Permit.

Phase 3: Operational Phase

16.6.29 Grey water (e.g. from wash basins) and black water (e.g. from toilets) that is generated during the operation of the power station will be collected and discharged through a permanent foulwater drainage network to the permanent wastewater treatment works. Treated final effluent will be discharged to the attenuation pond for discharge via the cooling water outflow tunnel. The assessment of these discharges to the marine environment is presented in **Chapter 18**.

Phase 4: Decommissioning Operational Foulwater Drainage System

16.6.30 At some time after secession of generation the use of the cooling water outfall tunnel as a wastewater disposal route will no longer be available. It will be necessary to disconnect the final effluent pipe from the attenuation pond and provide an alternative outfall. It is intended that the Foreshore Construction Outfall will be used for this purpose.

16.6.31 The wastewater treatment facility can continue to be used during decommissioning of the main operational site and to serve the Interim Spent Fuel Storage Facility which will remain in use until 2140. However, it may be necessary to modify the treatment plant in order that it can maintain final effluent standards whilst treating reduced wastewater volumes. Alternatively a new treatment plant may be required.

16.6.32 The existing foulwater drainage network will be abandoned in a staged process as demolition of buildings and structures proceeds.

iii. Holford Stream Culvert

16.6.33 During the construction phase, Holford Stream will be culverted from a point close to the western boundary of the HPC development site across to the eastern boundary of the site, where it will discharge water into the existing open Holford Stream watercourse. At the upstream face of the culvert, flow from Holford Stream will be diverted into a prefabricated box culvert, approximately 2.5m wide by 2.5m high (see Holford Stream Culvert Justification Report Ref 16.55), which will run parallel to the existing watercourse alignment at a distance of approximately 50m to the north. The culvert will run almost the entire width of the site, with a total length of approximately 690m. The culvert has been sized to enable access for small plant such as a bobcat for maintenance and inspection purposes. The culvert fall in a west to east direction will be approximately 1m, dropping from 6m AOD to 5m AOD. Energy dissipation measures will be implemented at the outfall of the culvert to reduce flow velocities.

16.6.34 The base of the culvert will be impermeable to prevent transmission losses through the channel bed when groundwater levels are low. However, adjacent to and along the length of the culvert, two 500mm drains will be installed and backfilled with sand/gravel to allow groundwater to be collected and discharged at the eastern end of the culvert (when groundwater levels are high enough).

iv. Water Management Zones

16.6.35 Surface water discharges to the HPC Drainage Ditch (during the site preparation phase), the intertidal area, Holford Stream and Bum Brook will be routed via respective WMZs. Sufficient surface water storage capacity is provided within the WMZs for pre-discharge treatment in order that conditions of Environmental Permits for discharges are met and, where necessary, to control discharge rates.

16.6.36 The WMZs discharging to Holford Stream and Bum Brook will be designed to store water up to the 3.33% AEP storm with discharge limited to greenfield discharge rates. To prevent inundation in times of flooding, bunds will be built around the two Holford Stream WMZs. The **Flood Risk Assessment** states that the height of bund around the eastern WMZ determined by modelling for the 1% AEP fluvial flood level in the watercourse, should be no less than 6.1m AOD, which includes a freeboard of 300mm. The bund is intended to prevent potential pollutants and sediments stored within the WMZs from being washed into the watercourses in the event of a fluvial flood.

v. Soil Retaining Wall

16.6.37 A temporary soil retaining wall will be constructed during the site preparation works phase at a location inland of the existing cliff edge as detailed in **Volume 1**, **Chapter 6**. This will be set back at least 10m from the cliff edge. Any construction drainage from around the working area for this structure would be collected and discharged following routing through a WMZ into the site preparation drainage system (either the HPC Drainage Ditch or the spine drains) and ultimately to the intertidal area. The retaining wall will become redundant and effectively replaced by the sea wall following its construction (during the construction phase).

vi. Sustainable Drainage Systems

16.6.38 Good practice measures will be adopted to reduce, where possible, the volume of surface drainage being collected and requiring disposal through discharge. By restricting drainage run-off rates, the erosion of bare soils would be reduced leading to a reduction in potential sediment generation. The use of the Sustainable Drainage System (SuDS) principle of porous surface is not deemed practical within the BDAW and BDAE for two principle reasons:

- There is no requirement for attenuation given that discharges of surface drainage are made directly to sea.
- There will be an on-going requirement for groundwater dewatering in order to avoid the risk of flotation to buildings due to groundwater pressure. Therefore the ground infiltration of surface drainage through SuDs would effectively contribute to a requirement for increased dewatering efforts.

16.6.39 SuDS principles will be adopted where practical within the SCPA. These would include the use of porous hard surface areas and, where soil conditions allow, the adoption of soakaway systems for disposal of uncontaminated surface drainage water.

16.6.40 The groundwater that has been recharged from the SuDS system would be low in suspended solids as the soakaway system would effectively remove solids through soil filtration.

vii.Provision for Emergency Run-off During the Construction Phase

Construction Phase

16.6.41 Provision would be made for rainfall events that exceed the normal design criteria for drainage systems in order to minimise the consequences associated with inundation of systems and potential failure/breach of water storage infrastructure. For example, the construction phase drainage system will be designed to a 3.33% AEP standard and any excess water will be controlled and temporarily stored on site up to and including the 1% AEP rainfall event plus allowance for climate change. Guidance with respect to designing for exceedence is given in CIRIA Manual 635 (Ref. 16.46). Such contingencies might include, but not be limited to:

- Locating water management infrastructure such that any flooding will be channelled to designated areas in which water can be contained by natural topographic features or by constructed bunds that would comprise a secondary line of defence. These provisions should minimise the risk of accidental discharges to controlled waters that would breach planning conditions or Environmental Permit conditions, with the exception of very low probability events.

- Allowing excess water to be channelled into excavations making sure that no damage is incurred to infrastructure already constructed within them. Under these circumstances sufficient pumping capacity would be made available to allow post-event dewatering of the excavations and agreed routes of disposal of water made with the regulator.

16.6.42 Run-off management during the operational phase is discussed above.

b) Off-site highway improvements

16.6.43 In addition to the main HPC development site, consideration has been given to the eleven off-site highway improvement works. The highway improvement schemes apply to existing roads and junctions and details and locations of each improvement scheme may be found in **Volume 2**, **Chapter 2** of this ES. Details of those schemes for which surface water interactions are notable are provided below.

16.6.44 The scope of each scheme has been investigated in relation to the surrounding surface water environment. The limited nature of the works (primarily road traffic management changes and existing junction widening) dictates that the existing road drainage will be sufficient to mitigate against any significant impacts to the water quality status of the nearby watercourses. Good construction practices will be sufficient to prevent any additional potential water quality impacts during the construction of the schemes.

16.6.45 Two schemes were not included in the highway improvements works **Flood Risk Assessment** as they were within Flood Risk Zone 1 and less than one hectare in size; therefore a **Flood Risk Assessment** was not required. These were the Claylands Corner Junction scheme and the Cannington Traffic Calming Measures scheme.

16.6.46 The **Flood Risk Assessment** concluded that six of the schemes would result in a net increase in impermeable surface area, four of which are located within Flood Risk Zone 2 or 3. The schemes would not result in a decrease in flood plain storage. Any increase in flood risk would arise from a very limited increase in surface water run-off.

Table 16.16: Off-site Highway Improvements that will Result in Increases in Impermeable Areas (Source: Highway Improvement Works **Flood Risk Assessment**) and Environment Agency Flood Risk Zone

Site	Site Area (ha)	Net Increase in Impermeable Area (m^2)	EA Flood Risk Zone
A39 Broadway/A38 Taunton Road Junction	0.9	0	3
Wylds Road/ The Drove Junction	0.5	352	3
A38 Bristol Road/Wylds Road Junction	0.4	404	3
A38 Bristol Road/The Drove Junction	0.3	0	3
A39 New Road/B3339 Sandford Hill Roundabout	0.6	376	3
M5 Junction 23 Roundabout	4.1	587	3

Site	Site Area (ha)	Net Increase in Impermeable Area (m^2)	EA Flood Risk Zone
Washford Cross Roundabout	1.5	782	1
C182/Farringdon Hill Lane, Horse Crossing	1.2	117	1

16.6.47 Six schemes have the potential to impact the surface water run-off, these are.

- Wylds Road/The Drove Junction – increasing width of road.
- A38 Bristol Road/Wylds Road Junction – increasing width of road.
- A39 New Road/ B3339 Sandford Hill Roundabout – new roundabout.
- M5 Junction 23 – increasing width of road.
- Washford Cross – new roundabout.
- C182/Farringdon Hill Lane, horse crossing – new crossing point.

16.6.48 Third party residential properties/land adjacent to highway improvement works may have an increased risk of flooding as a result of larger run-off due to greater impermeable areas (Wylds Road/ The Drove Junction; A38 Bristol Road/Wylds Road Junction; A39 New Road/B3339 Sandford Hill Roundabout; M5 Junction 23 Roundabout; Washford Cross Roundabout; and C182/Farringdon Hill Lane, Horse Crossing). However, any potential increase in run-off will either be managed within the existing highway drainage system, or the improvement works will include measures to improve the highway drainage system to reduce the surface water flood risk. Therefore the potential impact magnitude associated with elevated surface water run-off to the third party property/land is assessed to be very low and of minor significance and as a result the schemes are not given any further consideration within this chapter.

c) Construction Impacts

i. Hydrology and Drainage Construction Impacts

16.6.49 A full description of the construction phase activities is provided in **Volume 2**, **Chapter 3**. This element of works includes the site preparation works and the temporary jetty development. However, the key elements of the construction phase works which may impact the hydrology and drainage, are:

- creation of bare earth surfaces due to the stripping of topsoil and vegetation;
- changes to topography due to site levelling and terracing, stockpiling, deep excavations for the two UK EPR units; and the early landscaping works south of the 144750mN grid line;
- construction of semi-permeable and impermeable surfaces, such as the site entrances, roundabouts, site internal roads, site compounds areas, accommodation campus, substation, Nuclear Island, Conventional Island, ancillary buildings, sea wall and off-site highway improvements works;
- construction of an emergency access road including the bridge crossing over Bum Brook;

- installation of the construction phase drainage system and implementation of the surface water and sediment management system to include the following;
  - infilling of agricultural ditches and construction of a drain to intercept the upstream area of the HPC Drainage Ditch catchment at the western boundary of the HPC development site;
  - construction of three main spine drains and associated WMZs within the northern part of the site;
  - construction of a single outfall to the Hinkley Point foreshore;
  - culverting of a section of Holford Stream;
  - construction of two WMZs and two outfalls draining the southern part of the site to Holford Stream to facilitate discharge conditions; and
  - construction of one temporary WMZ and outfall to Bum Brook during the early landscaping works.

16.6.50 Common hydrology and drainage impacts, resulting from construction activities, will not occur in isolation and therefore have been grouped and are considered cumulatively.

16.6.51 A number of the works elements are likely to require some dewatering of excavated areas. Impacts to the groundwater regime as a result of dewatering are assessed within **Chapter 15** of this volume. As the lower section of HPC Drainage Ditch catchment including the ditch itself is to be removed during the deep excavations and replaced with new drainage infrastructure, there would be no further impact to the ditch catchment and drainage ditch once the relevant works are completed and therefore this drainage feature is not assessed beyond the construction phase of works.

16.6.52 Potential impacts common to the above activities include:

- elevated surface water run-off volume and run-off rates;
- pluvial flooding as a result of elevated surface water run-off;
- fluvial flooding due to a reduced channel capacity as a result of elevated sediment deposition in channels;
- fluvial flooding as a result of blockages in culverts and/or bridges;
- reduced flood storage capacity for flood waters resulting in:
  - increased flood risk to off-site receptors due to fluvial flooding; and
  - increased flood risk to off-site receptors due to tidal flooding;
- changes to Holford Stream hydraulic conditions.

16.6.53 The land-based elements of the construction phase works that have the potential to have an impact on surface water run-off (and which have been considered herein) include:

- the creation of bare earth surfaces (vegetation removal and topsoil stripping and stockpiling);

- changes to topography (cut and fill operations and the levelling and creation of construction and development platform areas); and
- creation of impermeable and semi-permeable surfaces (impermeable surfaces such as the access road, roundabouts, car parks, buildings and off-site highways improvements and semi-permeable surfaces such as the internal haul roads).

Creation of Bare Earth Surface

16.6.54 The creation of bare earth surfaces during the construction activities could increase the surface water run-off rate for the following reasons:

- reduced near-surface water retention due to the removal of the vegetated layer and compaction by vehicles and plant;
- reduced soil moisture deficit causing a potential increase in the propensity for saturation excess overland flow;
- increased propensity for infiltration excess overland flow resulting from the compaction of the bare earth surface;
- compounding effects of reduced surface roughness increasing the overland flow rate; and
- increased overland flow leading to channelisation via rills which would further enhance run-off rates.

16.6.55 Assuming that a storm event is preceded by a period of dry weather and that the soil moisture deficit (SMD) is relatively high, if the rainfall does not exceed the infiltration rate of the soil under these conditions then water would normally be stored within the vegetated layer. Vegetation removal would cause a reduction in average SMDs due to reduced evapotranspiration, with the result that saturation excess overland flow would be initiated more quickly, relative to the baseline greenfield condition.

16.6.56 If the rainfall rate exceeds the maximum infiltration rate of the soil then the portion of rainfall volume that is unable to infiltrate would remain at the surface and initiate infiltration excess overland flow. The propensity for such overland flow would be affected by the following:

- the capacity for infiltration would be reduced as a result of the compacted bare earth surface and loss of plant root system that provides preferential infiltration pathways;
- the infiltration capacity may reduce over time as a result of soil pore space and preferential infiltration flow paths being blocked by fine soil particles that would be more readily mobilised during the bare-earth condition; and
- compaction of the bare earth surface due to rainfall energy during intense rainfall events would exacerbate the reduction in infiltration.

16.6.57 If soil saturation and infiltration conditions are such that saturation excess and/or infiltration excess overland flow is initiated, the flow rate would be primarily influenced by vegetation roughness characteristics, the surface gradient, and the volume/depth of water. As such, by removing vegetation and increasing the steepness of slopes in certain areas (for example at the edges of the construction and development platforms), some areas of the site would be more prone to the risks associated with overland flow than others.

16.6.58 Over time and if left unmitigated, water that is allowed to flow over bare surfaces would potentially form preferential flow pathways that, over the duration of a storm event, would be subject to erosion action by flow such that the preferential pathways incise and become channelised; firstly in the form of rills and then evolving into gullies. Whilst further exacerbating run-off rates, these processes would result in the erosion and mobilisation of fine sediments which can potentially be delivered to receiving watercourses and suspended sediments subsequently deposited on the channel bed, potentially reducing the channel capacity.

16.6.59 The surfaces of relatively steep slope batters would, if left bare, give rise to relatively higher overland flow velocity which, in turn, would increase the capacity for erosion and transporting suspended sediments to surface watercourses. The entry of sediment-laden water into surface watercourses may potentially impact on both water quality status (increases in suspended solids concentrations) and the hydraulic regime (through siltation).

Change to Natural Topography

16.6.60 The changes to the natural baseline topography arising from the construction of the platforms and stockpiles, will result in a number of slope batters being located across the development area which could give rise to the following potential impacts:

- elevated surface water run-off;
- elevated discharge to controlled waters;
- more rapid run-off response to rainfall;
- increased soil erosion on-site; and
- in some areas, reduced surface water run-off where slopes have been reduced.

16.6.61 A number of terraces and new platforms are to be created that vary in elevation. The construction of the platform in Flood Zones 2 and 3 (see **Figures 16.7** and the construction phasing plans presented in the **Construction Method Statement**) would comprise a substantial batter to the east that would slope down at a relatively steep angle to the Holford Stream Valley floor from a level of 22m AOD to approximately 5.50m AOD.

16.6.62 The creation of platforms and terraces in the north of the site (BDAW and BDAE) will result in the removal of the lower section of the HPC Drainage Ditch catchment and infilling of HPC Drainage Ditch. Run-off generated in the upper catchment area will be intercepted by a drain at the west boundary of the HPC development site and incorporated and managed by the construction phase surface water drainage system. The removal of the catchment may result in a more rapid Run-off response and consequently elevated surface water run-off rates.

16.6.63 There will be one main stockpile area, with a limited maximum elevation, the creation of which would cause localised changes in catchment relief (i.e. from stockpile batters). Furthermore the development and evolution of stockpiles throughout the construction phase would lead to continual changes to topography.

16.6.64 The land to the south of the 144750mN grid line will undergo early landscaping works to be complete by early 2013 (see **Figure 4.1** in the **Construction Method Statement**). The land in the north-west of this area will be re-profiled and raised from an existing peak elevation of 28.8m AOD to an elevation of 35m AOD, with new slopes created to the south to blend in with the existing contours at around 20m AOD adjacent to Bum Brook. The land in the north-east will be raised from 23.5m AOD to 30m AOD. The early landscaping works will result in increased surface water run-off rates and increased run-off response to rainfall. It should be noted that some run-off which would naturally drain to Bum Brook will be diverted to Holford Stream by this stage of the development; therefore only limited potential additional surface water run-off to Bum Brook is expected relative to baseline conditions. During these earthworks, sediment-laden run-off may be generated which could be deposited within Bum Brook. The entry of sediment-laden water into Bum Brook may potentially impact on both water quality status (increase in suspended solids concentration) and hydraulic regime (through siltation), of this small watercourse.

Creation of Impermeable and Semi-Permeable Surfaces

16.6.65 The conversion of permeable greenfield land to impermeable and semi-permeable surfaces would result in the following potential impacts:

- elevated surface water run-off rates;
- elevated discharge rates to controlled waters; and
- more rapid run-off response to rainfall events.

16.6.66 A summary of the drainage system and the evolution of the drainage system throughout the site preparation works, subsequent construction phase and operational and removal/reinstatement phases is provided at the start of this section. Surfaces would typically comprise compacted Type 1 granular fill for the internal haul roads, together with areas of impermeable roofing and tarmac. Rain falling on these areas will ultimately be routed to the spine drain network via a network of piped and open drains. Therefore, discharge from the proposed outfall to the intertidal area will be at a greater flow rate than for the existing baseline condition. Discharges in the area of the outfall are currently diffuse land drainage rather than the point discharge associated with the proposed outfall and therefore this represents a change from baseline conditions.

16.6.67 The specification of appropriate discharge mechanisms to the intertidal area and subsequently offshore into the Severn Estuary via the cooling water outfall has given consideration to marine water quality standards, ecological sensitivities, and health and safety considerations. Further details on the impacts associated with the discharges via the cooling water outfall are provided in **Chapters 18** and **19** of this volume, respectively.

16.6.68 Any potential increase in run-off, due to the six highway improvement schemes, will be managed within the existing highway drainage system, given the limited nature of the scope of the works in most cases. In areas which may-be currently vulnerable to surface water ponding/flooding or where the existing drainage system would be unable to cope with the additional run-off, the improvement works will include additional measures to improve the highway drainage system to reduce the surface water flood risk.

Change to Flood Storage Capacity of Holford Stream Valley and Wick Moor

16.6.69 The site preparation works include the major earthworks activities associated with the creation of the platforms upon which construction activities will be carried out. The earthworks will include the infilling of a ditch in the northern section of the site (HPC Drainage Ditch) and the culverting and valley infilling of a watercourse (Holford Stream) in the southern section of the site. This infilling of Holford Stream valley is located within Flood Zone 1, 2 and 3 and therefore could result in off-site impacts. Fluvial and tidal modelling was carried out for the **Flood Risk Assessment** in order to quantify the impact of this activity on off-site receptors, such as third party properties. A summary of the **Flood Risk Assessment** findings is presented below.

16.6.70 The fluvial modelling carried out for the **Flood Risk Assessment** has indicated that for the 1% AEP 2017 and 2100 events the development would increase water levels downstream of the platform due to increased conveyance of Holford Stream culvert. However fluvial floods water are not predicted to reach third party properties. In addition, no impact upstream of the site boundary at Holford Stream is predicted.

16.6.71 The tidal modelling carried out for the **Flood Risk Assessment** indicates that, during the 2017 0.5% AEP flood event, there would be no increase in tidal flood risk to third party off-site receptors due to the infilling of Holford Stream valley caused by overtopping or breach of the existing sea defences. There is a very small predicted increase in flood depth (0.01m) at Wick Moor during the overtopping (2017) 0.5% AEP event. There is no impact during the equivalent breach event.

16.6.72 During a 0.5% AEP future (2100) flood event caused by overtopping the modelling showed an increase in flood depth of around 0.03m at the C182, HPA and HPB Sewage Treatment Works (STW) and some residential properties near Stolford. In all cases there would be no change in hazard rating. Under a 2100 0.5% AEP event breach scenario there would be an increased impact (up to 0.11m increase in flood depth) at the C182 and STW. There is no predicted impact to the third party properties during this breach event. There is no predicted change in hazard rating at off-site receptors apart from at the national grid tower (pylons) to the west of the existing HPA and HPB STWs.

16.6.73 In addition to the above scenario runs, the 1% AEP 2100 overtopping scenario was simulated. This showed an impact of 0.09m (increase in flood depth) to third party receptors southwest of Sharpham Embankment (these include the C182, Wick Moor, the national grid tower (pylons), the HPA and HPC STWs, and properties near to Little Dowden's Farm, and Fisheries Cottage. There is no impact to other properties in the Stolford area.

16.6.74 The Shoreline Management Plan (SMP) (Ref. 16.75) discusses the potential for managed realignment of the defence immediately to the east of the existing Hinkley Point B power station to Stolford further to the east. The preferred policy in the short-term (to 2025) is to continue to maintain the existing embankment defences under a hold the line policy and investigate opportunities for managed realignment. In the medium-term (2025 to 2055) the preferred policy is to implement managed realignment of the defences and in the long-term (2055 to 2105) to hold the line of the realigned defence. Therefore after 2025 it is the current policy that the defences should be improved and possibly realigned.

Changes to the Flood Regime of Bum Brook

16.6.75 A small area of the Bum Brook catchment and stream falls within the HPC development site boundary. Changes to the topography include raising the elevation of the slope to the north of the stream, and the provision of a bridge to carry the emergency access road over Bum Brook (see **Figure 4.2** in the **Construction Method Statement**).

16.6.76 Modelling carried out as part of the **Flood Risk Assessment** indicates that the proposed bridge over Bum Brook would increase flood levels in the watercourse immediately upstream and decrease flood levels downstream of the bridge. There would be no effect on third party residential receptors. The potential impact of a blockage under the bridge is assessed later in this section.

Change to Holford Stream Hydraulic Conditions

16.6.77 Currently, greenfield run-off from catchment Zones 2 and 5 (see **Figure 16.4**) is via Holford Stream. This will generally remain the case during the construction phase; however, there will be run-off from a small additional area from Zone 3 from which run-off will be routed from Bum Brook to Holford Stream and the loss of a section in the north which will be routed to the intertidal area.

16.6.78 The presence of impermeable surfaces and the operation of the Holford Stream culvert will potentially cause elevated water flow velocity in Holford Stream to the immediate east of the culvert outfall. Currently, the section of Holford Stream upstream of the C182 access road is densely vegetated (see paragraph 16.5.28). As such, the roughness of the stream channel is considerably greater (a Manning's n value of 0.07 is used in the modelling carried out for the **Flood Risk Assessment**) in comparison to a concrete culvert for which a Manning's n value of 0.015 is used in the modelling, therefore the flow velocities within the culvert may be greater than for the baseline condition.

16.6.79 Flooding upstream of the Holford Stream culvert could potentially arise as a result of the culvert being blocked by debris. The risk of potential blockage of the Holford Stream culvert is very low due to the large cross sectional area combined with the proposed proactive operational maintenance regime (that will be set out in an operation and maintenance manual for the Holford Stream culvert).

16.6.80 It is proposed that prior to the culvert becoming operational, the WMZs will be constructed upstream of the existing Holford Stream culvert under the C182. Here the water will be attenuated to discharge at the baseline greenfield run-off rates displayed in **Table 16.5** (see **Figure 16.4**).

16.6.81 An assessment of the fluvial impacts of culverting Holford Stream is presented in the **Flood Risk Assessment**. The **Flood Risk Assessment** has been prepared to be consistent with the requirements stipulated by the Environment Agency for consent for works affecting controlled waters under the Land Drainage Act 1991 (Ref. 16.19). As part of the discharge consent that will be required and in accordance with PPS25 (Ref. 16.1), discharge leaving the site via Holford Stream will be limited to greenfield rates, therefore no significant impacts would occur downstream of the Holford Stream culvert. This has been taken into account in the fluvial modelling carried out for the **Flood Risk Assessment**.

16.6.82 Prior to constructing the surface water drainage system, consent from the Environment Agency is required in accordance with the Land Drainage Act 1991 (Ref. 16.19). Holford Stream and the Wick Moor Rhynes are under the jurisdiction of the Parrett Internal Drainage Board (part of the Somerset Drainage Board Consortium). Therefore, Land Drainage Consent under the Land Drainage Act 1991 needs to be obtained from the Parrett Internal Drainage Board for the construction of the Holford Stream culvert and any modifications or for any works within 9m of an existing channel (see section 16.3).

Assessment of Construction Impacts

IMPACT: Effect of Elevated Surface Water Run-off Rate

16.6.83 Increased surface water run-off would result in elevated discharge to controlled waters and more rapid run-off response to rainfall potentially increasing the surface water flood risk. Six hydrological receptors have been identified which may be adversely impacted by elevated surface water run-off, the sensitivity of each of these receptors is presented in **Table 16.15**:

- HPC Drainage Ditch (during the initial stages of construction only, after which the HPC Drainage Ditch will be removed).
- Hinkley Point intertidal area (following the removal of HPC Drainage Ditch).
- Holford Stream.
- Wick Moor (via Holford Stream).
- Bum Brook (during the early landscaping works).
- Residential third party properties adjacent to the highway improvement works.

16.6.84 Discharges to HPC Drainage Ditch will be managed via attenuation in the WMZs in the north of the HPC development site to ensure that discharges do not exceed the capacity of the ditch. Therefore the potential impact magnitude associated with elevated surface water discharges to HPC Drainage Ditch is considered to be very low. Run-off to the intertidal area will not be attenuated however will still discharge via WMZs. The potential impact magnitude associated with elevated surface water discharges to the intertidal area is considered to be medium.

16.6.85 Provided that discharge to Holford Stream and Bum Brook is controlled to greenfield rates the impact magnitude associated to these receptors is assessed to be very low.

16.6.86 Based upon the value and sensitivity ratings of these receptors (**Table 16.15**) the resultant significance of potential impacts related to elevated surface water run-off has been assessed to have the following significance:

- HPC Drainage Ditch: very low impact magnitude; low value/sensitivity; leading to a **negligible** impact.
- Hinkley Point intertidal area (following the removal of HPC Drainage Ditch): medium impact magnitude; very low value sensitivity; leading to a **minor adverse** impact.
- Holford Stream (and ultimately Wick Moor): very low impact magnitude; high value/sensitivity; leading to a **minor adverse** impact.

- Wick Moor (via of Holford Stream): very low impact magnitude; high value/sensitivity (worst case value/sensitivity assumed in the instance of a low flow event); leading to a **minor adverse** impact.
- Bum Brook: very low impact magnitude; high value/sensitivity; leading to a **minor adverse** impact.
- Residential third party properties/land: very low impact magnitude; high value/sensitivity; leading to a **minor adverse** impact.

IMPACT: Effect of Elevated Sediment Delivery and Deposition in Watercourses

16.6.87 The Water Quality impact section below identifies increased sediment-laden run-off reaching the watercourses as an impact. In the following text the indirect impact presented from this potential source of impact is assessed with respect to the reduction in channel capacity and hence increased flood risk.

16.6.88 Three hydrological receptors have been identified which may be impacted by elevated sediment delivery and deposition, namely:

- HPC Drainage Ditch;
- Holford Stream; and
- Bum Brook.

16.6.89 The Water Quality section assesses the impact magnitude associated with delivery of sediment-laden run-off to watercourses to be low or very low due to the presence of the WMZs which will control discharge in line with conditions imposed by the Environment Agency (Ref. 16.47). Discharges to Holford Stream and Bum Brook are likely to be more strictly controlled (in relation to suspended solids concentrations) than discharges to the HPC Drainage Ditch. Therefore sediment-laden run-off is very unlikely to reach the watercourses in quantities large enough to deposit sufficient sediment to reduce the channel capacity and alter the watercourse hydraulics. Based upon the value and sensitivity ratings of these receptors (**Table 16.15**) the resultant significance of potential impacts has been assessed to have been found to have the following significance:

- HPC Drainage Ditch: low impact magnitude; low value/sensitivity; leading to a **minor adverse** impact.
- Holford Stream: very low impact magnitude; high value/sensitivity; leading to a **minor adverse** impact.
- Bum Brook: very low impact magnitude; high value/sensitivity; leading to a **minor adverse** impact.

IMPACT: Effect of Increased Flood Risk of Land Outside the HPC development site from Pluvial Sources of Flooding

16.6.90 Localised flooding off-site could result indirectly from elevated surface water run-off causing overland flow to flood land off-site. The assessment of these impacts follows that carried out for the assessment of elevated surface water run-off impacts.

16.6.91 Five hydrological receptors have been identified which may be impacted by pluvial flooding, namely:

- Hinkley Point intertidal area;
- agricultural land to the west of the BDAW;
- agricultural land to the west of the SCPA;
- Wick Moor; and
- Land adjacent to Bum Brook.

16.6.92 The sensitivity of these identified receptors to this potential impact ranges from very low to high (see **Table 16.3**).

16.6.93 Due to the implementation of the construction phase drainage strategy including elements such as the WMZs, the impact magnitude of pluvial flooding to these receptors as a result of elevated surface water run-off from the HPC development site is assessed to be very low to low. The likelihood of flooding is unlikely, only potentially occurring during low probability extreme rainfall events and over very short durations, and the consequences of flooding are likely to be insignificant due to the probable shallow depth of flood waters and short lived event durations. Based upon the value and sensitivity ratings of these receptors (**Table 16.15**) the resultant significance of potential impacts has been assessed to have the following significance:

- Hinkley Point intertidal area: low impact magnitude; very low value/sensitivity; leading to a **negligible** impact.
- agricultural land off-site from the HPC development site west of HPC Drainage Ditch: very low impact magnitude; low value/sensitivity; leading to a **negligible** impact.
- agricultural land off-site from the HPC development site west of Holford Stream to: very low impact magnitude; medium value/sensitivity; leading to a **minor adverse** impact.
- Wick Moor: very low impact magnitude; medium value/sensitivity; leading to a **minor adverse** impact.
- Land off-site adjacent to Bum Brook: very low impact magnitude; medium value/sensitivity; leading to a **minor adverse** impact.

IMPACT: Increased Fluvial Flood Risk to Land Outside of the HPC development site

16.6.94 Four hydrological receptor groups have been identified which may be impacted by increased fluvial flood risk during construction:

- Agricultural land to the west of the SCPA;
- Wick Moor;
- Residential third party properties (Doggett’s Farm and Little Dowden’s farm area); and
- Land adjacent to Bum Brook (upstream of the emergency access bridge).

16.6.95 Elevated off-site fluvial flood risk may arise due to the following mechanisms:

- Reduced channel capacity due to sediment deposition within the receiving watercourse.
- Reduced flood storage capacity of Holford Stream Valley due to platform and WMZs.
- Flow restriction or blockage under the emergency access bridge crossing Bum Brook.
- Flow restriction or blockage in Holford Stream culvert.

16.6.96 Flooding of Wick Moor and the land adjacent to Bum Brook may occur due to elevated sediment deposition in the Holford Stream and Bum Brook respectively which could cause a reduction in channel capacity. The impact on magnitude of flooding due to reduced channel capacity is assessed to be very low because the suspended sediment concentration of water discharging to Holford Stream will be controlled within the construction phase drainage system and associated WMZs in line with consents issued under the Environmental Permitting Regulations (Ref. 16.17) and therefore the volume of sediment reaching the watercourses will be minimal.

Table 16.17: Summary of Fluvial Flood Risk Impacts to Receptors as a Result of Infilling and Culverting Holford Stream Valley and the Emergency Access Road Bridge over Bum Brook

Receptor	Value/ Sensitivity	Scenario	Increase in flood levels	Impact magnitude	Impact rating
Wick Moor (CS4.13)	Medium	1.0% 2017	+0.05	Very low	**Minor**
		0.5% 2017	+0.03	Very low	**Minor**
		0.1% 2017	+0.03	Very low	**Minor**
		1.0% 2100	+0.06	Very low	**Minor**
		0.5% 2100	+0.06	Very low	**Minor**
		0.1% 2100*	+0.07	Very low	**Minor**
Agricultural land off-site, west of the HPC development site of Holford Stream	Medium	1.0% 2017	0.00	No impact	
		0.5% 2017	0.00	No impact	
		0.1% 2017	0.00	No impact	
		1.0% 2100	0.00	No impact	
		0.5% 2100	0.00	No impact	
		0.1% 2100*	0.00	No impact	
Land off-site adjacent to Bum Brook	Medium	1.0% 2017	+0.11**	Low	**Minor**
		0.5% 2017	+0.16**	Low	**Minor**
		0.1% 2100	+0.28**	Low	**Minor**
		1.0% 2100	+0.16**	Low	**Minor**
		0.5% 2100	+0.22**	Low	**Minor**
		0.1% 2100*	+0.36** and ***	Low	**Minor**

Receptor	Value/ Sensitivity	Scenario	Increase in flood levels	Impact magnitude	Impact rating
Residential third party properties	High	1.0% 2017	-0.02****	Very low	**Minor**
		0.5% 2017	No adverse impact	Very low	**Minor**
		0.1% 2017	-0.01*****	Very low	**Minor**
		1.0% 2100	-0.01*****	Very low	**Minor**
		0.5% 2100	-0.01****	Very low	**Minor**
		0.1% 2100*	0.00	No impact	

* These results are only indicative due to model instabilities during simulation.

** Adverse impact located upstream of Bum Brook emergency access road bridge (ISIS node CS2.42).

*** Low magnitude due to low probability event and future scenario (2100),

**** During the 1% AEP 2017 event a positive impact is experienced at Wick Village receptor, with a reduction in flood level of 0.02m.

***** During the 0.1% 2017, 1% and 0.5% 2100 events a **positive** impact is experienced at Doggetts Farm and Wick Village receptors, with a reduction in flood levels of 0.01m at each location.

16.6.97 The fluvial modelling reported within the **Flood Risk Assessment** predicts that the infilling and culverting of the Holford Stream Valley would cause a small increase in maximum water levels both upstream of the culvert and downstream across Wick Moor. Attenuation provided in the WMZs and in SuDS features, minimises the fluvial impact downstream of the platform as it attenuates run-off generated on the platform and discharges to Q_{BAR} greenfield rates under all scenarios. The 0.1% AEP 2100 results are only indicative due to model instabilities during simulation. **Table 16.17** shows the increase to flood depths off-site in Wick Moor is up to 0.06m (barring the 0.1% AEP event), but does not impact third party properties, therefore the impact magnitude for this event downstream of the platform is assessed to be very low.

16.6.98 The increase in maximum water levels upstream of the Holford Stream culvert is largely contained within the HPC development site boundary, with only a minimal increase (less than 0.01m) contained within the ditch west of Benhole Lane (see **Table 16.17 –** Agricultural land off-site, west of the HPC development site of Holford Stream), therefore it is assessed to have **no impact**.

16.6.99 The modelling of the proposed emergency road crossing bridge at Bum Brook has been based upon preliminary designs, with modifications, to suit local topography. The bridge has been represented by a three arch bridge, which slopes gently to the south with a deck level of 21m AOD at the southern end, rising to 24m AOD at the northern end.

16.6.100 The **Flood Risk Assessment** shows that the emergency access bridge would cause a limited throttling of flows during extreme flood events, however, this would only impact water levels immediately upstream and downstream of the bridge. **Table 16.17** summarises the impact for each model scenarios run. For the 1% AEP 2100 event the maximum increase in flood levels immediately upstream of the bridge of 0.28m. Off-site the impact is less severe with increases of up to approximately 0.2m (for this scenario) immediately west of the boundary and decreasing further west. The impact upstream does not affect any third parties properties. The impact magnitude is therefore assessed to be low. In addition a blockage under the bridge is very unlikely due to the size of the bridge arch openings and as the modelling will be used to inform the final design. As such, the impact magnitude of a blockage is assessed to be very low.

16.6.101 Downstream the bridge shows is a positive impact with slightly reduce water levels, see **Table 16.17 –** Third party properties footnotes, therefore **no adverse impact** is found and a positive impact with a magnitude of very low is assessed.

16.6.102 A blockage of Holford Stream is extremely unlikely due to the large size of the culvert, the WMZ upstream of the Holford Stream culvert entrance and the small upstream catchment area. Therefore the impact magnitude is assessed to be very low.

16.6.103 The C182 main route to Hinkley Point has not been assessed as an individual receptor. However it is assessed in the **Flood Risk Assessment**, which indicates the route would currently remain clear during all events apart from the 0.1% 2100 event (however these results are only indicative), where the crossing at Bum Brook would flood to depths of 0.13m, and Holford Stream crossing to depths of 0.10m. Post infilling of Holford Stream valley the depth at Bum Brook would decrease slightly though not significantly (-0.01m), due to the effect of the Bum Brook bridge. Whereas, at the Holford Stream crossing the depth would increase by 0.06m (to a total of 0.16m). If these depths were deemed to be unsafe, access/egress would still be possible via the emergency access bridge across Bum Brook, which the model results indicate will not flood during this event.

16.6.104 Based upon the value and sensitivity ratings of these receptors (**Table 16.15**) the resultant significance of potential impacts relating to increased fluvial flood risk has been assessed to have the following significance:

- Wick Moor (reduced channel capacity due to sediment deposition within Holford Stream): very low impact magnitude; medium value sensitivity; leading to a **minor adverse** impact.
- Land off-site adjacent to Bum Brook (as a result of reduced channel capacity due to sediment deposition within Bum Brook); very low impact magnitude; high value/sensitivity; leading to a **minor adverse** impact.
- Wick Moor (as a result of reduced flood storage capacity of Holford Valley): very low impact magnitude; medium value sensitivity; leading to a **minor adverse** impact.
- Land off-site adjacent to Bum Brook (due to restricted flow under the emergency access road bridge crossing Bum Brook); low impact magnitude; medium value/sensitivity; leading to a **minor adverse** impact.
- Residential third party properties (due to restricted flow under the emergency access bridge crossing Bum Brook): very low impact magnitude; high value/sensitivity; leading to a **minor positive** impact.
- Agricultural land off-site from the HPC development site west of Holford Stream (due to a blockage in the culvert): very low impact magnitude; medium value/sensitivity; leading to a **minor adverse** impact.

- Land off-site adjacent to Bum Brook (due to blockage under the emergency access bridge crossing Bum Brook); low impact magnitude; medium value/sensitivity; leading to a **minor adverse** impact.

IMPACT: Effect of Increased Tidal Flood Risk to Land Outside of the HPC development site

16.6.105 Four hydrological receptors have been identified which may be impacted by increased tidal flood risk:

- Wick Moor;
- residential third party properties;
- non-residential third party properties; and
- agricultural land to the west of the SCPA.

16.6.106 Elevated off-site tidal flood risk may arise due to reduced flood storage capacity of Holford Stream Valley due to infilling of the valley for the creation of platforms and materials stockpiling.

16.6.107 The area of land to the west and east of C182 falls within Flood Zone 2 and 3 of the Environment Agency's tidal flood risk map (see **Figure 16.5**). The Environment Agency flood maps are precautionary in that they do not account for the presence of the defences between Hinkley Point and Stolford Point.

16.6.108 The impact magnitude and rating to each receptor as a results of reduce floodplain storage is summarised in **Table 16.18**. It should be noted that the impact magnitude of a breach event is assessed to be less likely to occur than an overtopping event and therefore often has a lower magnitude rating.

Table 16.18: Summary of Tidal Flood Risk Impacts to Receptors as a Result of infilling Holford Stream Valley

Receptor	Value/ Sensitivity	Scenario	Increase in Flood Level	Impact Magnitude	Impact Rating
Wick Moor	Medium	0.5% 2017 overtopping	0.01m increase	Very low	**Minor**
		0.5% 2017 breach	No impact		
		0.5% 2100 overtopping	0.03m increase	Very low	**Minor**
		0.5% 2100 breach	0.11 increase	Very low	**Minor**
		1.0% 2100 overtopping	0.094 increase	Low	**Minor**
Agricultural land off-site, west of the HPC development site of Holford Stream	Medium	0.5% 2017 overtopping	No impact		
		0.5% 2017 breach	No impact		
		0.5% 2100 overtopping	0.013m decrease	No adverse impact	
		0.5% 2100 breach	No impact		
		1.0% 2100 overtopping	No impact		

Receptor	Value/ Sensitivity	Scenario	Increase in Flood Level	Impact Magnitude	Impact Rating
Residential third party properties	High	0.5% 2017 overtopping	No impact		
		0.5% 2017 breach	No impact		
		0.5% 2100 overtopping	0.03m increase*	Very low	**Minor**
		0.5% 2100 breach	No impact		
		1.0% 2100 overtopping	0.09m increase***	Low	**Moderate**
Non residential third party properties	Medium	0.5% 2017 overtopping	No impact		
		0.5% 2017 breach	No impact		
		0.5% 2100 overtopping	0.03m increase*	Very Low	**Minor**
		0.5% 2100 breach	0.11m increase**	Very Low	**Minor**
		1.0% 2100 overtopping	0.09m increase***	Low	**Minor**

* Impact to C182, the STW, national grid towers (pylons), Little Dowden's Farm, Fisheries Cottage, North of Croft Farm, Swallowcliffe, and Fisherman's Cottage (see Figure 32 of the **Flood Risk Assessment**).

** 0.11m increase in flood depth at C182, the STW and national grid tower (pylons) (see Figure 35 of the **Flood Risk Assessment**).

*** Impact to C182, the STW, national grid tower (pylons), Little Dowden's Farm and Fisheries Cottage.

16.6.109 It should be noted that all impacts, with the exception of a minor increase in flood depth to Wick Moor, are for future scenarios (2100) where allowance has been made for climate change. A breach event is very unlikely to occur and therefore the overall impact magnitude for these events is assessed to be very low. The impact magnitude of the 0.5% 2100 overtopping event has also assessed to be very low due to the minor increase in flood level. The impact magnitude for the 1% 2100 overtopping event is assessed to be low as the return period is AEP is higher and therefore is slightly more likely to occur and is as a result of overtopping rather than a breach event. The impact magnitude is low as it is a future event only predicted to occur in 2100. In addition, the preferred policy set out in Shoreline Management Plan (Ref. 16.75) is for managed realignment of this stretch of defence from 2025, which would potentially alleviate the impact to these receptors, this however is not presented as mitigation only context to the situation.

16.6.110 The C182 main route to Hinkley Point has not been assessed as an individual receptor. However it is assessed in the **Flood Risk Assessment**, and mitigation is presented in Section 16.7 of this chapter.

16.6.111 Based upon the value and sensitivity ratings of these receptors the resultant significance of potential impacts relating to increased tidal flood risk has been summarised in **Table 16.18**, showing a **moderate adverse** impact to residential third party properties (Little Dowden's Farm and Fisheries Cottage) during the 1% AEP 2100 overtopping event.

IMPACT: Change to Holford Stream Hydraulic Characteristics

16.6.112 Two hydrological receptors have been identified which may be impacted by a change to the baseline hydraulic conditions:

- Holford Stream; and
- Wick Moor.

16.6.113 The Holford Stream culvert will be constructed during the site preparation works phase and will be operational during the construction phase and might potentially result in increased flow velocities immediately downstream due to reduced channel roughness and the linear nature of the culvert. Increased flow velocities could potentially lead to flood and scour problems downstream.

16.6.114 Due to the energy dissipation measures implemented at the outfall of the culvert the impact magnitude of increased flow velocities is considered to be very low.

16.6.115 As the culvert would be constructed off-line and flow re-routed to the culvert, interruption to flow should be minimal and this impact magnitude is considered to be very low.

16.6.116 Given the size of the culvert, there will be an increased provision of in-channel water storage such that water levels in Wick Moor could be reduced. However, as the base of the culvert will be impermeable no transmission losses through the channel bed will occur when flows are not controlled by groundwater. The two adjacent groundwater interceptor drains will ensure that all available groundwater is transmitted to Wick Moor. Ponds created at either end of the culvert will also assist in providing a more consistent base flow in the stream. Water levels in Wick Moor may therefore be augmented as a result of reduced losses through the stream bed. The impact magnitude associated with reduced water levels in the Wick Moor SSSI due to the presence of the culvert is assessed to be very low as water levels in Wick Moor may be increased by the reduced losses through the stream bed along the length of the culvert. However, as this has not been quantified, the impact is still assessed as adverse.

16.6.117 Based upon the value and sensitivity ratings of these receptors (**Table 16.15)** the resultant significance of potential impacts has been assessed to have the following significance:

- Holford Stream (due to increased flow velocities): very low impact magnitude; high value/sensitivity; leading to a **minor adverse** impact.
- Holford Stream (due to interruption to flow): very low impact magnitude; high value/sensitivity; leading to a **minor adverse** impact.
- Wick Moor: very low impact magnitude; high value/sensitivity (during assessment of low flows); leading to a **minor adverse** impact.

ii. Water Quality Construction Impacts

16.6.118 Many of the potential impacts on the water quality status of freshwater receptors derive from the large scale earthworks that would necessitate major changes to existing surface water drainage patterns. These works would give rise to increased rates of run-off that are likely to contain elevated concentrations of suspended solids and, potentially, hydrocarbons from use of plant and equipment.

16.6.119 Increased suspended sediment concentrations can have a negative impact on water quality. Impacts are generally related to:

- changes in water temperature regime resulting from shallowing of the waterbody caused by siltation;
- physical disturbance effects; or
- mobilisation of sediments that are contaminated or are rich in organic matter or nutrients.

16.6.120 Run-off of hydrocarbons particularly from road drainage and compounds, may have a deleterious effect on the water quality status of receiving surface water features.

16.6.121 Concrete would be used throughout the construction works. The culvert for Holford Stream would be constructed from pre-cast concrete to avoid concrete leachate issues that could otherwise arise from the pouring of in-situ concrete. There is no intention to concrete hardstanding areas; these areas would instead be surfaced with aggregate and highly trafficked areas would be tarmacked. Where use of wet concrete is required, high pH leachate may be generated. Such leachate may potentially impact on the water quality status of receiving watercourses and in particular the freshwater systems such as Holford Stream.

16.6.122 All identified impacts on surface water quality are presented in **Table 16.19** below. Those impacts on surface water quality from sediment-laden run-off, hydrocarbon contaminated run-off and concrete leachate, i.e. those impacts related to commonly occurring activities, together with any potential impacts that have been found to be significant i.e. of moderate or major significance prior to mitigation are discussed below.

IMPACT: Sediment-Laden Run-off

16.6.123 During the site construction phase, there is the potential for the generation of sediment-laden run-off water. Activities that have been identified that could potentially produce sediment-laden run-off include:

- excavations, including dewatering of excavated areas;
- stockpiling of materials (particularly soil and rock);
- mobilisation of stream bed sediments due to increased water flows, resulting from surface compaction from plant movements for example; and
- general earthworks, which may include:
  - topsoil stripping;
  - vegetation stripping;
  - fencing;
  - construction of Holford Stream culvert;
  - construction of WMZs;
  - installation of the surface drainage system;

- construction of site compound and construction/upgrade of internal roads;
- construction of the soil retaining wall; and
- creation of development platforms.

16.6.124 Three water quality receptors have been identified which may be impacted by sediment-laden run-off, namely the HPC Drainage Ditch, Holford Stream and Bum Brook. The value/sensitivity of each of these receptors is presented in **Table 16.15**.

16.6.125 All surface waters would be directed to the surface water drainage system and the concentration of suspended sediments would be reduced, where necessary, prior to controlled discharge to the watercourses. Design measures that are incorporated into the surface water drainage system which will minimise sediment generation include:

- provision of WMZs;
- compliance with a site-specific **Water Management Plan** and best practice guidelines; and
- control of surface water run-off to greenfield rates from any WMZ to an existing watercourse.

16.6.126 As a result of these measures that will ensure the conditions set out within an Environmental Permit are met, many of the sediment-laden discharge impacts have a magnitude score that is assessed as low or very low (see **Table 16.19**).

16.6.127 It should be noted, as set out in **Table 16.15**, that Holford Stream is considered to have a high sensitivity, due to the dependence of the downstream wetland conditions in Wick Moor, which is part of the Bridgwater Bay SSSI.

16.6.128 Due to the sensitive nature of Holford Stream, inputs of sediment-laden surface run-off, in the absence of mitigation, could potentially have an impact greater than minor significance. These include:

- installation and removal of temporary drainage systems including WMZs, in the SCPA (low magnitude; high sensitivity; **moderate adverse** significance);
- earthworks activities in the SCPA (medium magnitude; high sensitivity; **major adverse** significance); and
- sediment-laden run-off water from stockpiling in the SCPA (low magnitude; high sensitivity; **moderate adverse** significance).

IMPACT: Hydrocarbon Contaminated Run-off

16.6.129 During the construction phase, there is the potential for the generation of run-off water contaminated with hydrocarbons.

16.6.130 There are two primary sources of potential hydrocarbons during the construction phase including the use of plant and equipment (construction type plant such as bulldozers) and run-off from hard surfaced areas such as compounds and plant/vehicle parking and maintenance areas. All run-off will pass through oil interceptors which form part of the WMZs prior to discharge to surface water receptors.

16.6.131 Potential adverse impacts upon water quality status would be local, temporary in nature and are considered to have a likelihood of possible occurrence. The magnitude of all potential adverse impacts associated with hydrocarbon contaminated run-off, taking into account design measures such as oil interceptors, is considered to be very low. Hydrocarbon contaminated run-off has the potential to impact the HPC Drainage Ditch and Holford Stream during the construction phase.

16.6.132 Taking into account the design measures such as the use of oil interceptors as an integral part of the drainage system (which incorporate best practice on management of fuels, oils and lubricants) that will ensure the conditions set out within an Environmental Permit are met, all potential impacts associated with potential hydrocarbon contaminated run-off are assessed to be of **negligible** to **minor adverse** significance (see **Table 16.19**).

IMPACT: Concrete Leachate

16.6.133 A number of construction phase works elements include the pouring of concrete in-situ, during which there is the potential for surface water quality impacts resulting from concrete leachate. Construction activities which may include the use of concrete in-situ include:

- construction of the foundations (note: all foundation pours will take place within excavations and therefore there will be no direct run-off pathway to surface water receptors);
- construction of headwall structures for the Holford Stream culvert (offline from the existing Holford Stream channel);
- construction of the chain-link perimeter fence threshold;
- construction of footings and foundations associated with the site compound and other temporary buildings and workshops in SCPA; and
- road construction for kerb areas on site access roads.

16.6.134 Further leachate will result from washout of concrete delivery lorries and equipment and routine cleaning maintenance of the concrete batching works. The wastewater from these sources is expected to be of low volume but with elevated pH and will be collected and passed through a proprietary treatment system prior to discharge in to the surface drainage system and receiving WMZ. The treatment system will recover solids and adjust the pH of the wastewater as required.

16.6.135 These potential impacts are considered to be local (spatial scale) and temporary (temporal scale) in nature. The likelihood of potential impacts is considered to be possible, although this is considered a conservative assumption given that these activities would be controlled through the measures described in the **Water Management Plan.** These measures will ensure that the discharge conditions set out within an Environmental Permit are met. The assessment magnitude for potential concrete leachate impacts is assessed as very low. The value/sensitivity of those water quality receptors that may be affected by concrete leachate impacts are presented in **Table 16.15**. All concrete leachate impacts have been assessed to have a **negligible** to **minor adverse** significance (see **Table 16.19).**

IMPACT: Run-off Containing Elevated Concentrations of Nutrients

16.6.136 During the earthworks activities including the installation of drainage infrastructure, there is a potential for nutrient mobilisation via disturbed sediment to occur. Since surface waters are draining former agricultural land, run-off is likely to contain raised levels of nutrients. Elevated nutrient concentrations (phosphorus being the key limiting nutrient in freshwater systems) may have an adverse impact upon water quality status and the functioning of the receiving watercourses, through increased growth of aquatic vegetation for example.

16.6.137 Baseline conditions within the surface water receptors have been considered in the assessment of potential nutrient additions arising from activities related to the construction phase and the general sensitivity classifications of each receptor are presented in **Table 16.15**. The potential changes in nutrient status are not likely to alter the conditions in the receiving watercourses and therefore the magnitude in each individual impact case has been assessed to be low. The nature of these potential impacts may also be described as local, temporary and direct. Potential impacts associated with the HPC Drainage Ditch have been assessed to be of **minor adverse** significance. In any event the ditch will be removed once the Foreshore Construction Outfall structure is available for use. However, due to the additional sensitivity that is afforded to Holford Stream and Bum Brook, the same potential impact on these receptors is considered to be of **moderate adverse** significance prior to mitigation (see **Table 16.19**).

IMPACT: Surface Run-off from Rock Stockpile Areas

16.6.138 The generation of acid rock drainage (ARD) from stockpiles of excavated mudstones (in the Southern Construction Phase Area), should it occur, may reduce the pH of surface water run-off that would be discharged from this area into Holford Stream. The discharge of low pH water directly into Holford Stream could impact on water quality status as the stream is currently characterised by neutral pH conditions. Given that any surface drainage discharged to Holford Stream would be subject to treatment and attenuation within the proposed WMZs that will ensure the conditions set out within an Environmental Permit are met, the impact magnitude is assessed as low. This impact would be local, adverse, temporary, direct and may possibly occur. Holford Stream provides an important water supply to support the downstream freshwater wetland features in Wick Moor, which is part of Bridgwater Bay SSSI, therefore the maintenance of good water quality conditions in the SSSI area is important and the value and sensitivity of the receptor has been assigned a high status (**Table 16.15**). The potential significance of this impact has therefore been assessed as **moderate adverse** without mitigation.

iii. Surface Water Construction Risks

16.6.139 There is a risk of potential impacts occurring as a result of accidents or incidents. It is not likely that accidents and incidents will arise under normal circumstances hence these scenarios are presented as risks rather than as impacts. The risks and their likelihood of occurrence can be managed, and minimised through the use of good practice management measures. Such measures are outlined in the **Water Management Plan**. These management measures may not influence the significance of an incident should it occur but will reduce the risk of an incident to a very low level of probability.

16.6.140 In combination with the subject specific management plans, an **Environmental Incident Control Plan** is being developed by EDF Energy that sets out the response and management techniques that will be applied for a range of different incident types, should they occur. The implementation of this plan effectively acts as the mitigation to any incident through providing measures to reduce impact magnitude primarily through containment.

16.6.141 The **Environmental Incident Control Plan** would be instigated through an issue identified from routine monitoring and inspection and more importantly through a system of efficient incident reporting. For the **Environmental Incident Control Plan** to be effective then rapid implementation of the containment or other mitigation measures is required to reduce the potential impact to a non-significant level. The **Environmental Incident Control Plan** therefore acts as the overarching mitigation measure for managing incidents and accidents and reducing impact significance.

16.6.142 In respect of surface water, the following risks have been identified during the construction phase as being of potential concern:

- failure of water management infrastructure such as pipe collapse, balancing pond breach, pump failure etc. due to an extreme rainfall event;
- accidental spillage relating to operation of water bowsers (e.g. for concrete water/dust suppression), operative error;
- blockages of drainage infrastructure;
- accidental release of suspended sediments generated by collapse of banks, failure of silt settlement systems, deposition of soils into a watercourse, collapse of a stockpile into a watercourse;
- accidental spills of fuels or oils;
- emergency discharges associated with firewater; and
- accidental spillage of wet concrete and/or cement.

d) Cumulative Construction Impacts

16.6.143 Surface water drainage, groundwater and other wastewater will be collected from across the site during the construction phase and passed through WMZ prior to discharge into the identified surface water receptors. The different wastewater streams will be subject to individual Environmental Permits that will set conditions on each discharge in terms of volume rate and chemical quality. In setting the discharge conditions for each Environmental Permit, the regulator takes into account any other discharges to the watercourse, in addition to those from the HPC development site, and any downstream uses of the watercourse (i.e. abstractions) to ensure there is no significant deterioration in water quality status.

16.6.144 Discharges to Holford Stream and Bum Brook (during the landscape restoration phase only) will also be managed at greenfield runoff rates to ensure the current hydraulic regime is maintained to provide protection to downstream reaches from flooding issues.

16.6.145 Given that all discharges to surface watercourses during the construction phase will be subject to the conditions of Environmental Permit, applied to each of a limited number of outfall locations, there is not expected to be any significant cumulative impact on either water quality status or hydraulic regime in the receptor watercourses.

16.6.146 A summary of the overall combined water quality and hydrology impacts on each of the receptors during the construction phase is detailed below:

Hinkley Point C Drainage Ditch

16.6.147 This watercourse will be used as a conduit for the discharge of surface drainage and groundwater to the intertidal area during the initial construction phase in the northern area of the site. Surface water and groundwater will be collected from across the BDAW and BDAE and routed to a WMZ (described above) prior to discharge into the HPC Drainage Ditch.

16.6.148 The surface water drainage to the ditch will come from the BDAW and BDAE and is expected to be characterised by elevated suspended solids concentrations and potential contamination by residual hydrocarbons and concrete leachate.

16.6.149 In addition, groundwater pumped from the excavation dewatering borehole system as a result of the dewatering of the nuclear islands may be characterised by elevated mineral content and a degree of metal contamination (see **Volume 2, Chapter 15**).

16.6.150 Within the WMZ, facilities will be provided in order to attenuate flows and treat the water to the necessary standard to meet the conditions of the Environmental Permit. As a minimum this is likely to include a lagoon for the settlement of suspended solids and flow attenuation and oil inceptors to remove residual hydrocarbons. Other facilities will also be provided as required, depending on the quality of the water received by the WMZ, in order for achieving the necessary level of treatment to the conditions of discharge in to the HPC Drainage Ditch. Groundwater routed to the WMZ will be maintained as a separate waste stream from the surface water drainage and will be subject to an individual Environmental Permit. Measures to ameliorate any groundwater contaminants may include chemical treatment for elevated metal concentrations, if present.

16.6.151 The measures above (and others, as required by the Environment Agency) will ensure there is no significant deterioration in the quality of water of the HPC Drainage Ditch, as compared with its baseline characteristics, and there is no alteration in its flow characteristics.

16.6.152 Further, the impacts considered above will be temporary in that following completion of the temporary construction drainage system and Foreshore Construction Outfall the HPC Drainage Ditch will be in-filled and form part of the development platform.

16.6.153 In conclusion, for the reasons set out above (in particular the measures to ensure no deterioration in quality and impact on flow) as detailed in **Table 16.19**, the overall impact on this receptor, up to point where it is in-filled, is assessed to be of **minor adverse** significance. This ditch will be permanently removed during the construction phase.

Holford Stream and Wick Moor

16.6.154 The reach of Holford Stream the SCPA will be permanently diverted through an offline culvert. The existing stream channel and valley within the HPC development site will then be used for materials stockpiling and construction platforms. The culvert has been designed as an oversized structure, for routine maintenance purposes, and therefore is not expected to present a flood risk. The infilling of Holford Valley will lead to some loss of flood storage capacity for low probability tidal flooding events that will lead to small increases in the normal flood water level to a small number of third party properties.

16.6.155 Discharges in to Holford Stream will be made through two WMZs located at each end of the culvert. The WMZs will receive surface water drainage, groundwater pumped from shallow excavations with the SCPA and treated sewage effluent from the accommodation campus during the construction phase.

16.6.156 The surface water drainage to Holford Stream will come from the SCPA and is expected to be characterised by elevated suspended solids concentrations and potential contamination by residual hydrocarbons, concrete leachate, elevated nutrient concentrations and reduced pH from acid rock drainage from rock stockpiles.

16.6.157 Discharges of treated sanitary effluent from the accommodation campus will also be directed towards the WMZ at the western end of the Holford Stream culvert. Package treatment works effluent will be subject to a specific Environmental Permit that will that will set conditions for flow rate and chemical and microbiological quality at the discharge point into the drainage system upstream of the WMZ.

16.6.158 Within the WMZs associated with Holford Stream, facilities will be provided in order to attenuate flows and treat the water to the necessary standard to meet the conditions of the Environmental Permit. As a minimum this is likely to include a lagoon for the settlement of suspended solids and flow attenuation (to greenfield rates) and oil inceptors to remove residual hydrocarbons. Other facilities will also be provided as required, depending on the quality of the water received by the WMZ, in order for achieving the necessary level of treatment to the conditions of discharge into Holford Stream. Treatment of low pH drainage from rock stockpiles is likely to be undertaken within the drainage system upstream of the WMZs.

16.6.159 The measures above (and others, as required by the Environment Agency) will ensure there is no significant deterioration in the quality of water and change to flow characteristics of Holford Stream and consequently the downstream Wick Moor area, when compared with the baseline characteristics.

16.6.160 In conclusion, for the reasons set out above (in particular the measures to ensure no deterioration in quality and impact on flow) as detailed in **Table 16.19**, the overall impact on this receptor, is assessed to be of **minor adverse** significance.

Bum Brook

16.6.161 A road bridge will be constructed across Bum Brook. The design of this spanning crossing point will not require in-channel works to be undertaken. The design has also taken into account the conveyance of flood flows and has been developed to not increase the risk of local flooding. At the end of the construction phase landscaping of the SCPA will be undertaken. During this period an additional WMZ will be developed to which surface drainage will be routed for discharge into Bum Brook.

16.6.162 The surface water drainage to Bum Brook will come from SCPA landscaping works at the end of the construction phase to be characterised by elevated suspended solids concentrations and potential contamination by residual hydrocarbons.

16.6.163 Within the WMZs associated with Bum Brook, facilities will be provided in order to attenuate flows and treat the water to the necessary standard to meet the conditions of the Environmental Permit. As a minimum this is likely to include a lagoon for the settlement of suspended solids and flow attenuation (to greenfield rates) and oil inceptors to remove residual hydrocarbons. Other facilities will also be provided as required, depending on the quality of the water received by the WMZ, in order for achieving the necessary level of treatment to the conditions of discharge into Bum Brook.

16.6.164 The measures above (and others, as required by the Environment Agency) will ensure there is no significant deterioration in the quality of water and change to flow characteristics of Bum Brook as compared with the baseline characteristics.

16.6.165 In conclusion, for the reasons set out above (in particular the measures to ensure no deterioration in quality and impact on flow) as detailed in **Table 16.19**, the overall impact on this receptor, is assessed to be of **minor adverse** significance.

16.6.166 Cumulative effects with elements of the HPC project and with other planned or reasonably foreseeable projects are considered in **Volume 11** of this ES.

e) Operational Impacts

16.6.167 The only activity to take place during the operational phase of HPC that may result in an impact to the baseline surface water conditions is the operation of the operational phase surface water drainage system. No significant impacts (i.e. greater than minor in significance) were identified in relation to surface waters during the operational phase of the development (see **Table 16.19**).

16.6.168 It is proposed that surface waters (from the restored landscaped areas of the HPC development site) will primarily drain to ground during the operational phase. Surface water run-off generated from the built elements of the operational site will be collected and discharged into the building known as the HXO, for discharge to the marine environment via the cooling water outfall tunnel. Groundwater generated from the passive groundwater level management system and treated sanitary effluent will also be discharged via this route. The operational site will effectively be isolated from the local terrestrial surface water environment.

16.6.169 All other areas used during the construction phase, will be restored to a greenfield state in the latter stages of construction and early stages of the operational phase. After these restoration works are complete this area of land will not undergo any further changes during the operational phase. The impact on future flood risk during the operational phase has been considered within the construction phase impacts section, and therefore is not repeated within this section.

16.6.170 The landscaped areas to the south of the development site will continue to drain at greenfield rates to either Holford Stream or Bum Brook.

i. Operational Risks

16.6.171 During the site operation phase the risks of incidents and accidents occurring will be reduced by measures that are incorporated into the design of the plant infrastructure and drainage systems and through appropriate management procedures.

16.6.172 The risk of water quality incidents occurring during the operational phase to the retained surface water receptors of Holford Stream and Bum Brook, the HPC Drainage Ditch having been abandoned, is extremely low due to an absence of operational activities within their catchments. This area of the site will be re-landscaped during the restoration phase to restore greenfield conditions.

16.6.173 The HPC operational site topography and landform will be designed in such a way to manage excess overland flow under very extreme exceedence events (up to and including the 0.01% AEP storm event). This will include designing surface features to convey (and temporarily store) excess run-off.

16.6.174 As with the construction phase the **Environmental Incident Control Plan** will form part of the operational phase design measures. The implementation of this plan will effectively act as mitigation to reduce the magnitude of any incidents to a non-significant level.

f) Cumulative Operational Impacts

16.6.175 No significant flood risk or change to hydraulic regime is expected in the receptor watercourses of Holford Stream and Bum Brook during the operational phase. Surface water drainage and operational groundwater dewatering will be collected across the northern area of the site (BDAW and BDAE) by the permanent drainage system and discharged to the marine environment, following any necessary treatment, through the cooling water discharge (see **Chapter 18**). During the operational phase there are no proposed discharges to surface watercourses other than permanent greenfield land drainage from the restored landscaped areas in the SCPA (see Removal and Restoration Impacts section below). The Holford Stream culvert and Bum Brook bridge crossing will be retained as permanent features throughout the operational phase of the development. No cumulative impacts as a result of on-site operational activities have been identified with respect to all surface freshwater receptors.

16.6.176 Taking into account of the range of potential impacts on the water quality status and hydraulic regime of Holford and Bum Brook Stream during the operational phase and detailed in **Table 16.19,** the overall impact on these receptors is assessed as **negligible.**

16.6.177 Cumulative effects with other elements of the HPC project and with other planned or reasonably foreseeable projects are addressed in **Volume 11** of this ES.

g) Removal/Restoration Impacts

16.6.178 The removal/restoration phase of the development includes the dismantling and removal of the jetty structure and the restoration of land surrounding the built elements of the Hinkley Point C Power Station.

Hydrology and Drainage Removal/Restoration Impacts

16.6.179 Activities that may result in change to the baseline hydrology and drainage environment are listed below:

- removal of impermeable and semi-permeable surfaces such as the access roads and roundabouts;
- removal of temporary aggregates storage area;
- removal of any redundant construction phase drainage systems, not including Holford Stream culvert which is to be retained;
- restoration of topography; and
- restoration of vegetated surfaces.

16.6.180 These activities will contribute to returning the restored areas of the site to a greenfield drainage regime.

16.6.181 Elements of the WMZs will be retained beyond the construction phase and the restoration works will be carried out to prevent any additional adverse hydrological or drainage impacts beyond those already identified within the construction phase (discussed above). Discharges to Holford Stream and Bum Brook for example, during the restoration phase may still be subject to discharge under Environmental Permit and are therefore restricted in terms of discharge rate. Best practice measures and management controls required under the **Water Management Plan** will still operate during this phase of works.

16.6.182 There will be no restoration works to the area of site draining to Bum Brook during this phase of works. All work on this area will have been completed during the early part of the construction phase. The removal of the drainage system infrastructure will reverse the effects of installing the system, removing the pathway by which accidental on-site discharges can reach surface water receptors.

Water Quality Removal/Restoration Impacts

16.6.183 With respect to terrestrial water quality, the assessment process has identified that similar potential impacts may be expected during the removal/restoration phase as for those identified in relation to the construction phase. Typically, the magnitude of potential impacts arising during the restoration phase may be expected to be less than similar impacts during the construction phase. For example, the earth movements that are required during the restoration phase will be reduced in scale when compared to the construction phase, with associated reduction in the potential for sediment-laden run-off to be generated.

16.6.184 Given that the same standard of working practice and Environmental Permit discharge standards applied during the construction phases will apply during the restoration phase, it is not considered necessary to present the impacts to surface water quality that will occur during this latter stage because similar activities and impacts of greater magnitude are already taken account of and provided for.

h) Cumulative Removal/Restoration Impacts

16.6.185 No cumulative impacts as a result of removal and restoration activities have been identified with respect to all surface water receptors.

16.6.186 Cumulative effects with other elements of the HPC project and with other planned or reasonably foreseeable projects are addressed in **Volume 11** of this ES.

16.7 Mitigation of Impacts

16.7.1 The impact assessment has identified that there is the potential for surface watercourses to be adversely affected as a result of a range of activities associated with the construction and landscape restoration phases of the development if appropriate mitigation measures are not put in place. During these phases a range of potential impacts were identified that had a significance rating of greater than minor which requires mitigation measures to be implemented. For the hydrology and drainage assessment these identified impacts relate to:

- An increase in tidal flooding to Wick Moor, the C182, the STW, national grid tower (pylons), and the areas around Little Dowden's Farm and Fisheries Cottage during the 1% AEP 2100 overtopping event; and
- increased risk of flooding due to reduced channel capacity of Holford Stream/Bum Brook as a result of accidental release of sediments.

16.7.2 For the water quality assessment these identified impacts may be broadly divided into:

- the generation of sediment-laden surface drainage water from a range of construction and earth working activities;
- surface drainage discharges with elevated concentrations of nutrients (phosphates) being discharged into Holford Stream;
- discharges of low pH (acidic) drainage from rock stock piles into Holford Stream; and
- accidental spillages of chemicals, including hydrocarbons during construction activities on the site.

16.7.3 The Impact and Mitigation Table presented as **Table 16.19** details mitigation proposals for each of the identified impacts.

a) Hydrology and Drainage

i. Drainage System Monitoring and Maintenance

16.7.4 All drainage systems employed during the construction and operation of Hinkley Point C would be frequently monitored and maintained to ensure their capacity for storage and/or flow conveyance is kept at the maximum for which they were originally designed. For open surface ditches, the monitoring process would ensure that:

- no flow obstructions are present in open ditches such as general litter, general construction works waste, construction materials, plant and leaf litter, wood debris and dead wildlife;

- any sediment deposits are not restricting the flow along any sections of watercourse. Sediment deposits might take the form of particles that have settled out of suspension during transportation through the network or at localised points where the ditch banks may have failed, thus causing a more significant obstruction to flow;
- ditch linings remain effective and damage is repaired in a timely manner; and
- where sediment control measures (e.g. sediment tubes) are employed, channel margins are not eroded at the deployment locations.

16.7.5 Monitoring will also include regular inspection of Bum Brook in the vicinity of the emergency access road bridge to prevent and/or remove any loss debris from the channel.

16.7.6 The condition of deep stone-filled drains would be less easy to monitor, although by implementing the measures at the drain surface highlighted above, the transportation of sediment into the drain should be minimised. Stone drains can be maintained by building access sumps at sufficiently spaced intervals such that pressure washers are able to effectively wash sediment between sections. Deposits can then be removed from individual sumps, either manually or by gully suckers. Equally, drains can be excavated and reinstated.

16.7.7 Where weirs are employed throughout the temporary drainage network, the effective crest levels will be periodically checked to ensure that the weir is still hydraulically functional in terms of flow control.

16.7.8 The **Water Management Plan** would be prepared by the operations maintenance team, however examples of methods which could be included in the plan are:

- annual CCTV inspections of pipe network to check structural integrity and for potential sources of blockage;
- frequent cleaning of road gullies, channel and kerb drains and Holford Stream culvert to ensure no blockage from leaf litter, general litter, etc.; and
- periodic consultation with professional drainage consultants or engineers throughout the operational phase to ensure that current guidance with respect to hydrological assessment is maintained, e.g. to allow for any potential changes in the severity of climate change predictions with respect to increasing rainfall intensity.

16.7.9 The implementation of the above mitigation (or proposals of a similar scope) will result in the impact magnitude, associated with increased fluvial flood risk at Bum Brook due to a blockage at the bridge, being as the likelihood of an incident would be very much reduced.

ii. Increased Flood Risk

16.7.10 A moderate adverse impact to the C182, the STW, national grid tower (pylons), and the areas around Little Dowden's Farm and Fisheries Cottage was determined during the tidal 1% AEP 2100 climate change tidal overtopping event, For further detail of the flood risk management strategies and options see Section 10 of the **Flood Risk Assessment**. No adverse impacts to the fluvial flood risk at third party properties were found.

Third Party Off-Site Receptors

16.7.11 A moderate impact to residential third party properties has been assessed during a tidal 1% AEP 2100 tidal overtopping event, with a minor impact assessed during 0.5% AEP 2100 events. These properties would be subject to flooding under tidal overtopping events despite the HPC development. The effect of the development will be to cause a minor increase in flood level under these low probability events. This assessment needs to be placed in the context of predictions in sea level rise and maintenance of the existing sea defence configuration in 2100. EDF Energy is proposing an agreement in the form of a compensatory scheme to be put in place to cover the potential increased risk to property owners in Stolford. This would involve entering into a Section 106 type agreement with the local planning authority to:

- continue to monitor sea levels and climate change with reference to Hinkley Point; and
- inform local residents if an agreed “trigger point” is reached based on monitoring of sea levels (which would not be expected to occur, if at all, until towards the end of this century).

16.7.12 In these circumstances EDF Energy would:assess the likely flood impact to each identified property;

- enter into a covenant with each property owner based on an appropriate contribution to the cost of repairs related to flood damage, proportionate to the impact caused by the Hinkley Point C development; and
- agree to pay the appropriate contribution should a flood event actually occur.

16.7.13 Further details are provided within the **Flood Risk Assessment**.

C182 main route

16.7.14 Access/egress to and from the site via the primary access route (C182) is not impacted during fluvial 2017 flood events, the 0.1% AEP 2100 event is covered below. However the Holford Stream crossing may be affected during tidal flooding via breaching and/or overtopping of the defences to the east of the existing Hinkley Point Power Station Complex. Should this crossing become impassable, access to the site would continue to be possible via the southern site access route to 2140, without the need to use the emergency access road during tidal flood events. Therefore no additional mitigation to protect this section of the C182 is considered necessary at this time.

16.7.15 EDF Energy will monitor the frequency of any future partial restriction to access which may be caused by tidal flooding, and may implement adaptive mitigation measures to limit the inconvenience such flooding may cause. Adaptive mitigation measures could include:

- raising the sections of the C182 access road; or
- enhancement of site access via the southern access route.

16.7.16 During the 0.1% AEP 2100 fluvial event modelling indicates that the C182 at the existing Holford Stream crossing and Bum Brook crossing would flood, with the greatest depths at the Bum Brook crossing of 0.22m. Although there is a small reduction in flood level downstream of the new emergency access road bridge (-0.01m), it would still be necessary to provide an alternative route in the event the bridge becomes impassable. Under these circumstances access/egress would still be possible via the emergency access bridge across Bum Brook, which the model results indicate would not flood during this event.

iii. Contingency Discharge

16.7.17 Contingencies for pumped emergency discharges or surface water following high rainfall events would be identified such that consents/permit conditions for discharge would be agreed with the contractor(s) and with the appropriate authorities prior to the commencement of the relevant works on-site.

iv. Accidents and incidents

16.7.18 Mitigation measures will be put in place to ensure that impacts are minimised in the case of accidents or incidents on site. The proposed measures will include:

- identification, at the earliest possible stage, of possible sources and locations of accidents that could potentially lead to on-site discharge of water;
- assessment of the likely extent of the area that could potentially be inundated should an accident occur;
- assessment of potential risks to infrastructure; and
- development of procedures to:
  - enable prompt isolation of the inundation area with respect to the safety of site operatives;
  - ensure prompt recovery and clean-up of the area of potential inundation; and
  - allow assessment of incidents to inform the need for updates to the emergency procedure.

b) Water Quality

16.7.19 Water quality mitigation measures are presented within this section. Mitigation measures are considered necessary to manage to acceptable levels any identified significant impacts on water quality (i.e. moderate and major adverse impacts).

16.7.20 The main anticipated impact (associated with all phases of the proposed development) was found to be the generation of sediment-laden water which may impact upon the water quality status of surface watercourse receptors. Therefore, the majority of the mitigation is directed towards the reduction of sediment-laden surface drainage. A **Water Management Plan** will be implemented for the construction of HPC. Subsequent sections of this chapter describe mitigation measures for sediment control which form part of the **Water Management Plan**.

16.7.21 Further potential impacts may be anticipated from oils and fuels (hydrocarbons) related to the use of construction plant and equipment and leachate from the use of fresh concrete and cement. Both of these impact types have been assessed as being negligible or minor adverse; and it is assumed that best working practice procedures would be adopted during construction practices to effectively manage the impacts.

16.7.22 An **Environmental Incident Control Plan** will also be developed for the site. A full suite of equipment will be made available by the contractors for managing the range and magnitude of potential spillages. This will include emergency spill kits and equipment for containment and clean-up.

i. Surface Water Drainage Environmental Permits

16.7.23 The key mitigation for protection of the freshwater quality status in local watercourses will be treatment and attenuation to discharges into Hinkley C Drainage Ditch, Holford Stream and Bum Brook (the latter during the early landscaping works only). The requirements of the permit(s) in terms of chemical quality and flow volume will be met through the use of (a) WMZs, where attenuation and any required treatment of water quality will be undertaken, and (b) the adoption of appropriate working practices.

16.7.24 Environmental Permits (which set out discharge consent requirements) are set by the Environment Agency under the Environmental Permitting Regulations (2010) (Ref. 16.17). Based on the range of expected potential contaminants that may be present in surface drainage as a result of activities during the construction phases for HPC key discharge specifications for water quality are proposed below. These proposals will be subject to detailed discussion and agreement with the Environment Agency.

ii. Discharges to Holford Stream and Bum Brook

16.7.25 Discharges to Holford Stream and Bum Brook will be made following attenuation to greenfield run-off rates and treatment within the WMZs. The proposed basic chemical quality of the discharges is based on WFD EQS values for 'Good' Status for pH (Ref. 16.8) and the Fish Directive (Ref. 16.5) guideline value for suspended solids. In proposing these values, consideration has been given to the small size of these watercourses and the sensitivity of downstream aquatic habitats. Basic proposed criteria for discharges to these watercourses are as follows:

- suspended solids : 25mg/l;
- pH : 6 (5 percentile) to 9 (95 percentile) pH units; and
- no visible oils.

16.7.26 In addition to these basic parameters further additional water quality conditions may be applied to the permit for the eastern discharge into Holford Stream in relation to treated sanitary effluent from the accommodation campus. Further conditions may also be applied to the Environmental Permits for the two proposed discharges into Holford Stream in terms of nutrient concentrations (phosphate) due to the potential sensitivity of downstream wetland habitats to eutrophication.

iii. Discharges to Hinkley C Drainage Ditch

16.7.27 Surface drainage discharges to the Hinkley C Drainage Ditch during the early part of the construction phase will ultimately discharge to the Hinkley intertidal area. As part of the drainage design, discharges will be subject to attenuation and treatment in WMZs. Given that that HPC Drainage Ditch has a low sensitivity and value and will be backfilled during installation of the construction drainage system, the value proposed for suspended solids is a higher value based on the mean concentration recorded in the marine surface water sampling campaign (Ref. 16.76) of 264mg/l.

The following values have been proposed for the HPC Drainage Ditch discharges to the Hinkley intertidal area:

- suspended solids: 250mg/l;
- pH : 6 (5 percentile) to 9 (95 percentile) pH units; and
- no visible oils.

16.7.28 Surface water discharges will transfer to the intertidal area once the Hinkley Foreshore Construction Outfall has been constructed and commissioned, at which time the HPC Drainage Ditch will be abandoned. The proposed discharge quality values will remain the same.

iv. Disposal of Groundwater

16.7.29 During the construction phase, there will be a requirement to dewater accumulations of ground and surface water within excavated areas. If the water is deemed to be of suitable quality, following monitoring, it will be pumped from the excavated area into the surface drainage system for disposal either to Holford Stream or the Hinkley Foreshore Construction Outfall. In the BDAE and BDAW, the wastewater stream from the dewatering of excavations will be maintained separately from the active dewatering system proposed for the lowering of groundwater levels across the northern area of the site.

16.7.30 During the initial excavations required for construction of the Holford Stream culvert, the SCPA WMZs will still be in preparation and therefore unavailable. Excavation dewatering discharges from this area will be routed, though suitable treatment, directly in to Holford Stream via a series of discharge locations that will be subject to individual Environmental Permits.

16.7.31 Mitigation measures will be implemented to ensure that any encountered contaminated groundwater is not disposed of in to the drainage systems so that there will be no resultant impact upon the quality or status of the local watercourse receptors. The chemical quality characteristics of the groundwater suitability for disposal will be agreed with the Environment Agency, together with an appropriate monitoring and management regime.

16.7.32 Groundwater that is found to be contaminated and to exceed discharge chemical or radiochemical quality parameters set by the Environment Agency will be managed in two ways:

- use of on-site techniques to treat the water to a suitable discharge standard such as removal of sediments by settlement or mechanical methods; and
- for chemically or radiochemically contaminated water that is found to be unsuitable for in-situ treatment then off-site disposal to a suitable facility will be implemented.

v. Sediment-Laden Run-off

Reducing Sediment Generation: Introduction

16.7.33 A range of techniques will be adopted to reduce sediment generation from the relevant activities which may act as a source of sediment. A **Water Management**

Plan will be in place to ensure that surface water run-off and sediments generated during earthworks activities are properly managed and controlled and this plan will be provided for approval by the appropriate bodies (principally the Environment Agency) prior to the commencement of the relevant works on-site. This **Water Management Plan** incorporates the techniques described below to reduce sediment generation.

16.7.34 Sediment generation is normally associated with surface drainage and de-watering operations from earth working areas where soils are exposed. The main sources are drainage from exposed soil in working areas which have been recently excavated or landscaped; excavated or imported materials which have been temporarily stockpiled; and exposure and erosion of surface soils associated with movements of construction plant. The key requirement is to prevent uncontrolled and untreated surface drainage from these areas reaching surface water features.

Reducing Sediment Generation: Exposed Soils

16.7.35 A range of techniques will be employed to reduce erosion and generation of sediment-laden surface drainage from newly excavated areas. These include the placement of sediment fencing or tubes at intervals up the face of a slope which has a dual effect in reducing the speed of water flow down the excavated slope face, which causes the erosion, and the trapping of sediment behind these barriers. Other techniques that will be used, as appropriate, include: placement of hessian netting and geo-grid soil stabilisation systems to assist in soil retention and therefore reduce sediment generation.

16.7.36 These techniques are most suited for exposed soils prior to the establishment of soil-stabilising vegetation. Seeding of the slopes and the topsoil and subsoil stockpiles will be undertaken at the earliest opportunity to allow rapid establishment of plants and consolidation of the soils.

16.7.37 Such approaches are not usually practical in areas where continued earthworks activities are being undertaken due to a requirement for continued movement of the sediment barriers for construction plant access and movements. In these areas the development of a temporary drain at the foot of the slope to collect drainage water is often more practical.

16.7.38 Sediment fencing and sediment tubes may also be deployed at strategic locations as appropriate around working areas to retain sediments within that area and close to the source of generation.

Reducing Sediment Generation: Dewatering of Excavated Areas

16.7.39 During the dewatering of excavated areas, for example after periods of heavy rain or through groundwater ingress, a temporary area for collection of water will be allocated within the excavated zone. This will involve excavation of a sump area in the lowest part of the excavation into which temporary ditches flow from around the excavation area. Water is then pumped from this area for discharge into soakaway areas or to the drainage system, for attenuation and settlement of solids within WMZs prior to discharge. Settlement of solids may occur within the sump area and therefore pumping of water will occur from the surface layers to reduce the movement of sediments outside the working area.

Reducing Sediment Generation: Stockpile Areas

16.7.40 Stockpiled soils and materials would be sited away from floodplains of surface watercourses to prevent the entry into watercourses of sediment-laden surface drainage and to ensure that the flood storage capacity of the fluvial floodplain is not compromised where possible. A number of approaches will be adopted to reduce the generation of sediment-laden drainage water from stockpiled areas. These techniques will include ring fencing the stockpile with either sediment fencing or sediment tubes to retain sediment run-off. If stockpiles are to be left for an extended period prior to re-use of the material then seeding with fast growing vegetation would be carried out in order to reduce surface erosion from rainfall. Perimeter drainage ditches will be established around stockpiles as necessary to collect surface drainage which would then either be discharged into the surface drainage system for treatment in the WMZ, or to a soakaway area.

Reducing Sediment Generation: Construction Plant Movements

16.7.41 The movement of heavy construction plant across exposed soils can lead to erosion and rutting that can generate sediment-laden surface drainage water. Haul roads will be constructed for areas and routes of frequent plant movement and restrictions on traffic movements enforced so that there is no unnecessary access for vehicles or plant to areas of soft soils. Where plant access is required across soft soils, then movements would be restricted to pre-defined corridors and suitable lateral or perimeter drainage ditches employed to collect surface drainage run-off.

Reducing Suspended Solids Concentrations in Surface Drainage Water: Introduction

16.7.42 There is a requirement to ensure high concentrations of suspended solids are not discharged into surface watercourses. There is the potential that surface water drainage collected during construction phases may have a higher concentration of suspended solids than the consented discharge level that has been detailed in the Environment Agency discharge conditionality report. Therefore, techniques will be employed to reduce the suspended solids concentration to an acceptable level prior to discharge. Large sediment particles will readily settle out under reduced flow velocity conditions (e.g. settlement lagoon). However, the finer fractions (such as clays) may tend to persist as a colloidal suspension and require more intensive physical or chemical intervention for effective removal (e.g. chemical flocculation).

Reducing Suspended Solids Concentrations in Surface Drainage Water: Sediment Removal within Temporary Surface Drainage Systems

16.7.43 Temporary drainage ditches used to collect water from construction areas across the site will incorporate a number of features to reduce further sediment treatment requirements prior to discharge. Main collection ditches that feed into settlement lagoons in the WMZs will be stone or geotextile lined to prevent bed erosion during periods of high flows. They will incorporate stepped weirs to encourage sediment settlement within the ditch and may also incorporate sediment trapping barriers (e.g. sediment tubes) to further retain silt and sediments within the ditch. Surface drainage may also be diverted through small silt trap areas constructed within the drainage system for the removal of suspended solids.

Reducing Suspended Solids Concentrations in Surface Drainage Water in the Water Management Zones

16.7.44 There will be a need to construct temporary settlement lagoons into which water from the construction phase surface drainage system and water from dewatering of excavations will be passed to allow the settlement of solids. The lagoons within the WMZs will serve an additional function of attenuating flows. To be as effective as possible, such lagoons require as long a retention time as possible to promote effective settlement. Residence time within the lagoons would be increased, if necessary, by the use of geo-textile baffles.

Reducing Suspended Solids Concentrations in Surface Drainage Water: Mechanical Recovery of Suspended Solids

16.7.45 A range of commercial systems are available that may be employed to mechanically separate solids from water. These include technology such as ‘silt busters’ and wedge wire screen drum filters. These systems will likely form part of a ‘tool box’ of techniques necessary to ensure discharges to terrestrial surface water systems meet the Environmental Permit discharge consent conditions.

Reducing Suspended Solids Concentrations in Surface Drainage Water: Chemical Recovery of Suspended Solids

16.7.46 Suspended solids may also be removed from surface drainage water through the use of chemical flocculants in treatment lagoons. These are particularly effective for removal of the finer particles (e.g. clay) that may not settle out in settlement facilities due to colloidal effects. Alum is routinely used in the wastewater industry for flocculation, however there are noted pH reduction effects associated with its application. Other available chemical flocculants that may be applied are usually synthetic organic polymers. Agreement would be sought from the Environment Agency on the potential need for and use of chemical flocculants if necessary. However, it is not envisaged that the use of chemical flocculants would be required.

vi. Sustainable Drainage Systems

16.7.47 Good practice measures would be adopted to reduce, where possible, the volume of surface drainage that may have elevated suspended solids concentrations, being collected and requiring disposal through discharge. By restricting drainage run-off rates, the erosion of bare soils would be reduced leading to a reduction in potential sediment generation. Where practical during the construction phase, Sustainable Drainage System (SuDS) principles would be adopted for the surface drainage system in the SCPA This would include techniques such as the use of porous hard surface areas, the adoption of soakaway systems for disposal of uncontaminated surface drainage water where practicable. There are no opportunities for use of SuDs techniques within the BDAW and BDAE during either the construction or operational phases as disposal of surface drainage will be made directly to the sea and the use of infiltration techniques will conflict with the requirement to actively maintain groundwater levels at reduced level to prevent damage to buildings.

16.7.48 Currently it is proposed that a green roof system will be developed on some of the HPC buildings.

vii. Management of Site Areas

16.7.49 Stockpiled materials will need to be placed outside the area of flood zones for surface watercourses. This will ensure that there is limited potential for increased risk of localised flooding from the use of floodplain storage capacity or sediment generation resulting from floodwater inundation of stockpiles.

16.7.50 To ensure protection of Holford Stream, a buffer zone would be created during the pre-culverting phase along the stretch of stream parallel to the culvert alignment. The buffer zone would be demarked with sediment fencing. This physical barrier will serve several purposes:

- to prevent heavy plant accessing the riparian zone and causing bank erosion and potential bank collapse;
- to ensure materials are not deposited within areas that have the potential to flood; and
- to reduce the potential for sediment-laden water from the stockpiling areas and haul routes entering Holford Stream.

viii. Monitoring

16.7.51 An environmental monitoring strategy will be set out within the EMMP for all elements of the terrestrial surface drainage system to ensure the conditions of Environmental Permits for discharges to terrestrial surface watercourses are met on all occasions. Specific additional details will be provided in the supporting **Water Management Plan**. The monitoring strategy will extend to routine inspection, assessment of system performance, maintenance, and monitoring of all elements of the surface drainage system across the entire HPC development site. The deployment of mitigation measures will be dictated by the results of the monitoring programme in combination with the status of the construction works programme and prevailing weather conditions. This will require a flexible and pro-active approach to provide protection to retained surface water features within and local to the site.

ix. Nutrient Concentrations in Surface Drainage

16.7.52 Phosphorus is the key nutrient associated with the eutrophication of freshwater systems. Disturbance of the existing agricultural soils during construction works may increase the mobilisation of phosphorus and discharge of this substance within surface drainage to Holford Stream and Bum Brook. This may negatively impact both water quality and ecological conditions. The majority of phosphorus is likely to be associated with suspended solids and therefore the removal of suspended solids prior to discharge, would be a likely requirement of conditions under an Environmental Permit. Removal of suspended solids would be achieved through the implementation of control measures within the surface drainage system and treatment of surface drainage prior to discharge from the WMZs. The requirement to reduce suspended solids to acceptable concentrations would assist in limiting nutrient inputs into Holford Stream and Bum Brook.

16.7.53 It may be deemed appropriate to routinely monitor the nutrient status of drainage water being discharged to watercourses. If nutrient concentrations are present that are significantly above existing baseline concentrations then additional remedial measures may be required such as treatment within attenuation basins provided in the WMZs with a phosphorus binding agent such as 'Phoslock'.

x. Acid Rock Drainage (ARD)

16.7.54 The potential impact of acid rock drainage discharges to Holford Stream, from stockpiled areas of mudstone in the SCPA, has been assessed to be of moderate significance and therefore requires mitigation measures to be adopted. The mitigation for this impact would involve use of appropriate stockpiling techniques to minimise ARD generation and monitoring of surface run-off from stockpiles and treatment, if required.

16.7.55 Monitoring of the drainage collected from areas of stockpile material will include measurement of pH. If low pH conditions are recorded then further testing may be required to determine if leaching of other trace elements is taking place. Example mitigation approaches that may be adopted which are:

- reducing the generation of ARD from the stockpile using techniques such as compaction or prevention of water ingress; and
- treatment of the low pH surface drainage within the WMZs using techniques such as Anoxic Limestone Ditches (ALDs) to ameliorate the acidic conditions prior to discharge.

xi. Spillages Including Soils, Hydrocarbons and Concrete

16.7.56 Best practice measures will be adopted for the maintenance of plant and equipment, storage of fuel and other chemicals and refuelling of construction plant and equipment. These activities will be located at distance from the surface watercourses. Biodegradable greases and lubricants would be used where possible on mobile construction plant. Oil separators/interceptors will be incorporated into the surface drainage system to prevent discharge of hydrocarbons to the HPC Drainage Ditch and Holford Stream.

16.7.57 To mitigate against potential impacts of leaching from fresh concrete, Environment Agency guidance detailed in PPG 5 and 6 (Ref. 16.39) would be followed. Quick setting concrete formulas would be used where possible and any spillages would be contained immediately. Where possible, concreting would be carried out in dry conditions.

xii.Mitigation of Impacts during Removal and Restoration

16.7.58 The same range of impacts are expected for removal/reinstatement (if required) and, therefore, the same range of mitigation measures as proposed for the construction phase works would be applied.

16.8 Residual Impacts

16.8.1 Residual impacts for all identified impacts including those which were not at a level of significance that required mitigation have been detailed in the summary impact assessment table (see **Table 16.19**).

a) Construction Impacts

16.8.2 A **moderate adverse** impact remains during a during 1% AEP 2100 overtopping event for the residential third party receptors at Little Dowden's Farm and Fisheries Cottage, with more widespread minor impacts to residential and non-residential third party receptors during other tidal events. The managed adaptive approach to mitigation discussed in section 16.7.11 and 16.7.12 recognises that impacts are only predicted as a result of sea level rise and do not impact immediately In addition, the hazard rating to these residential third party receptors does not increase. The **Flood Risk Assessment** shows that the receptors would flood with or without the HPC development.

16.8.3 No other (greater than minor) residual impacts on surface water receptors have been identified, in relation to the construction phase.

b) Operational Impacts

16.8.4 No significant (greater than minor) residual impacts on surface water receptors have been identified, in relation to the operational phase.

c) Removal/Restoration Impacts

16.8.5 No significant (greater than minor) residual impacts on surface water receptors have been identified, in relation to the removal/restoration works.

16.9 Summary of Impacts

Table 16.19: Surface Water Impact and Mitigation Table

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Construction Impacts – Hydrology and Drainage							
Elevated surface water run-off							
Elevated surface water run-off.	HPC Drainage Ditch	Very low (Due to WMZs controlling discharge to greenfield rates)	Local Adverse Temporary Direct Possible	Low	Negligible	No mitigation required	Minor
Elevated surface water run-off.	Hinkley Point intertidal area	Medium (Due to WMZs)	Local Adverse Temporary Direct Possible	Very low	Minor	No mitigation required	Negligible
Elevated surface water run-off.	Holford Stream (and Wick Moor)	Very low (Due to WMZs controlling discharge to greenfield rates)	Local Adverse Temporary Direct Unlikely	High	Minor	No mitigation required	Minor
Elevated surface water run-off.	Wick Moor (via Holford Stream)	Very low (Due to WMZs controlling discharge to greenfield rates)	Local Adverse Temporary Indirect Unlikely	High	Minor	No mitigation required	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Elevated surface water run-off.	Bum Brook	Very low (Due to WMZs controlling discharge to greenfield rates)	Local Adverse Temporary Indirect Unlikely	High	Minor	No mitigation required	Minor
Elevated surface water run-off from the highway improvement works.	Residential third party properties/land	Very low	Local Adverse Temporary Indirect Unlikely	High	Minor	No mitigation required	Minor
Elevated sediment delivery and deposition in watercourses							
Elevated sediment delivery and deposition in watercourses.	HPC Drainage Ditch	Low (Practices to follow PPG and discharges under Environmental Permit)	Local Adverse Temporary Indirect Possible	Low	Minor	No mitigation required	Minor
Elevated sediment delivery and deposition in watercourses.	Holford Stream	Very low (Practices to follow PPG and discharges under Environmental Permit)	Local Adverse Temporary Indirect Unlikely	High	Minor	No mitigation required	Minor
Elevated sediment delivery and deposition in watercourses.	Bum Brook	Very low (Practices to follow PPG and discharges under Environmental Permit)	Local Adverse Temporary Indirect Unlikely	High	Minor	No mitigation required	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Increased flood risk of land outside the HPC development site from pluvial sources of flooding							
Increased flood risk due to elevated surface water run-off from the proposed HPC development site.	Hinkley Point intertidal area	Low	Local Adverse Temporary Indirect Possible	Very Low	Negligible	No mitigation required	Minor
Increased flood risk due to elevated surface water run-off from the proposed HPC development site.	Agricultural land off-site from the HPC development site west of HPC Drainage Ditch	Very low	Local Adverse Temporary Indirect Unlikely	Low	Negligible	No mitigation required	Minor
Increased flood risk due to elevated surface water run-off from the proposed HPC development site.	Agricultural land off-site from the HPC development site west of Holford Stream	Very low	Local Adverse Temporary Indirect Unlikely	Medium	Minor	No mitigation required	Minor
Increased flood risk due to elevated surface water run-off from the proposed HPC development site.	Wick Moor	Very low	Local Adverse Temporary Indirect Unlikely	Medium	Minor	No mitigation required	Minor
Increased flood risk due to elevated surface water run-off from the proposed HPC development site.	Land off-site adjacent to Bum Brook	Very low	Local Adverse Temporary Indirect Unlikely	Medium	Minor	No mitigation required	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Fluvial flood risk							
Increased fluvial flood risk due to reduced channel capacity as a result of sediment deposition within Holford Stream.	Wick Moor	Very low	Local Adverse Temporary Indirect Unlikely	Medium	Minor	No mitigation required	Minor
Increased fluvial flood risk due to reduced channel capacity as a result of sediment deposition within Bum Brook.	Land off-site adjacent to Bum Brook	Low	Local Adverse Temporary Indirect Unlikely	Medium	Minor	No mitigation required	Minor
Increased fluvial flood risk due to reduced flood storage capacity of Holford stream valley as a results of the platform and WMZs.	Wick Moor	Very low	Local Positive Temporary Direct Likely	Medium	Minor	No mitigation required	Minor
Increased fluvial flood risk due to a blockage in Holford stream culvert.	Agricultural land off-site from the HPC development site west of Holford Stream	Very low	Local Adverse Temporary Direct Unlikely	Medium	Minor	No mitigation required (however regular monitoring of the culvert will be carried out to ensure that lose debris does not build up)	Minor
Increased fluvial flood risk due restricted flow under bum brook emergency access bridge during a flood event.	Land off-site adjacent to Bum Brook	Very low	Local Adverse Temporary Direct Possible	Medium	Minor	No mitigation required	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Increased fluvial flood risk due restricted flow under Bum brook emergency access bridge during a flood event.	Residential third party properties	Very low	Local Positive Temporary Direct Possible	High	Minor	No mitigation required	Minor
Increased fluvial flood risk due a blockage under Bum brook emergency access bridge.	Land off-site adjacent to Bum Brook	Low	Local Adverse Temporary Direct Possible	Medium	Minor	No mitigation required (however regular monitoring of Bum Brook will be carried out to ensure that lose debris does not build up)	Minor
Tidal flood risk							
Increased tidal flood risk during 0.5% AEP 2017 overtopping event due to reduced flood storage capacity of Holford stream valley due to infilling of the valley for the platform.	Wick Moor	Very low	Local Adverse Temporary Direct Unlikely	Medium	Minor	No mitigation required	Minor
Increased tidal flood risk during 0.5% AEP 2100 overtopping event due to reduced flood storage capacity of Holford stream valley due to infilling of the valley for the platform.	Wick Moor	Very low	Local Adverse Temporary Direct Unlikely	Medium	Minor	No mitigation required	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Increased tidal flood risk during 0.5% AEP 2100 breach event due to reduced flood storage capacity of Holford stream valley due to infilling of the valley for the platform.	Wick Moor	Very low	Local Adverse Temporary Direct Unlikely	Medium	Minor	No mitigation required	Minor
Increased tidal flood risk during 1% AEP 2100 overtopping event due to reduced flood storage capacity of Holford stream valley due to infilling of the valley for the platform.	Wick Moor	Low	Local Adverse Temporary Direct Unlikely	Medium	Minor	No mitigation required	Minor
Increased tidal flood risk during 0.5% AEP 2100 overtopping event due to reduced flood storage capacity of Holford stream valley due to infilling of the valley for the platform.	Residential third party properties (Little Dowden's Farm, Fisheries Cottage, North of Croft Farm, Swallowcliffe, and Fisherman's Cottage)	Very low	Local Adverse Temporary Direct Unlikely	High	Minor	EDF Energy will monitor sea levels and climate change and should a "trigger point" be reached, EDF Energy would assess the likely flood impact to each identified property, enter into a covenant with each property owner based on an appropriate contribution to the cost of repairs related to flood damage, proportionate to the impact caused by the Hinkley Point C development and agree to pay the appropriate contribution should a flood event actually occur.	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Increased tidal flood risk during 0.5% AEP 2100 overtopping event due to reduced flood storage capacity of Holford stream valley due to infilling of the valley for the platform.	Non-residential third party properties (C182, the STW, and the national grid tower (pylons))	Very low	Local Adverse Temporary Direct Unlikely	Medium	Minor	No mitigation required	Minor
Increased tidal flood risk during 0.5% AEP 2100 breach event due to reduced flood storage capacity of Holford stream valley due to infilling of the valley for the platform.	Non-residential third party properties (0.11m increase in flood depth at C182, the STW and national grid tower (pylons))	Very low	Local Adverse Temporary Direct Unlikely	Medium	Minor	No mitigation required	Minor
Increased tidal flood risk during 1% AEP 2100 overtopping event due to reduced flood storage capacity of Holford stream valley due to infilling of the valley for the platform.	Residential third party properties (Little Dowden's Farm and Fisheries Cottage)	Low	Local Adverse Temporary Direct Unlikely	High	Moderate	EDF Energy will monitor sea levels and climate change and should a "trigger point" be reached, EDF Energy would assess the likely flood impact to each identified property, enter into a covenant with each property owner based on an appropriate contribution to the cost of repairs related to flood damage, proportionate to the impact caused by the Hinkley Point C development and agree to pay the appropriate contribution should a flood event actually occur.	Moderate

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Increased tidal flood risk during 1% AEP 2100 overtopping event due to reduced flood storage capacity of Holford stream valley due to infilling of the valley for the platform.	Non-residential third party properties (C182, the STW, and the national grid tower (pylons))	Low	Local Adverse Temporary Direct Unlikely	Medium	Minor	No mitigation required	Minor
Change to Holford Stream Hydraulic Characteristics due to the construction of Holford Stream culvert							
Increased flow velocities due to Holford stream culvert.	Holford Stream	Very low (Due to energy dissipation measures)	Local Adverse Permanent Direct Unlikely	High	Minor	No mitigation required	Minor
Interruption of flows in Holford Stream due to construction of culvert.	Holford Stream	Very low (Due to offline construction)	Local Adverse Temporary Direct Unlikely	High	Minor	No mitigation required	Minor
Influence on water levels in the wick moor SSSI due to Holford stream culvert.	Wick Moor	Very low (Due to impermeable culvert base and adjacent groundwater collector drains)	Local Positive Permanent Direct Unlikely	High	Minor	No mitigation required	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Construction Impacts – Water Quality							
Installation and removal of Temporary Surface Water Drainage System including Water Management Zones in the Built Development Areas East and West							
Sediment-laden run-off associated with topsoil stripping, excavations and excavation dewatering.	Freshwater Quality Status – HPC Drainage Ditch	Low	Local Adverse Temporary Direct Certain	Low	Minor	No mitigation required, however, assessment of magnitude assumes good practice measures adopted.	Minor
Hydrocarbon contaminated run-off deriving from plant activities.	Freshwater Quality Status – HPC Drainage Ditch.	Very low	Local Adverse Temporary Direct Possible	Low	Negligible	No mitigation required, however, assessment of magnitude assumes good practice measures adopted.	Negligible
Mobilisation of stream bed sediments as a result of increased flows.	Freshwater Quality Status – HPC drainage ditch.	Very low	Local Adverse Temporary Direct Possible	Low	Negligible	No mitigation required, however assessment of magnitude assumes attenuation of discharges to greenfield run-off rates.	Negligible
Installation and removal of Temporary Surface Water Drainage Systems including Water Management Zones in Southern Construction Phase Area							
Sediment-laden run-off associated with topsoil stripping, excavations and excavation dewatering.	Freshwater Quality Status – Holford Stream	Low	Local Adverse Temporary Direct Certain	High	Moderate	Mitigation measures required to reduce sediment generation at source and removal prior to discharge into Holford Stream under Environment Agency consent.	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Hydrocarbon contaminated run-off deriving from plant activities.	Freshwater Quality Status – Holford Stream	Very low	Local Adverse Temporary Direct Possible	High	Minor	Ensure oil interceptors are present in drainage systems. Use biodegradable oils and lubricants on construction plant.	Minor
Mobilisation of stream bed sediments as a result of increased flows.	Freshwater Quality Status – Holford Stream	Very low	Local Adverse Temporary Direct Possible	High	Minor	Attenuation of flows to allow discharges to be made at greenfield run-off rates	Minor
Construction of culvert for Holford Stream							
Sediment-laden run-off associated with topsoil stripping, excavations and excavation dewatering.	Freshwater Quality Status – Holford Stream	Very low (culvert to be constructed offline)	Local Adverse Temporary Direct Certain	High	Minor	Mitigation measures required to reduce sediment generation at source and removal prior to discharge into Holford Stream under Environment Agency consent.	Minor
Hydrocarbon contaminated run-off deriving from plant activities.	Freshwater Quality Status – Holford Stream	Very low (culvert to be constructed offline)	Local Adverse Temporary Direct Possible	High	Minor	Ensure oil interceptors are present in drainage systems. Use biodegradable oils and lubricants on construction plant.	Minor
Mobilisation of stream bed sediments as a result of increased flows.	Freshwater Quality Status – Holford Stream	Very low (culvert to be constructed offline)	Local Adverse Temporary Direct Possible	High	Minor	Attenuation of flows to allow discharges to be made at greenfield run-off rates.	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Concrete leachate from construction of culvert.	Freshwater Quality Status – Holford Stream	Very low (culvert to be constructed offline and use of best practice)	Local Adverse Temporary Direct Possible	High	Minor	Minimise in-situ concrete use using pre-cast components.	Minor
Construction phase earthworks							
Sediment-laden surface drainage from earthworks activities, including vegetation removal, topsoil stripping, creation of development platform levels, creation of temporary aggregates storage area, landscaping, fence erection and dewatering of excavations.	Freshwater Quality Status – HPC Drainage Ditch.	Medium	Local Adverse Temporary Direct Certain	Low	Minor	No mitigation required, however assessment of magnitude assumes good practice measures adopted.	Minor
Sediment-laden surface drainage from earthworks activities, including vegetation removal, topsoil stripping, creation of development platform levels, landscaping, fence erection and dewatering of excavations.	Freshwater Quality Status – Holford Stream	Medium	Local Adverse Temporary Direct Certain	High	Major	Adopted best practice measures to reduce sediment generation at source. Collection and treatment of sediment-laden surface drainage and treatment to reduce suspended solids concentrations to levels of discharge consent.	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Sediment-laden run-off from short-term stockpiling areas in Built Development Areas East and West.	Freshwater Quality Status – HPC Drainage Ditch.	Low	Local Adverse Temporary Direct Possible	Low	Minor	No mitigation required, however, assessment of magnitude assumes good practice measures adopted such as ring-fencing of stockpiles with sediment fencing.	Minor
Sediment-laden run-off from short-term and long-term stockpiling areas in Southern Construction Phase Area.	Freshwater Quality Status – Holford Stream	Low	Local Adverse Temporary Direct Possible	High	Moderate	Mitigation measures to be adopted to minimise sediment generation by stockpiles. Collection of surface drainage water from stockpiling area and treatment in WMZ prior to discharge under consent	Minor
Concrete leachate from foundation works e.g. fence erection works, workshop footings, etc.	Freshwater Quality Status – HPC Drainage Ditch.	Very low (highly localised and use of best practice guidance)	Local Adverse Temporary Direct Possible	Low	Negligible	No mitigation required	Negligible
Concrete leachate from foundation works e.g. fence erection works, workshop footings, etc.	Freshwater Quality Status – Holford Stream	Very low (highly localised and use of best practice guidance)	Local Adverse Temporary Direct Possible	High	Minor	No mitigation required	Minor
Run-off containing elevated concentrations of nutrients following sediment disturbance.	Freshwater Quality Status – HPC Drainage Ditch.	Low	Local Adverse Temporary Direct Possible	Low	Minor	No mitigation required, however, assessment of magnitude assumes good practice measures adopted.	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Run-off containing elevated concentrations of nutrients following sediment disturbance.	Freshwater Quality Status – Holford Stream	Low	Local Adverse Temporary Direct Possible	High	Moderate	Removal of sediments in surface drainage system and WMZ prior to discharges to reduce nutrient inputs in to watercourse.	Minor
Run-off containing elevated concentrations of nutrients following sediment disturbance (during landscape restoration works).	Freshwater Quality Status – Bum Brook	Very low	Local Adverse Temporary Direct Possible	High	Minor	No mitigation required. Removal of sediments in surface drainage system and WMZ prior to discharges to reduce nutrient inputs in to watercourse.	Minor
Surface water run-off containing elevated concentrations of hydrocarbons from temporary plant.	Freshwater Quality Status – HPC Drainage Ditch.	Very low	Local Adverse Temporary Direct Possible	Low	Negligible	No mitigation required, however, assessment of magnitude assumes good practice measures adopted such as use of oil interceptors in drainage system.	Negligible
Surface water run-off containing elevated concentrations of hydrocarbons from temporary plant.	Freshwater Quality Status – Holford Stream	Very low	Local Adverse Temporary Direct Possible	High	Minor	No mitigation required, however, assessment of magnitude assumes good practice measures adopted such as use of oil interceptors in drainage system.	Minor
Groundwater pumped into surface drainage system.	Freshwater Quality Status – HPC drainage ditch.	Low	Local Adverse Temporary Direct Possible	Low	Minor	No mitigation required. Assessment of magnitude assumes good practice measures adopted such as routine quality monitoring of pumped groundwater.	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Surface run-off from rock stockpile areas, of potentially low pH.	Freshwater Quality Status – Holford Stream	Low	Local Adverse Temporary Direct Possible	High	Moderate	Stockpiling techniques to minimise percolation. Monitoring of surface drainage from rock stockpiling area. Treatment of any low pH using techniques with Water Managements Zones such as anoxic limestone ditches.	Minor
Construction of site compound, development site roads (access and haul roads)							
Surface run-off containing elevated concentrations of suspended sediment.	Freshwater Quality Status – HPC Drainage Ditch.	Low	Local Adverse Temporary Direct Certain	Low	Minor	No mitigation required, however, assessment of magnitude assumes good practice measures adopted.	Minor
Concrete leachate from in-situ construction of footings and foundations.	Freshwater Quality Status – HPC Drainage Ditch.	Very low (highly localised and use of best practice guidance)	Local Adverse Temporary Direct Possible	Low	Negligible	No mitigation required, however, assessment of magnitude assumes good practice measures adopted.	Negligible
Surface run-off containing elevated concentrations of hydrocarbons from temporary plant and vehicle parking areas.	Freshwater Quality Status – HPC Drainage Ditch.	Very low	Local Adverse Temporary Direct Possible	Low	Negligible	No mitigation required, however, assessment of magnitude assumes good practice measures adopted.	Negligible

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Surface run-off containing elevated concentrations of suspended sediment.	Freshwater Quality Status – Holford Stream	Very low (On basis of culvert already installed isolating receptor)	Local Adverse Temporary Direct Certain	High	Minor	No mitigation required, however, assessment of magnitude assumes good practice measures adopted.	Minor
Concrete leachate from in-situ construction of footings and foundations.	Freshwater Quality Status – Holford Stream	Very low (highly localised and use of best practice guidance)	Local Adverse Temporary Direct Possible	High	Minor	No mitigation required, however, assessment of magnitude assumes good practice measures adopted.	Minor
Surface run-off containing elevated concentrations of hydrocarbons from temporary plant and vehicle parking areas.	Freshwater Quality Status – Holford Stream	Very low	Local Adverse Temporary Direct Possible	High	Minor	No mitigation required, however, assessment of magnitude assumes good practice measures adopted.	Minor
Surface run-off containing elevated concentrations of suspended sediment during construction of emergency access route crossing Bum Brook.	Freshwater Quality Status – Bum Brook	Very low (Single span bridge crossing watercourse avoiding need for in-river works)	Local Adverse Temporary Direct Possible	High	Minor	No mitigation required, however, assessment of magnitude assumes good practice measures adopted.	Minor
Concrete leachate from in-situ construction of footings and foundations during construction of emergency access route crossing Bum Brook.	Freshwater Quality Status – Bum Brook	Very low (Single span bridge crossing watercourse avoiding need for in-river works)	Local Adverse Temporary Direct Possible	High	Minor	No mitigation required, however, assessment of magnitude assumes good practice measures adopted.	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Surface run-off containing elevated concentrations of hydrocarbons from temporary plant and vehicle parking areas during construction of emergency access route crossing Bum Brook.	Freshwater Quality Status – Bum Brook	Very low (Single span bridge crossing watercourse avoiding need for in-river works)	Local Adverse Temporary Direct Possible	High	Minor	No mitigation required, however, assessment of magnitude assumes good practice measures adopted.	Minor
Construction of Soil Retaining Wall (during site preparation)							
Surface run-off containing elevated concentrations of suspended sediment.	Freshwater Quality Status – HPC Drainage Ditch.	Low	Local Adverse Temporary Direct Certain	Low	Minor	No mitigation required, however, assessment of magnitude assumes good practice measures adopted.	Minor
Surface run-off containing elevated concentrations of hydrocarbons from temporary plant.	Freshwater Quality Status – HPC Drainage Ditch.	Very low	Local Adverse Temporary Direct Possible	Low	Negligible	No mitigation required, however, assessment of magnitude assumes good practice measures adopted.	Negligible
Discharges from Water Management Zones							
Discharges into surface water feature, including treated sanitary effluent discharges from accommodation campus.	Freshwater Quality Status – Holford Stream	Very low (subject to WMZ configured to meet environmental permit conditions)	Local Neutral Temporary Direct Certain	High	Minor	No mitigation required.	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Discharges into surface water feature prior to installation of subsequent drainage infrastructure.	Freshwater Quality Status – Hinkley C Drainage Ditch	Very low (subject to WMZ configured to meet environmental permit conditions)	Local Neutral Temporary Direct Certain	Low	Negligible	No mitigation required.	Negligible
Discharges into surface water feature at end of construction phase during landscape restoration.	Freshwater Quality Status – Bum Brook	Very low (subject to WMZ configured to meet environmental permit conditions)	Local Neutral Temporary Direct Certain	High	Minor	No mitigation required.	Minor
Reconfiguration of Water Management Zones (WMZs) during landscape restorations							
Sediment laden run-off associated with reconfiguration of WMZs.	Freshwater Quality Status – Holford Stream	Very low (subject to WMZ configured to meet environmental permit conditions until works complete)	Local Adverse Temporary Direct Possible	High	Minor	No mitigation required. Schedule should ensure that sediment mitigation measures are in place during all phases of reconfiguration, or alternatively that no pathway exists for surface drainage to reach receptor.	Minor
Sediment laden run-off associated with reconfiguration of WMZs.	Freshwater Quality Status – Bum Brook	Very low (subject to WMZ configured to meet environmental permit conditions until works complete)	Local Adverse Temporary Direct Possible	High	Minor	No mitigation required. Schedule should ensure that sediment mitigation measures are in place during all phases of reconfiguration, or alternatively that no pathway exists for surface drainage to reach receptor.	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Hydrocarbon contaminated run-off from plant during reconfiguration of WMZs.	Freshwater Quality Status – Holford Stream	Very low (subject to WMZ configured to meet environmental permit conditions until works complete)	Local Adverse Temporary Direct Possible	High	Minor	No mitigation required	Minor
Hydrocarbon contaminated run-off from plant during reconfiguration of WMZs.	Freshwater Quality Status – Bum Brook	Very low (subject to WMZ configured to meet environmental permit conditions until works complete)	Local Adverse Temporary Direct Possible	High	Minor	No mitigation required	Minor
Operational Impacts							
Hydrology and Drainage							
Risk: Elevated surface water run-off due to an extreme rainfall event (greater than 0.1% AEP).	Hinkley Point intertidal area	Very low	Local Adverse Temporary Direct Unlikely	Low	Negligible	No mitigation required	Minor
Water Quality							
Site drainage discharges to Holford Stream.	Freshwater quality status – Holford Stream	Very low (Run-off from landscaped areas)	Local Neutral Permanent Direct Certain	High	Minor	No mitigation required	Minor

Potential Impact	Receptor	Potential Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact Assessment
Removal/Restoration Impacts							
Hydrology and Drainage							
Assessed above within construction impacts because a similar suite of construction type activities (but generally of lesser magnitude).	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Water Quality							
Assessed above within construction impacts because a similar suite of construction type activities (but generally of lesser magnitude).	n/a	n/a	n/a	n/a	n/a	n/a	n/a

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CHAPTER 17: COASTAL HYDRODYNAMICS AND GEOMORPHOLOGY

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17. COASTAL HYDRODYNAMICS AND GEOMORPHOLOGY

17.1 Introduction

17.1.1 This chapter of the Environmental Statement (ES) provides an assessment of the potential effects on coastal hydrodynamics and geomorphology associated with the construction and operational phase of Hinkley Point C (HPC) (see **Chapters 2**, **3**, and **4** of this volume of the ES for details).

17.1.2 The site for the proposed new power station is on the southern shore of the Inner Bristol Channel. As part of the proposed works there will be a need to establish a series of structures at the head of the shore, across that shore and on the local seabed. There will be a consequential degree of interaction between these structures and their operation and marine and estuarine hydrodynamic and sedimentary processes.

17.1.3 This chapter describes the existing hydrodynamic regime and sediment transport processes operating in the Inner Bristol Channel, with an emphasis on the Hinkley Point area where these processes could potentially interact with the proposed development. The predicted effects to these processes during the construction and operational phases of the proposed development are then described.

17.1.4 While the development of HPC may alter hydrodynamic and sedimentary processes (both locally and potentially more widely), the significance of such a change or effect has not been defined in this chapter as an impact. This is because coastal processes themselves are not considered to be a receptor sensitive to change. Hence, while a change to a process can be predicted and described with respect to the known baseline in terms of its magnitude, it is not appropriate to predict the significance of an impact on the process. The significance of this change is nevertheless assessed with respect to those environmental receptors that could be influenced, such as marine ecological interests, within the other relevant technical chapters of this ES.

17.1.5 Where required, mitigation measures are identified to prevent, reduce and, where possible, off-set any potentially adverse effects that could have a significant impact on another receptor. In some instances, mitigation measures are an integral aspect of the initial project design (e.g. the temporary aggregate jetty design or cooling water outfall location).

17.1.6 Consultation has been undertaken throughout the EIA process and further information may be found in the **Consultation Report**. Of particular relevance to coastal issues, regular meetings of the Marine Authorities Liaison Group (MALG) were held in 2009 and 2010 (after which they were replaced by topic specific meetings). The MALG comprised a technical forum attended by representatives of regulatory and advisory agencies with a particular interest in the HPC Project from a marine and coastal perspective.

a) Scope of Assessment

17.1.7 The following development components have been identified as having the potential to influence coastal hydrodynamics and/or coastal geomorphology:

- During construction:
  - the emplacement of the new sea wall fronting the HPC site;
  - drainage from the construction site across the shore;
  - the construction, operation and subsequent dismantling of the temporary jetty;
  - the drilling of vertical shafts offshore for the cooling water intake and outfall structures;
  - the establishment of a discharge point for the Fish Recovery and Return system; and
  - the capital and any subsequent maintenance dredging of the berthing pocket for the temporary jetty.
- During operation:
  - the presence of the new sea wall;
  - the abstraction and discharge of cooling water; and
  - the presence of cooling water intake and outfall headworks and any other structures on the seabed, including those associated with the Fish Recovery and Return and Acoustic Fish Deterrence systems.

17.1.8 The assessment presented in the following sections addresses the potential effects of the activities and structures described above on processes operating within the littoral and offshore zones and, where relevant, the geomorphological features present. For the purposes of this chapter the littoral zone is regarded as the area between the seaward limit of terrestrial plants (i.e. the splash-zone, above Mean High Water Mark) and the subtidal location where seabed sediment is not disturbed by waves. In this area, both tidally-driven and wave-driven sediment transport processes are active, although the relative significance of these will vary both through the tidal cycle and according to wave conditions at any specific location.

17.1.9 Current best estimates of future trends in sea level, driven in part by climate change, are considered where appropriate.

17.1.10 In the offshore zone of the Inner Bristol Channel, tidal currents are dominant. The effects of the proposed development on both bedload processes (sediment particles transported in contact with the bed) and suspended sediment processes (sediment particles transported in suspension) are considered where these are relevant to overall sediment transport processes. The effects of the proposed development with regard to suspended sediment concentrations as an attribute of water quality are covered in **Chapter 18** (Marine Water and Sediment Quality) of **Volume 2**.

17.2 Legislation, Policy and Guidance

17.2.1 The legislative, policy and guidance context for coastal hydrodynamics and geomorphology is addressed below.

a) International Legislation

17.2.2 The two key international legislative instruments associated with disposal of dredged material at sea are the London Convention (LC), 1972 and OSPAR Convention, 1992. The licensing of disposal of dredged material from the jetty development and its maintenance will be subject to these requirements.

b) European Legislation

17.2.3 Given that coastal hydrodynamic or geomorphological effects may affect designated European coastal and marine sites, the EC Habitats Directive (92/43/EC) is relevant to this assessment. Under the Habitats Directive it is necessary to take into account whether an activity is likely to have a significant effect on the interest features of relevant European sites alone or in combination with other plans / projects and activities. A report to inform the relevant Habitats Regulations Assessment (HRA) is being submitted in parallel to this ES as part of the DCO application.

17.2.4 The Water Framework Directive (WFD) requires that all inland and coastal waters within defined river basin districts must reach at least ‘good status’ (or 'good potential’, if considering a heavily modified water body) by 2015 and defines how this should be achieved through the establishment of environmental objectives and ecological targets for surface waters. Under the requirements of the Directive, the present water quality status must be assessed and any significant water quality issues identified. The overall aim is to enhance water resource quality, reduce pollution and promote sustainable use of water resources.

17.2.5 The WFD is implemented in the UK under The Water Environment (England and Wales) Regulations 2003. Coastal and estuarine waters have been split up into water bodies by the “competent authority” (Environment Agency for England and Wales) and these bodies are assessed individually. Bodies are grouped according to a type defined by hydromorphological assessment, physico-chemical criteria and are designated as coastal or transitional. The area of the Inner Bristol Channel under consideration is regarded as a coastal water from the English shore across to the Welsh shore and the Parrett is a transitional (estuarine) water.

17.2.6 WFD prioritises ecological assessment as a way of classifying water bodies but also includes physico-chemical assessment and the use of environmental chemical standards for priority substances and specific pollutants, as well as an assessment of defined hydromorphological criteria. A WFD assessment is provided in Appendix 18B.

c) UK Legislation

17.2.7 The Environment Agency, the Marine Management Organisation (MMO), the Welsh Assembly Government’s (WAG) Marine Licensing Unit (with regards to Welsh waters) and the statutory port and harbour authorities also have important roles in managing some aspects of the marine and coastal environment.

i. Water Resources Act (as amended)

17.2.8 The Water Resources Act 1991 (as amended by the Water Act 2003) controls the abstraction and impounding of water. It is relevant here because a number of waste streams will be discharged from the site. Discharge consents have recently been superseded by Environmental Permits issued under the Environmental Permitting Regulations 2010.

ii. UK Marine and Coastal Access Act

17.2.9 The UK Marine and Coastal Access Act 2009 (Marine Act) provides the legal mechanism to help ensure clean, healthy, safe, productive and biologically diverse oceans and seas by putting in place new systems for improved management and protection of the marine and coastal environment. Of particular interest in the context of this EIA, is that the Act has superseded the two existing Acts which set the framework for the current marine licensing system (i.e. the Food and Environment Protection Act 1985 (FEPA) and the Coast Protection Act 1949).

iii. Food and Environment Protection Act / Marine and Coastal Access Act

17.2.10 FEPA licences both permit construction within the marine environment and the deposition of materials at sea following an assessment of whether the specific activities are likely to cause harm to the food chain, thus impacting on human and environmental health. FEPA licences have recently been replaced by Marine Licences under the Marine and Coastal Access Act. However the requirements of the licensing process in terms of sampling and environmental assessment have not changed significantly. The dredging and construction activities (below MHWS) that are proposed as part of the HPC Project will require Marine Licences. Assessment of the contaminant status of offshore silts is presented as part of the Marine Water and Sediment Chapter in **Volume 2**, **Chapter 18**.

d) National Policy

17.2.11 There are no national policies relevant to the proposals for the HPC development in terms of effects on the local hydrodynamic regime or geomorphological processes. Coastal change, however, is covered in the supplement to Planning Policy Statement 25: Development and Coastal Change (which largely replaces PPG20).

e) Regional Policy

17.2.12 Within England and Wales flood and coastal defence proposals that affect the intertidal zone are regulated by the Environment Agency in accordance with Shoreline Management Plans. Further regulatory influence is also extended to Natural England and CCW as statutory consultees, particularly where development proposals concern designated European Marine Sites.

17.2.13 A Shoreline Management Plan (SMP) is a large-scale assessment of the risks associated with coastal processes which sets out measures to reduce these risks to people and the developed, historic and natural environments. The second generation of SMP is currently being developed by the North Devon and Somerset Coastal Advisory Group. An Issues and Objectives document has recently been produced.

17.2.14 The draft North Devon & Somerset SMP (www.ndascag.org/ of October 2010, marked on that site as 'final') divides the coastline into eight sections. Hinkley Point features in two of these sections: 'Minehead to Hinkley Point' and 'Hinkley Point to Brean Down'. The section of the coast along the length of the application site is identified as having nationally important geological features, where the SMP objective is to avoid adverse impacts. A key objective of the SMP document is to ensure critical services remain operational at the Hinkley Point Power Station Complex.

17.2.15 Part 5 of the SMP report, published as 'final' in October 2010, (www.ndascag.org/) describes the policies that have been established for the site and its neighbouring frontages.

17.2.16 For 'Lilstock to Hinkley Point', policy unit 7d30, being the frontage to the West of the proposed Hinkley Point C site (taken, within the SMP, as having its Eastern boundary at Benhole Point), the policy is 'to allow the natural coastal evolution to continue' in the short, medium and longer terms.

17.2.17 For 'Hinkley Point', policy unit 7d31, being the frontage of the existing Hinkley Point A and Hinkley Point B sites, and the proposed Hinkley Point C site frontage as far as Benhole Point to the West, the short and medium term policies are to 'hold the line', with this policy being applied for the longer term if the Hinkley Point power station site is extended, as proposed here.

17.2.18 For 'Hinkley Point to Stolford', policy units 7d32 and 7d33, being immediately to the east of the Hinkley Point power stations, the short term policy is to 'hold the line', the medium term policy is 'managed realignment', and the longer term policy is 'hold the line at the set back defences'.

f) Local Policy

17.2.19 There are no local policies relevant to the proposals for the construction and maintenance of works and structures in terms of effects on the local hydrodynamic regime or geomorphological processes.

17.3 Assessment Methodology

a) Study Area

17.3.1 The geographical extent of the area of interest for this assessment is dependent upon an understanding of the highly dynamic physical processes that govern the form, function and ecology of the Severn Estuary and Bristol Channel and the potential reach of effects, particularly those associated with thermal plume dynamics. Due to the extreme tidal regime, tidal excursions local to the Hinkley Point site are substantial and, as a result, the area within which dedicated surveys were completed extended across the local sea area from Watchet in the West to Brean Down in the North, including the whole of Bridgwater Bay and the lower Parrett Estuary and associated shores. Where information was necessary to secure a baseline or boundary condition beyond the immediate bounds of that area, this was also obtained.

b) Assessment Methodology

17.3.2 As noted in 17.1 above, the methods adopted in this chapter to understand and assess changes to coastal processes inevitably differ from those adopted for other chapters of this ES. That is, while the development of HPC may alter hydrodynamic and sedimentary processes, the significance of such a change or effect in terms of its impact cannot be readily measured (i.e. they are not considered to be a receptor sensitive to change). Hence, while a change to a process can be predicted and described with respect to the known baseline, it is not appropriate to predict the significance of an impact on the process (see Ref. 17.55). For example, a local change in current speed that may result from the construction of a solid structure in the path of a current can be described with reference to known current speed in the affected area and the nature and magnitude of this 'change' determined in relation to natural variability. However, in the context of the process an 'impact' will not have arisen, (for example, an estuarine current is not a receptor).

17.3.3 The commentary in this chapter therefore focuses on describing the potential magnitude of change in process variables rather than on defining an impact. This magnitude of change, or the extent to which the natural variables of the process are affected, is classified as high, medium, low or negligible and justification is provided in Sections 17.8 and 17.9. Potential impacts on marine resources caused by changes in hydrodynamic and sedimentary processes are described in **Volume 2**, **Chapter 19** (Marine Ecology) of this ES.

c) Limitations, Constraints and Assumptions

17.3.4 Due to the extremely large (hypertidal) tidal range and tidal currents off Hinkley Point, the local subtidal and intertidal sedimentary environment is highly dynamic. As a result the marine surface sediments are kept in a state of almost constant flux.

17.3.5 Many years of study of this particularly dynamic environment have permitted the development of a high level of consensus on its key features. A reflection of this understanding, directly pertinent to the topics covered within this chapter as well as those on marine ecology and marine water quality and the design and operation of the engineering plant itself, is provided below.

17.4 Baseline Assessment

17.4.1 A wide range of studies have been undertaken in order to better understand the coastal processes operating in the Bristol Channel and Severn Estuary. Much of this work was carried out in the 1970s and 1980s and, although there has been relatively little field based data collection and re-interpretation of this data undertaken since then, much of this earlier work remains of direct relevance to the current proposed development.

17.4.2 Much of that historical effort is summarised and reviewed for this application within the Hinkley Point Physical Science Report (Ref. 17.1). The material presented in this chapter is based both upon that Physical Science Report and a number of other relevant sources, referenced where appropriate.

17.4.3 The published studies have been supplemented by specifically commissioned marine surveys undertaken in support of this particular development application as a component of the British EDF Estuarine & Marine Studies project (BEEMS). Extensive measurements of bathymetry, sediment type and distribution, waves, tidal currents and suspended sediment concentrations have been taken and, where pertinent, continue. The results of these surveys are described in the references listed below. On the basis of these findings a series of numerical hydrodynamic models have been developed and validated. Outputs from that modelling effort are summarised in **Volume 2**, **Chapters 18** and **19** and supporting appendices.

17.4.4 The following studies and assessments were carried out as part of the BEEMS program and are referred to within this chapter:

- wide field bathymetry and habitat mapping via sidescan and swath sonar and associated ground truthing (Ref. 17.2);
- expert assessments of potential scour around proposed structures (Ref. 17.3);
- a range of surveys (Ref. 17.15) to monitor oceanographic processes (including tidal excursion; current flows and spatial variation; wave measurements; turbidity; water quality and meteorological conditions) was undertaken between August and October 2008 covering four Spring-Neap cycles; see **Figure 17.1**. The work used both mobile and fixed instrumentation. The sampling sites included three subtidal moorings (H1, H5 and H6), three intertidal moorings (H2, H3 and H4), three Acoustic Doppler Current Profile (ADCP) sections (A, B and C), a short ADCP anchor station at H1, and the deployment of a series of drogues and a thermal-plume monitoring survey (the locations are shown in **Figure 17.2**) designed to calibrate the numerical hydrodynamic models described in **Volume 2**, **Chapters 18** and **19** and allied appendices:
- additional seabed instrument deployments (Ref. 17.4);
- additional sea surface instrument deployments (Ref. 17.5);
- expert workshops on potential future geomorphological scenarios (Ref. 17.6);
- mineralogy assessment (Ref. 17.7);
- analyses of oceanographic extremes (Ref. 17.8); and
- analyses of coastal extremes (Ref. 17.9).

17.4.5 In addition, a series of engineering design studies have been carried out in association with the HPC development proposal that are relevant to this chapter:

- rate of infill study for temporary jetty berthing pocket (Ref. 17.10);
- sea wall design report (Ref. 17.11);
- jetty design report (Ref. 17.12); and
- cooling water intake and outfall design (Ref. 17.13).

17.5 Baseline Environmental Characteristics

a) Setting

17.5.1 For the purpose of descriptions in both this chapter and **Chapters 18** and **19**, the Hinkley Point site is located on a rocky section (**Figure 17.8**) of the southern shore of the Inner Bristol Channel, and marks the western limit of Bridgwater Bay, itself bound to the north and east by the promontory of Brean Down. Within Bridgwater Bay, a substantial intertidal area is split into two parts by the estuarine channel of the River Parrett, with Stert Flats and the outer Gore Sands to the south and Berrow Flats to the north. The Inner Bristol Channel extends from a line between Hurlestone Point (west of Minehead, Somerset) and Nash Point (Glamorgan) to the west, and Brean Down (Somerset) and Lavernock Point (Glamorgan) to the east, upstream of which lies the Severn estuary. The Bristol Channel as a whole is taken to extend as far seaward as a line running approximately between Hartland Point on the Cornish coast and Old Castle Head on the Pembrokeshire coast.

b) Key Features

17.5.2 A consideration of the key features of the physical environment is directly relevant to both the design of engineering plant and its management within a dynamic environment.

17.5.3 A current understanding of the key physical features of the Inner Bristol Channel and Severn Estuary (after Ref. 17.14) is summarised in **Table 17.1**.

17.5.4 The bathymetry and dynamics of the Inner Bristol Channel and the immediately associated Severn Estuary make it unique in the UK. It is a highly turbid system although much of the seabed itself is bare of soft sediment. There appears to be no modern source of sand and gravel within the system (Ref. 17.34) and small grain fractions of sediment are constantly reworked in suspension. What sediment there is on the seabed is strongly affected by the Spring/Neap cycle and it is highly mobile. Where subtidal sediment is found, its depth and composition will change significantly over time.

17.5.5 The vast majority of the seabed in the Inner Bristol Channel and Severn Estuary system is rock or coarse gravel; there is relatively little sand and most (though not all) of the mud is in suspension or is intermittently mobilised. The sediments are not related to the hypertidal (i.e. > 6 m tidal range) nature of the system, but rather to the geological and indeed comparatively recent industrial history. The suspended material off Hinkley Point contains a very high proportion of coal and slag-derived particulates (see Ref. 17.7).

Table 17.1: Key Physical Features of the Bristol Channel and Severn Estuary, derived from Reference 17.14

Key Physical Features	Comment
Large funnel shaped Estuary facing the Atlantic	Influences physical features, particularly tidal regime.
Large branching Estuary	The sub-estuaries within the Bristol Channel and Severn Estuary absorb energy at tidal frequencies, but input energy at longer frequencies because of river flow variation. The Parrett, Usk and other sub-estuaries are not insignificant regarding freshwater influx into the system.
High salinity variation	There is a high salinity variation as a result of the seasonal and tidal variation. The discharge from the Parrett significantly adds to this variation in the Hinkley Point area.
Estuary controlled by geological constriction	The geological constriction in the area of the Holm Islands, between Cardiff and Brean Down (constraining the Estuary in terms of both width and depth) is the key large scale physical feature. To landwards, the waters of the Severn Estuary are generally vertically mixed (in terms of salinity). To seawards, the waters of the Inner Bristol Channel are less uniform and may at times be density (by salinity) stratified. The constriction also acts to divide different suites of physical sedimentary processes, regarding waves, currents and sediment transport.

Key Physical Features	Comment
Hypertidal	This area experiences one of the highest tidal ranges in the world and is classified as hypertidal, being > 6 m. The range at Hinkley Point, between mean high and low water Spring tides, is 10.7m. This regime has direct consequences for physical sedimentary processes and sediment transport.
Periodic energy inputs	Spring to Neap changes are very large, with Spring tides having a mean value of 10.7m and Neaps 4.8m, resulting in a system with a major component of fortnightly change (as well as other tidal periods). Long periods of low winds reduce the suspended solids concentrations, at least in surface waters. The sedimentary system is thus periodic, directly impacting upon the light regime (hence production), the benthic habitats and the benthos.
Waves dominant in shallow water	In shallow areas, waves are dominant over the effects of tidal currents. Most important in the Hinkley Point area are the intertidal and shallow 'flats' where it is waves that are mostly responsible in terms of mobilising and/or changing the physical environment and thus affecting the biota.
Surprisingly sediment starved	The vast majority of the seabed in the Bristol Channel and Severn Estuary system is rock or coarse gravel; there is relatively little sand, and most (though not all) of the mud is in suspension or is intermittently mobilised.
Not in morphological equilibrium	For the Severn Estuary and Bristol Channel, the geological constriction at the Holm Islands means that the Estuary is compartmentalised.
No new significant sources of sediment	The limited supply of 'new' sediments makes the Severn Estuary and Inner Bristol Channel susceptible to change, e.g. from developments such as the Bristol Port and the various proposed tidal power schemes. Because of the preponderance of hard surfaces on the seabed, and the relatively thin nature of sands and muds where present, a small change in the sedimentary regime might cause major changes in the nature of the seabed habitats – i.e. significant change can happen relatively easily.
Physics makes change in subtidal habitats the norm, not the exception	Changes to the sediment transport system have the potential to induce major changes in habitat. Changes in sediment distribution (natural and man made) are likely and these will affect habitats.
Highly turbid environment (unique in UK)	High concentrations of sediment are present within the water column (in both permanent and temporary suspension and is intermittently deposited) but there is relatively little contribution from the rivers or from the outer Bristol Channel.
Entrance to the Parrett – mobile banks	The mouth of the Parrett has a variety of intertidal and subtidal banks, which consist of layered sediments and are extremely mobile; as such they tend to have low density biota.
Influence of existing Parrett plume on the intertidal area	Existing freshwater runoff peaks are significant in that they affect the extent of the plume across Bridgwater Bay.
Periodic major changes in bed elevation	Erosion/deposition cycles occur naturally and periodically, especially in outer Bridgwater Bay.
Coastline and seabed near the Parrett susceptible to change	The Steart Flats peninsula is susceptible to breaching in the longer term (century scale), and breaching would significantly affect cooling water flows across the (greatly changed) intertidal habitats.

Key Physical Features	Comment
Residual circulation	Tidal averaging of flows shows strong outward residual flow from Flat Holm to the south side of the Channel off Kilve. Recirculation cells occur to north and south. This could both trap persistent contaminants or effluent, and provides routes for fish migration. Crudely summarised as: 'fish in north, out south'. This feature persists to Holm Island. Given the small magnitude of any residual circulation compared to the regular tidal flows the significance of this feature is uncertain.

c) Hydrodynamic Regime

i. Tides

17.5.6 **Table 17.2** illustrates the tidal levels currently associated with the Hinkley Point site (from Ref. 17.9) on the basis of UK National Tidal Sea Level Facility (NTSLF) predictions for the 2008-2026 period and their field observations from the Hinkley Point tide gauge (part of the UK Tide Gauge Network managed by the National Oceanographic Centre) for the period 1990-2008. This shows that the Mean High Water Spring and Mean Low Water Spring elevations at Hinkley Point are 5.64m Ordnance Datum Newlyn (ODN) and -5.10m ODN, respectively. The mean Spring tide range is therefore 10.74m. The highest tidal elevation recorded over the period 1993-2008 by the Proudman tide gauge at Hinkley was 7.36m ODN (see Ref. 17.9) (ODN, frequently abbreviated to 'OD', with 'AOD' meaning 'above Ordnance Datum', is the vertical reference level in national use across the UK against which land based mapping is set). This particular level of 7.36m represented an instance of Highest Astronomical Tide combined with a surge.

Table 17.2: NTSLF Predicted Tidal Levels to ODN at Hinkley Point from Reference 17.9

Tidal Condition or Range		Elevation Relative to Ordnance Datum Newlyn (m)
Lowest Astronomical Tide	LAT	-6.10
Mean Low Water Springs	MLWS	-5.10
Mean Low Water Neaps	MLWN	-2.30
Mean Sea Level	MSL	0.10
Mean High Water Neaps	MHWN	2.50
Mean High Water Springs	MHWS	5.64
Highest Astronomical Tide	HAT	7.12
Mean Spring Tidal Range	MSTR	10.74
Mean Neap Tidal Range	MNTR	4.80

***Note**: Local Chart Datum (CD) is -5.9m ODN*

17.5.7 Tidal currents in the Inner Bristol Channel and Severn Estuary flow from west to east on the flood tide and east to west on the ebb tide. Maximum tidal current velocities increase upstream, from approximately 0.7m.s^{-1} at Lundy to 2.4m.s^{-1} off Avonmouth. Data from two Admiralty tidal diamonds, one 6km north of Watchet and the other between Steep Holm and Brean Down, show that peak ebb current velocities are slightly higher than flood velocities (**Table 17.3**); a typical range of tidal variation over Spring/Neap cycles is shown in **Figure 17.1**.

Table 17.3: Peak Ebb and Current Velocities at two Locations in the Bristol Channel (from Admiralty Chart: Bristol Channel: Nash Point to Sand Point)

	6 km North of Watchet		Between Steep Holm and Brean Down	
	Neaps ($m.s^{-1}$)	Springs ($m.s^{-1}$)	Neaps ($m.s^{-1}$)	Springs ($m.s^{-1}$)
Flood	0.75	1.45	0.85	1.6
Ebb	0.80	1.5	0.80	1.5

17.5.8 The marine surveys undertaken to gather site-specific tidal current data (**Figure 17.2**) are described in Ref. 17.4 and 17.15. The data arising from these studies show that tidal currents flow approximately parallel with the shoreline. In the subtidal zone adjacent to Hinkley Point, current velocities reached a maximum of $1.5m.s^{-1}$ on Spring tides and $1.0m.s^{-1}$ on Neap tides. Further offshore, the maximum velocities increased to $1.7m.s^{-1}$ on Spring tides and $1.4m.s^{-1}$ on Neap tides. At Gore Buoy, where a 'Waverider' buoy was established for long term use (see 17.5.12), peak surface velocities were approximately $2.0m.s^{-1}$. At all locations the ebb currents were faster than the flood currents. Typical currents at the intertidal zone moorings were approximately 1.0m/s on Spring tides, but did reach a maximum of $1.3m.s^{-1}$ during a strong wind event.

ii. Wind and Wave Climate

17.5.9 Due to its geographical location, winds at Hinkley Point are dominated by those arriving from the west-north-west (**Figure 17.3**). These wind directions occur around one third of the time and there is an effective fetch (the extent of open water) for wave generation of 400km. 50% of the winds of force 5 and above come from this direction (Ref. 17.17). Winds from the north-west to north-east occur for around 10% of the time; the fetch in this direction is 23km. Winds are least frequent and are weakest from the north-east to south sector, where fetch is also minimal. In combination with the regional bathymetry and coastal configuration, the result is that Hinkley Point is mostly subjected to waves from the west-north-west. The shoaling effects of the near-shore bathymetry are highly significant in determining the actual wave field experienced on the Hinkley Point frontage.

17.5.10 Reference 17.18 describes a significant swell component within the wave climate of the Bristol Channel, dominated by the open fetch to the North Atlantic. Wave energy is focused at headlands, although the offshore banks do dissipate energy.

17.5.11 Waves are understood to play a significant role in sediment transport at the coast itself (Ref. 17.18). As noted above, tidal circulation within the Bristol Channel is complex but is considered to be ebb-dominant with large volumes of sand and mud being transported westward in the Channel's centre. Conversely, the dominant waves from the west and south-west are held to drive the littoral drift, predominantly eastward, and flood-dominant sediment transport occurs for limited periods throughout the year along the coastal fringe.

17.5.12 Additional wave data was obtained between December 2008 and July 2009 (over a period of 225 days) using the Waverider at Gore Buoy, offshore and north-west of Hinkley Point in about 10m of water (Ref. 17.5). The data collected from the Waverider show that the dominant wave approach was from the west to north-west with less frequent waves from the west. Significant wave heights (the mean height of the highest third of waves) were mostly less than 1m, but did reach over 2m at times, with a peak of 2.3m recorded in early March. The highest energy waves with periods greater than five seconds approached from the west-north-west with less frequent shorter period waves from the west. **Figure 17.3** summarises the wind direction, speed and frequency and **Figure 17.4** the analogous wave distribution in terms of wave height and **Figure 17.5** in terms of wave period.

iii. Extreme Water Levels

17.5.13 The astronomical tidal elevations can be raised significantly by interaction with surge events influenced by global weather systems. Positive surges, causing higher tidal elevations in the Bristol Channel, are associated with low pressure systems crossing the Atlantic and approaching from the west. Small surges are frequent (Ref. 17.19), with positive surges of about 1m occurring every one to two years, and those of 2m or more occurring on a decadal time scale (Ref. 17.20). There is also a potential response to meteorological forcing at frequencies similar to the tide, resulting in intense surges which are generated and then decay during a single semi-diurnal tidal cycle.

17.5.14 The baseline extreme water levels and storm surge profile used in the **Flood Risk Assessment** that accompanies this ES have been taken from the recently published Environment Agency study into extreme water levels which covered the whole UK, including Hinkley Point (Ref. 17.60).

17.5.15 The Environment Agency data includes extreme water levels at 2km chainages/nodes along the coastline. Node location 326 is located directly offshore of HPC. Node location 328 is located offshore of Stolford. Therefore, different baseline extreme water levels are applicable dependent upon the area being considered.

17.5.16 The Environment Agency extreme water levels were published in 2011, subsequent to EDF Energy's Stage 2 consultation on the HPC Project proposals, and subsequent to several flood related studies commissioned by EDF Energy to demonstrate the nuclear safety case, including a physical modelling study for the new sea wall. The nuclear safety case studies are based upon a HR Wallingford study into the joint probability of extreme water levels and wave heights, which was commissioned by EDF Energy specifically for the HPC development (Ref.17.61). This study provided lower, best and upper estimates for extreme still water levels relative to Ordnance Datum for 2080 using Defra 2006 climate change allowances (although the nuclear safety case will rely upon the HR Wallingford extreme water levels with UKCP09 allowances as opposed to the Defra allowances). The HR Wallingford Study did not provide values for the 100%, 5% and 0.5% Annual Exceedance Probability (AEP – the chance of an event of given size occurring in any one year) events, as these were not required for the nuclear safety case studies.

17.5.17 Comparison of the Environment Agency and HR Wallingford extreme water levels for 2008 (which were back calculated using the Defra 2006 climate change allowances) is provided in **Table 17.4**. The datasets are generally comparable, with the Environment Agency levels generally lying between the HR Wallingford 'best' and 'upper' estimates. The use of the HR Wallingford upper estimates is considered appropriate to provide the precautionary approach required to demonstrate the nuclear safety case. However, following discussions with the Environment Agency, the modelling carried out specifically for the **Flood Risk Assessment** has used the latest Environment Agency extreme levels.

17.5.18 The predicted pattern of waves modelled (seasonal mean and extreme waves etc.) around the UK is one of high variability, although there is a suggestion of a slight decrease in the Bristol Channel area. Observations in the north-east Atlantic and south-west approaches show considerable variability on a decadal timescale (Ref. 17.9).

Table 17.4: Comparison of baseline (2008) extreme still water levels for the Bristol Channel at HPC and Stolford (m AOD)

AEP Event	HR Wallingford (at HPC) (m AOD)			Environment Agency (m AOD)	
	Lower Estimate	Best Estimate	Upper Estimate	HPC (Node 326)	Stolford (Node 328)
100	-	-	-	7.10	7.14
5				7.31	7.35
2	7.55	7.61	7.67	7.64	7.68
1	7.69	7.76	7.83	7.74	7.78
0.5	-	-	-	7.84	7.89
0.2	7.889	7.98	8.07	7.98	8.03
0.1	7.98	8.09	8.20	8.09	8.14
0.01	8.26	8.44	8.62	8.45	8.52

17.5.19 Reference 17.9 has calculated return water levels for 2100 based on estimated joint probability of predicted astronomical tides, observed storm surges at Hinkley Point over 1990 to 2008 and waves recorded off Hinkley Point in 2008 to 2009 – see **Table 17.5**.

Table 17.5: Estimation of Return Periods of Extremely High Water Levels (in m ODN) at Hinkley Point, using Joint Probability Analysis of Predicted Tides, Surges and Waves in the Year 2100, after Reference 17.9

Return Period (years)	Joint Probabilities of Tides and Surges Predicted for 2100			Probabilities of Tides, Surges and Waves Predicted for 2100		
	Predicted tides + surge residuals	Predicted tides + skew surges	Predicted tides + surges at high water	Predicted tides + surge residuals + waves	Predicted tides + skew surges + waves	Predicted tides + surges at high water + waves
1	8.12	8.10	8.10	8.52	8.51	8.51
2	8.22	8.19	8.19	8.65	8.63	8.63
5	8.37	8.30	8.31	8.82	8.79	8.79
10	8.49	8.40	8.41	8.95	8.91	8.91
20	8.63	8.51	8.53	9.08	9.02	9.03
50	8.82	8.69	8.71	9.26	9.18	9.19
100	8.98	8.83	8.85	9.40	9.29	9.30

	Joint Probabilities of Tides and Surges Predicted for 2100			Probabilities of Tides, Surges and Waves Predicted for 2100		
200	9.16	8.98	8.99	9.54	9.41	9.42
500	9.38	9.16	9.16	9.74	9.56	9.57
1000	9.53	9.27	9.27	9.90	9.67	9.68
5000	9.84	9.46	9.46	10.12	9.92	9.93
10000	9.94	9.53	9.53	10.34	10.02	10.03
100000	10.18	9.65	9.65	10.70	10.35	10.35

17.5.20 A number of increases are assumed in the calculations, e.g. high water increase, skew surge increase (the difference between the elevation of the projected astronomical high tide and the nearest (in time) simulated high water), and significant wave height increase. The results of this study are illustrative only, but indicate that by 2100 a 1:10,000 year event combination of high water levels, surge and waves could produce resultant water levels marginally in excess of 12m ODN. This level may be compared to the proposed sea wall crest height of 13.5m ODN and development platform height of 14m ODN, as seen in **Figures 17.6** and **17.7**.

17.5.21 Occurrences of extreme water levels associated with the coincidence of high tides, surges and even large waves are not necessarily of great importance from the viewpoint of coastal morphological change (erosion or accretion). Morphological changes, such as changing patterns of coastal erosion/accretion or changes in the pattern of estuarine banks and channels, are brought about by coastal processes over extended periods; seasonal storms will tend to have a predominant influence (Ref. 17.1).

17.5.22 The effect of storm waves on the shoreline during a single storm is dependent on the duration, as well as the elevation, of high water levels. The dissipation of wave energy at various levels across the intertidal and supra-tidal zones is strongly dependent on the time interval over which higher water levels are maintained (Ref. 17.9). In areas of very large tidal range, such as Bridgwater Bay, the wave energy is spread over a large vertical range during any single tide. An increase in average wave energy conditions, or the occurrence of several severe storm surge events within a short period of time, is likely to result in lowered foreshore levels. If sustained for a significant period of time, greater wave energy may be expected to enhance the break-up and erosion of the limestone intertidal platform which fronts the existing Hinkley Point power station and neighbouring cliffs; however, this is likely to be a progressive rather than a catastrophic process. These potential changes are as a result of predicted future change in coastal processes, they are not changes as a result of the power station development.

iv. Observed Sea-level Rise and Climate Change

17.5.23 Hinkley Point has a tide-gauge station operated by the Proudman Oceanographic Laboratory as part of a national network, and this particular gauge has recorded local levels at high resolution for the past 15 years. The data shows a rise of 4.65mm/yr for Mean High Water Spring over this time period (Ref. 17.22). This rate is considered likely to increase in the future due to climate change.

17.5.24 Relevant sources of historical data on the range of marine hazards that could potentially be influenced by climate change, together with the most recent advice available (e.g. Ref. 17.23, Ref. 17.24 and Ref. 17.25) and the 2009 outputs of the UK Climate Impacts Programme (UKCIP) (primarily Ref. 17.26 and Ref. 17.27) have been taken into account in considering the engineering design requirements for HPC. The detailed analysis is provided in the **Flood Risk Assessment** accompanying this ES.

17.5.25 **Figures 17.6** and **17.7** (after Ref. 17.9) provide a profile of the planned sea wall and platform level set against historical, current and potential future extremes in sea level, incorporating both surge and wave.

17.5.26 The sea wall has been designed to allow for adaptation in the future, if necessary, should future trends in climate change differ from those currently predicted. The potential means of adaptation include:

- the rock armour toe could be extended to protect against an increased period of beach lowering;
- the sea wall and return walls could be raised to accommodate potential increases in water level and wave height;
- further rock armour could be added to the east and west sea wall boundaries to protect against the effects of coastal erosion and to prevent outflanking of the structure; and
- the return walls could be extended further inland to protect against the effects of coastal erosion and outflanking.

17.5.27 As with the sea wall, the cooling water pumping stations have been designed based on a current understanding of climate change. In this instance, however, consideration of the relevant H++ scenarios (Ref. 17.26 and Ref. 17.27) has also been taken into account in that initial design.

17.5.28 Further information on sea level rise and climate change scenarios considered in relation to potential flood risk associated with the HPC development proposals are detailed within the Flood Risk Assessment (FRA) associated with this ES.

17.6 Sedimentary Processes and Geomorphology

a) Introduction

17.6.1 This section provides details on the existing geomorphology at HPC, present distribution of sediments and the nature of sedimentary processes operating in the Severn Estuary and Inner Bristol Channel. Consideration is also given to potential future geomorphological scenarios for the area and changes that might be expected in relation to the distribution and transport of sediments.

17.6.2 The importance of understanding and identifying potential geomorphological and sedimentary change has been highlighted by recent guidance on best practice from the Environment Agency (Ref. 17.28). That report notes that, given the long life-cycle of nuclear power stations, coastal processes in some dynamic locations could lead to shifts in bathymetry that have the potential to effect the cooling water supply. Some sedimentation can be dealt with by dredging, but the movement of offshore banks can cut off or limit flow around intake and outfall zones, which will reduce coastal water exchange. Understanding the potential for such coastal process and geomorphological change at the design stage for a nuclear power station is therefore of critical importance in order that the dynamics of these processes can be accommodated within the design philosophy and measures are implemented to monitor and manage the potential change.

17.6.3 Studies of sediment distribution and landforms can provide clear evidence for the nature and magnitude of some past environmental changes and trends, and thus give a robust basis for the development of clear indicators of possible future geomorphological scenarios. However, it is apparent that when dealing with a wide variety of physical oceanographic and sedimentary processes, significant uncertainty may exist in our knowledge and hence in the assessment process. For example, models of sediment transport simply do not exist at the levels of sophistication and reliability which will be required to sensibly predict the sedimentary future of the Inner Bristol Channel and Severn Estuary system. In dealing with this uncertainty, the role of expert opinion in reviewing available information and evidence is an essential approach to address areas of complexity and increase confidence in the conclusions reached.

17.6.4 The work described in this chapter has used the advice of an expert group to consider the potential future scenarios that this development might be subject to in the longer term. They reviewed and assessed available information and determined likely geomorphological and coastal process responses to the proposed development. This ‘future geoscenarios’ process and its detailed outcome is described in Reference 17.6.

b) Geological and Geomorphological Setting of the Inner Bristol Channel

17.6.5 Reference 17.29 describes the geology and superficial sediments of the Inner Bristol Channel and Severn Estuary. The area is floored by a gently folded and faulted succession of limestones, mudstones and siltstones. Over much of the western part of the area, bedrock is exposed at the seabed. In the Inner Bristol Channel this bedrock comprises gently folded interbedded limestones and shales.

17.6.6 Overlying the bedrock is a series of superficial sediment, divided by Reference 17.29 into: glacial till; post-glacial valley infill; thick recent accumulations and surface sediments. These sediments lie atop an incised valley drainage system, whose overall axial profile drops from -20 to -30m OD in the east to approximately -40m north of Minehead, in the extreme west. This system represents the net effect of drainage and erosion during the last glacial period combined with the erosive effects of postglacial marine inundation and estuarine erosion.

17.6.7 The post-glacial marine transgression associated with melting of the continental ice sheets and glaciers led to the sedimentary infilling of many areas around the valley margins, such as the Somerset Levels. Elsewhere, superficial sediments form a variety of sedimentary features, including mudflats, linear sand ridges, sand banks and sandwave fields, which partly overlie older valley infill or glacial till (Ref. 17.29).

17.6.8 Close to Hinkley Point, sedimentation is strongly influenced by that of Bridgwater Bay. The bay comprises an extensive area of coastal lowland bounded in the north by Brean Down and the south by Hinkley Point. On the coast south of Brean there are a set of coastal aeolian dunes overlying post-glacial estuarine deposits and freshwater peats, whilst between the estuary of the River Parrett and Hinkley Point, Holocene deposits are mainly overlain by storm shingle ridges which reach elevations of +6m OD, which are in turn backed by relict aeolian sand dunes near Steart (Ref. 17.30).

17.6.9 Reference 17.30 defines coastline changes as either small scale (over decades to centuries and one to two kilometres) or large scale (occurring over thousands of years and tens of kilometres). The large-scale changes have involved major inundations of the Somerset Levels during the early and late Holocene. The main factor to note is that this is a sedimentary system which has largely adapted to the past few thousand years of coastal change. Whilst it is not liable to undergo major changes, there is greater potential for small scale change, particularly in terms of the structure of and sedimentary processes in Bridgwater Bay.

17.6.10 Hinkley Point forms a natural boundary between two lengths of shoreline along which the behaviour of physical and sedimentary processes are essentially consistent and relatively independent from each other.

17.6.11 The shoreline to the west of Hinkley Point as far as Lilstock is characterised by a cliff fronted by a cross-shore rock platform (**Figure 17.8**). The cliffs are approximately 3m high immediately to the west of the existing power stations and rise up to 25m high at Lilstock, and are composed of friable limestones and shales interbedded with mudstones of the Blue Lias series (see **Volume 2**, **Chapter 14** of this ES for a detailed description of this geology). Fronting the cliffs is a shore platform, up to 500m wide, composed of limestones and shales dipping to the north, partially covered by a veneer of limestone and shale cobbles. A narrow storm beach is present at the junction between the platform and the cliff consisting of shingle derived from erosion of the cliffs and platform. Immediately offshore from the platform is a narrow discontinuous zone of subtidal sand and gravel, followed by large areas of mud that extend towards the centre of the Inner Bristol Channel.

17.6.12 To the east of Hinkley Point, the shoreline forms part of the outer Parrett Estuary and is characterised by post-glacial saltmarsh and mudflat deposits. These deposits have, historically, been largely reclaimed for agricultural purposes. At Stolford, this extensive reclaimed area is interrupted by a ridge of head deposits that project into the nearshore. East of Stolford, the shoreline comprises a complex series of shingle ridges with some sand dunes fronted by a narrow strip of saltmarsh. Offshore, the sediments comprise a wide expanse of intertidal mudflat (and some sandflat) up to 3 km wide extending into Bridgwater Bay. **Figure 17.9** illustrates the distribution of intertidal sediments around Hinkley Point (Refs. 17.58 and 17.59) and **Figure 17.10** the distribution of seabed sediments (Ref. 17.2).

17.6.13 Coastal erosion along the Hinkley frontage is predominantly of two types: cliff erosion (where no sea wall already exists) and shore platform down-cutting. Cliff erosion occurs largely by undercutting at the cliff base (a wave-cut notch may develop particularly where shale is exposed) followed by collapse of the overlying strata. In addition to wave undercutting, it is likely that the cliffs also fail due to excess groundwater pressures just behind their face as well as weathering by rain and frost for example. Based on measurements over a period of 30 months, Reference 17.17 shows that the rate of cliff recession was approximately 0.1 to 0.5 $m.yr^{-1}$. A longer-term recession rate, since 1888 (Ref. 17.21), for the cliff section along the proposed development site has been estimated as approximately 0.13 $m.yr^{-1}$. The rate of cliff erosion may increase in the future as a result of higher sea levels and enhanced wave attack linked to climate change.

17.6.14 Erosion of the Blue Lias shore platform is caused by subaerial weathering and marine erosion processes, including abrasion by tidally-driven sediments. Weathering of the platform takes place along planes of weakness, joints and bedding planes in the limestone and bedding planes in the shales. Marine processes, particularly mechanical wave erosion, leads to the detachment of cobble-sized blocks from the platform which are then scattered across the surface. During storms, some of these detached pieces are transported by waves to form a shingle beach at the base of the cliffs.

17.6.15 There is no information relating to the down wearing of the Blue Lias rock shore platform at Hinkley Point, however a study carried out (Ref. 17.32) on the Blue Lias platform on the Glamorgan Coast provides an analogous site with very similar environmental characteristics. Erosion measurements of the Blue Lias platform were carried out using laser scanning and mirco-erosion measurements (MEM). The laser scanner showed net erosion rates of approximately 0.04 $mm.yr^{-1}$ and the MEM showed swelling of the shore platform surface by, again, approximately 0.04 $mm.yr^{-1}$; however more recent studies have shown that measurements based on these techniques are difficult to extrapolate over large timescales. Evidence suggests that ‘joint-block removal’ will be the main method of platform development on this coastline caused by high magnitude low frequency events (Ref. 17.33). It is therefore not appropriate to extrapolate local micro-scales erosion rates to the whole platform. In the absence of site specific information, a conservative estimate of platform down wearing of 1.5m over the next 100 years is predicted based upon available evidence (Ref. 17.11).

c) Sediment Distribution – Bristol Channel and Hinkley

17.6.16 Due to the large tidal range and strong currents operating in the Bristol Channel and Severn Estuary the sedimentary regime is very dynamic. Deposits of fine sediments in the Bristol Channel are highly mobile and a large amount of mobile fine sediment (Ref. 17.34) is present in the system at any one time. Suspended sediment concentrations are relatively high and the process of bedload sediment erosion, transport and deposition is complex, with many areas subject to continual or periodic reworking. The majority of fine sediment in the Severn Estuary and Bristol Channel is material eroded originally from the surrounding catchments and supplied via rivers. The hard bedrock and coastal cliffs are not a major source of fine sediment (Ref. 17.35).

17.6.17 There is a large variation in the type and distribution of sediment within the Bristol Channel and along the Hinkley Point frontage. Exposed bedrock covers extensive sections of the bottom of the Bristol Channel, particularly across the central Bristol Channel (Refs. 17.36 and Ref. 17.37). The tidal velocity is an important factor influencing the distribution of seabed sediment and respective grain size within the Bristol Channel and large areas of the Bristol Channel are characterised by thin veneers of sand and gravel that are mobile on the bed.

17.6.18 Regionally, the seabed is dominated by mud with significant areas of mega-rippled sand at the Parrett Estuary confluence and around Gore Sand. Coarse sediment comprising gravel and cobble substrates occurs throughout the area, with the most extensive deposits to the north-west of the site, as illustrated in **Figure 17.10**. In some areas the underlying bedrock is close to the surface beneath the mud. Locally, the intertidal and subtidal areas are dominated by the bedrock shore platform. As demonstrated by high resolution sidescan and swathe, this platform is fronted offshore by narrow strips of gravel and mega-rippled sand (Ref. 17.2), followed further seaward by mud with sand (**Figure 17.10**).

17.6.19 Generally, sediments range from finer sediment in the east (around Bridgwater Bay) to coarser material in the west. The seabed sediments immediately offshore of Hinkley Point are muds (Ref. 17.36) and described in Reference 17.38 as a thin muddy veneer overlaying the bedrock.

17.6.20 The superficial sedimentary succession and spatial distribution of sediments in the sea area immediately off Hinkley Point is detailed in Reference 17.39, which draws upon a total of 50 vibrocores and a variety of geophysical and oceanographic techniques. The study found that most vibrocores penetrated through soft sediments to a stiff clay which lay immediately above the rockhead. In general, there was a thin topmost layer of about 10 cm thickness, consisting of a brown, very soft, silty clay (representing oxidised sediments changed over the last few tides), which was underlain by dark grey, very soft, silty clay. These soft sediments were underlain in many cores by a soft, medium grey, silty clay, which in turn was underlain by a thin, firm layer or layers of peat of about 10cm thickness at depths of 3-4 m. These organic layers finally graded into the stiff, bottom clay layer in which the vibrocores refused. Sand and gravels were also found at various levels throughout most of the cores, interpreted by as representing storm events (Ref 17.39).

17.6.21 Subsequent work used the presence and absence of radionuclides (e.g. ^{137}Cs) to investigate past changes in bed elevation offshore of Hinkley Point. At a location 1.4 km west-north-west of the existing Hinkley Point B (HPB) cooling water intake, Reference 17.17 interpreted vertical changes in radionuclides and past bathymetric survey data to indicate approximately 2 m of sediment accumulation since the 1950s.

17.6.22 More recent analysis has been undertaken on vibrocore data from Bridgwater Bay (Ref 17.30). Of particular relevance to HPC are the detailed results from cores taken in 2001 close to Hinkley Point (BWB11, approx 1 km NW and BWB15, 2.5 km NW of Hinkley Point respectively – see **Figure 17.11**). Based on the assumed introduction of the radionuclide ^{137}Cs into the system during atomic weapons testing in the 1950s, a maximum estimated net sediment accumulation rate of 4 mm.yr^{--1} was determined for the location at BWB11 and a maximum accumulation rate at BWB15 of 18 mm.yr^{-1}. For further details, see Reference 17.30.

17.6.23 Both on the basis of these studies and the side scan sonar survey data (Ref. 17.2), the area around the proposed cooling water intake and outfall locations may be described as one of sediment accumulation.

d) Sediment Distribution - Bridgwater Bay

17.6.24 To the east of Hinkley Point, Bridgwater Bay is characterised by a large (18 km^2) subtidal and intertidal expanse of muddy silts. The sublittoral substrate is described as highly mobile, nearly liquid mud with some areas of sand waves and isolated reefs of agglomerated *Sabellaria* worm tubes (Ref 17.40).

17.6.25 The sediment cover over the intertidal area of Bridgwater Bay is also mobile, both in terms of movements within the bay and changes to the height of these flats over short time scales (Ref. 17.41).

17.6.26 Over most of the Bristol Channel and Severn Estuary superficial sediments are a few metres thick, but in Bridgwater Bay, the present 'mud belt' (or patch) sediments (shown as 'mud' in **Figure 17.10**) are over 6m thick in places. These sediments are dark grey to black, soft, plastic, silty sandy muds with sand laminae (Ref. 17.29). The seaward extent of the mud belt is clearly defined on side-scan sonar records (Ref. 17.2), but thin mud drapes and mud pebbles are common outside this limit.

17.6.27 Based on extensive datasets from geophysical surveys, water column samples and bed samples, the authors of Reference 17.42 have proposed that the mud belt comprises three distinct regions of mobile and stationary suspensions, and of settled mud (see **Figure 17.12**). There is strong evidence supporting long term sediment accumulation in the western part of this 'mud patch' (Ref 17.30).

e) Sediment Transport

17.6.28 At a relatively simple level, it is considered that the distribution of sediment within the Bristol Channel correlates with maximum bed shear stress and that this explains the existence of fine sediment around the margins of the Bristol Channel and sand, gravel and rocky areas in axial regions.

17.6.29 There is no major modern source of sand fraction sediment (0.05-2.0mm) currently present for the Inner Bristol Channel and Severn Estuary (Ref. 17.34). Bedrock, subtidal rock and coastal cliffs are made of material that would not principally produce sand grade materials and supply from rivers is likely to be minimal given the various weirs along their length (Ref. 17.43). The most mobile sediments present are generally fine sands and muds.

17.6.30 A wide range of sandy bedforms can be found in the subtidal off Bridgwater Bay, e.g. megaripples, sand waves and sand ribbons (Ref. 17.2). The distribution of these bedforms is highly variable and studies of these features have been used to aid understanding of this complex sediment transport system.

17.6.31 Many studies have described an apparent net eastward (up-Estuary) movement of sand from an approximate line between Bridgwater Bay and Barry, and a net westward (seaward) movement to the west of this line. The presence of this 'sediment transport divide' is based upon various observations of sediment distributions, movements, bedforms and grain size studies (e.g. see **Figure 17.13**) together with 1-D tidal modelling. The sediments that are transported eastwards are thought to accumulate within the Severn Estuary, on the Cardiff Grounds and Middle Grounds for example. Sediments that are swept westwards are transported into the Outer Bristol Channel. This model of sand transport may be an oversimplification of the situation, and study of the bedforms in particular indicates local transport pathways and upstream coastal sand transport (flood dominated), contrasting with downstream mid-Channel movement (ebb dominated) (Refs. 17.44 and 17.45).

17.6.32 Interpretation of the available wave data indicates that in the region offshore of Hinkley Point, waves will tend to enhance the tidally-driven transport by increasing bed shear stresses (Ref. 17.1). Waves are thus likely to enhance the magnitude of transport rather than greatly influence its direction. In contrast, at the coast, waves are likely to drive and dominate sediment transport to the east. On the intertidal platform this will enhance along-shore transport of any packets of sand arriving from the west, and also of gravel, pebbles and cobbles (which tend to be generated on the platform itself and at the cliff face) during storm events. The short period, height and occurrence of waves from the north north-east would not appear to provide a significant mechanism to move cobble and pebbles to the west along the shoreline.

17.6.33 A pattern has been suggested (Ref. 17.16) of periodic (spring tides) and episodic (storms) erosion of material from the intertidal flats and its transport seawards as pulses of fluid mud, along the seabed seaward of the wave-cut platform, to accumulate there temporarily, especially at neap tides.

17.6.34 Large sand deposits occur outside the mouth of the River Parrett and along Gore Sand (Refs. 17.1 and 17.2). Many small gravelly-sand patches are located across the Bristol Channel, which includes the Culver Sand, a 'wake feature' created in the lee of the island of Steep Holm (Ref. 17.37). Culver Sand is a mobile sandbank (overlying rocky seabed) and is steadily moving westwards, as shown from historic charts. It is considered highly unlikely that Culver Sand will migrate inshore and pose a significant risk to the proposed intake structures as the evidence indicates that Culver Sand is migrating away from the proposed intake location, and is likely to continue to do so (Ref. 17.38).

17.6.35 The distribution of sediments within Bridgwater Bay is influenced by the presence of the River Parrett. The channel of the River Parrett turns to an east-west orientation below the low water mark and meets the Bridgwater Bar offshore of Hinkley Point. This low water channel bisects the pattern of muddy sediments within Bridgwater Bay and the low water channel exhibits an area of sand, which overlays the mudflats.

f) Suspended Sediments

17.6.36 The dynamic processes operating in the Bristol Channel and Severn Estuary, in particular the strong tidal currents, lead to erosion of intertidal and shallow subtidal deposits and active re-suspension of muddy seabed sediments. The suspended sediment levels in the Inner Bristol Channel can be exceptionally high. A field campaign, recorded suspended sediment concentrations in the Inner Bristol Channel within the range of less than 100 $mg.l^{-1}$ to approaching 200,000 $mg.l^{-1}$ (fluid mud) (Ref 17.38).

17.6.37 The Institute of Ocean Sciences (IOS) undertook five years of vertical sediment profiling covering an area between Watchet and The Shoots. This data was built up into representative Spring and Neap tide distributions of suspended concentration and is presented in Reference 17.43, Reference 17.46 and Reference 17.47. A summary plot of the survey results for observed average suspended concentrations from Reference 17.47 is shown in **Figure 17.14** and illustrates the strong variation in surface to bed values for Spring and Neap tides.

17.6.38 The greatest suspended sediment concentrations found during the marine water quality sampling campaigns (see **Volume 2**, **Chapter 18**) were recorded close to the seabed, which is consistent with data recorded from previous studies, and is what one would expect. Turbidity measurements at the three subtidal stations (H1, H5 and H6 – see **Figure 17.2**) recorded suspended sediment concentrations in excess of 1 $g.l^{-1}$ on both flood and ebb Spring tides (Ref. 17.15). Suspended sediment concentrations are strongly linked to tidal current velocity (**Figure 17.15**).

17.6.39 Studies, supported by remote sensing, have recorded a contrast in suspended sediment concentrations indicating the presence of a sediment front running down the centre of the Inner Bristol Channel, with the highest concentrations occurring on the English side and clearer water on the Welsh side of the Channel (Ref. 17.48). To the south of that front the main control on suspended sediment concentration is tidal velocity, levels of suspended sediments being greater on the flood than the ebb, greater during Spring tides when compared to Neaps and generally proportional to tidal range.

17.6.40 The bedrock and coastal cliffs are not likely to be a major source of fine sediment. Regionally, suspended sediment concentrations are highest between Avonmouth and Bridgwater Bay, including the waters fronting Hinkley Point (Ref. 17.49). A mineralogical analysis of suspended material collected off Hinkley Point (Ref. 17.7) found that 57% of particles within the modal size of the >63 µm fraction of 152.2 µm were composed either of coal or heavy iron-rich minerals, probably industrial slag remnants. The remainder of material was predominantly made up of quartz grains.

g) Longshore Sediment Transport

17.6.41 Reference 17.21 defines a series of coastal units around Hinkley Point, and notes historic evidence for and magnitudes of coastal change. Halcrow's 'Unit 4' covers the frontage of the proposed development site, where evidence indicates that the interbedded limestones and shales of the Blue Lias cliff top has retreated at around 0.13 $m.yr^{-1}$ since 1888. Material arising from this retreating frontage and from the rocky intertidal shore itself will be moved by wind, wave and tide driven processes and as the dominant waves pattern suggests a trend of transport to the east, the geomorphological characteristics of the shoreline to the east of Hinkley Point are discussed in more detail here.

17.6.42 Studies of the pebble ridges between Stolford and Steart (which, with Environment Agency management, form the primary beach defence along that particular area of shore) have been undertaken (Refs. 17.50, 17.51 and 17.17). These are the Catsford, County Wall and Wall Common complexes comprising modern active ridges seaward of older 'fossil' ridges. The coast at Hinkley Point forms part of an intertidal pebble and cobble transport pathway to the east which supplies these features. This transport system is most active in the upper intertidal zone, around the Mean High Water Mark and above. The pebble ridges were perhaps emplaced at the same time as the dune belt at Brean, around 3-4 thousand years ago (Ref. 17.1). The planform morphology, mapped location and mineralogy of these shingle ridges indicate long-term migration to the east, possibly accompanied by a temporal change in the sediment source.

17.6.43 Reference 17.52 provides evidence for the West-East transport pathway: "The overall pebble size in the complexes decreases from west to east, although all sizes are present throughout the length. In the west a half of all large material and most of the total is limestone, with other lithologies only in the smallest shingle. At the extreme eastern end only 10-20% limestone remains, the 80-90% fraction of Fenning Island gravel (near Stert Point) being ORS [Old Red Sandstone] sandstone pebbles.[Reference 17.50 attributes this longshore gradation in lithology to destruction of the limestone along the transport path. He notes that older ridges inshore have a much greater abundance of sandstone pebbles than their offshore equivalents and attributes this to source variations with time. Possibly the Lias

Limestone bedrock has only recently become exposed following erosion of the intertidal sand and later underlying mud deposits?"

17.6.44 Reference 17.52 also notes that: *"It is clear that little new material currently reaches the shingle complexes from the west".* This is supported by a study involving the injection and tracking of shingle across a number of intertidal transects for three or six months over the winter period, including one gale which included gusts of gale Force 10 (48 knots). This work, reported in Reference 17.17, led these authors to conclude that shingle does not leave the spit in front of Catsford Common *"in significant quantities"*. They thus stated that the Wall Common Complex and areas to the east may therefore be *"considered as isolated from any influence on littoral drift by the power station"*. They also stated that: *"The power station is not acting as a barrier to the transport of the pebbles and cobbles around the Hinkley Point itself"*.

17.6.45 Long term erosion on the intertidal mud flats is indicated by the exposure of peat beds (e.g. on the upper intertidal of Wall Common) and 'submerged forests', (e.g. immediately to the east of Hinkley Point). A transect line at Catsford Common (east of Hinkley Point and Stolford), surveyed across a 20 year period, revealed a loss of sediment at all levels, with the beach crest having retreated some 12 m and the upper intertidal area retreating at approximately the same pace (Ref. 17.57).

17.6.46 Erosion on the frontage to the east of Stolford has been a chronic problem for many years, so much so that the Environment Agency has actively maintained the ridges by artificial heightening and re-profiling to prevent flooding of the low-lying land behind. The current intent is to abandon this activity and engage in managed realignment. The Parrett Estuary Flood Risk Management Strategy (Ref. 17.53) described four scenarios for managed realignment of the area to the east of Hinkley Point, with a breach located through the shingle complex in all four cases.

h) Sediment Budget

17.6.47 Such is the dominance of tidally-driven sediment transport processes within the Severn Estuary and Bristol Channel, summaries of sediment budgets for the entire system (i.e. the balance of sediment volumes entering, residing in and leaving the Estuary) are generally presented in terms of suspended sediments alone. Suspended sediments include fine sediments, as discussed above, but also sand grade sediment fractions. **Figure 17.16**, from Reference 17.54, summarises the estimated sediment budget. Reference 17.54 reports a long residence time for suspended solids material in the Severn Estuary and Inner Bristol Channel area, with little gain or loss from the system.

17.6.48 The intertidal zones are composed largely of relict sediments (Ref. 17.48), although short term deposits will occur during calm conditions; as such, intertidal mudflats will act as localised small capacity sinks. The subtidal zone is the most important sediment sink (Ref. 17.48) and probably receives as much as two million tonnes annually. Conversely, erosion of intertidal flats represents a major source of sediment to the Bristol Channel. To put these values in context, Reference 17.48 describes the combined total of fine sediment present in the subtidal mudflats, wetlands and in the water body as amounting to 1.16×10^{10} tonnes.

17.7 Assessment of Effects

17.7.1 In the sections that follow, potential effects on hydrodynamic and sedimentary processes associated with the construction and operational phases of the proposed development are assessed. Unlike many other environmental parameters, specific impact significance ratings are not provided. This is because essentially these processes have no attributable value or sensitivity and the effects resulting from the development are limited to a potential alteration in a physical parameter (e.g. current velocity), that may be of a certain magnitude, rather than an actual 'impact' upon it. For the purposes of assessment, therefore, an indication of the magnitude (or extent) of change from observed values is provided. Where possible, the assessment is quantified through comparison of predictions with known values. The implications of any predicted changes in hydrodynamic and sedimentary processes on environmental parameters that are inherently linked to these processes (e.g. marine water quality and marine ecology) are presented in the relevant chapters of this ES.

17.7.2 Potential effects during the proposed construction and operation phases are considered separately below and assessed in the context of the baseline description provided above. Further information about the construction and operational programmes is provided in **Chapters 2**, **3** and **4**, **Volume 2**.

17.7.3 As set out in Section 17.1 above, the key construction elements for HPC that could affect the hydrodynamic and sedimentary regime are works associated with:

- the emplacement of the new sea wall fronting the HPC site;
- drainage from the construction site across the shore;
- the construction, operation and subsequent dismantling of the temporary jetty;
- the drilling of vertical shafts for the cooling water intake and outfall structures;
- the establishment of a discharge point for the Fish Recovery and Return (FRR) system; and
- the capital and any subsequent maintenance dredging of the berthing pocket for the temporary jetty.

17.7.4 The key elements of the development during the operational phase that could affect the hydrodynamic and sedimentary regime are:

- the presence of the new sea wall;
- the abstraction and discharge of cooling water; and
- the presence of cooling water intake and outfall headworks and any other structures on the seabed, including those associated with the Fish Recovery and Return (FRR) and Acoustic Fish Deterrence (AFD) systems.

17.7.5 These activities and structures may lead to changes in:

- bathymetry;
- hydrodynamic (tidal) regime;
- wave regime;

- sediment transport and turbidity regime; and
- water quality.

17.7.6 Any change to the local hydrodynamic regime (e.g. through the emplacement of structures in the Bristol Channel) may also have an influence upon sedimentary processes and, consequently, the geomorphology.

17.7.7 Given the very high suspended sediment concentration of the Inner Bristol Channel, the marine waters and the physical habitats associated with them have a particularly low sensitivity to potential releases of sediment-laden water during the construction and operational phases.

17.7.8 Similarly, the extremely dynamic nature of the Inner Bristol Channel (i.e. an exceptionally large tidal range on a global scale, associated with high current speeds), its physical scale and the level of temporal and spatial variance that are already the norm, due primarily to tidal processes, strongly suggest that in order for any observable change to occur a human intervention in the system would, itself, have to be very large indeed, e.g. on the scale of a tidal barrage. In this context, the main marine infrastructure components considered as a part of this development are, in comparison, either of a very small scale (e.g. the intake-outfall structures) or designed so as to limit hindrance to coastal processes (e.g. the temporary jetty). These factors are reflected in the following assessment of the likely effects of the works on estuarine hydrodynamics and geomorphology.

17.7.9 Where the assessment has led to an understanding that mitigation measures will be required, these are discussed in Sections 19.10 and 19.11 below.

17.7.10 Issues relating to water quality are assessed within **Volume 2**, **Chapter 18**.

17.8 Construction Effects

17.8.1 Construction by its very nature is temporary and, therefore, any effect that the construction works have on hydrodynamic and sedimentary processes, even in a very much less dynamic system than the one involved here, will tend also to be of a temporary nature. Additionally, as construction is defined as the actual process of building (rather than the built structure itself), effects tend to be largely related to the disturbance to the system that construction generates. In dynamic, large-scale systems, such as the Bristol Channel and Severn Estuary (Ref. 17.14), construction related disturbance events (e.g. sediment released during excavation on the foreshore) are likely to be localised and transient, and thus small scale in magnitude. Overall, therefore, it is generally the case that construction causes very limited change to hydrodynamic and sedimentary properties within this system, unless it is either prolonged or undertaken at a very significant scale (e.g. large-scale dredging). For HPC, generally, construction of the coastal/marine located infrastructure can be viewed as of relatively short duration and localised with respect to the scale of the system.

17.8.2 As the temporary jetty will be constructed and operated during the construction phase for HPC, the effects of its construction, operation and dismantling phases are considered within this section.

b) Land Based Drainage Works

i. Increase in Suspended Sediment Concentrations

17.8.3 During onshore construction activities (tunnel boring, dewatering, earthworks and site drainage) it is anticipated that existing watercourses will be removed and a series of three interconnected spine drains will be installed. These drains will take most of the surface water run-off from the construction site via a dedicated drainage system, incorporating means of treatment as appropriate, and then discharge water to the foreshore.

17.8.4 Discharges of suspended sediment of less than 50 $mg.l^{-1}$ are anticipated and a limit value of 250 $mg.l^{-1}$ has been proposed, which is identical to the median value of suspended solids observed through the local water quality surveys (see **Volume 2, Chapter 18**). As described above, background suspended sediment concentrations within the Inner Bristol Channel are generally extremely high, in the order of 1 $g.l^{-1}$ near bed within 5 m water depth. Hence they are significantly higher than the discharge predicted. The effect of such a limited suspended solids loading will be discernible within only a few metres of the discharge itself and, therefore, the magnitude of this effect is predicted to be negligible.

c) Influence of the Temporary Jetty

17.8.5 The key build elements of the jetty are summarised below:

- It is a temporary structure with an expected operational lifespan of approximately seven years, after which it will be dismantled and the site restored.
- The temporary jetty is located to the north-west of the development site.
- It will comprise a piled bridge structure of 500m in length that terminates in a jetty head in order to accommodate berthed vessels and off loading plant.
- Construction will be undertaken from both land and sea (e.g. using a jack-up barge or platform).
- Steel tubular piles of the order of 0.9m diameter will be installed into the bedrock layer at intervals across the intertidal shore and near sublittoral, in order to support the bridge structure; the jetty head and associated dolphins will also be supported upon piles likewise installed into the bedrock.
- The operating face of the jetty head will be aligned with the direction of ebb/flood tidal currents in the vicinity. A berthing pocket immediately associated with that operational area will be dredged in order to allow safe delivery of materials across a range of tidal conditions. This dredged area is planned to be 160m in length and 27m in width with sediments removed to a uniform depth of around 3.5m below the existing seabed.
- Delivery of materials from the jetty head to the shore will be by covered conveyor for aggregates and a closed pipe delivery system for cement.

17.8.6 The route chosen for the jetty, following a consideration of engineering practicability, navigational safety and environmental sensitivities, crosses a gently sloping section of the shore dominated by an exposed rock platform before extending into the near sublittoral, where it first crosses a relatively steep exposed rock slope and then extends onto the edge of the extensive muddy plain habitat that dominates the local seabed (Ref. 17.2).

i. Construction of the Jetty

17.8.7 During construction of the temporary jetty one or more jack-up platforms may be required. For example piling works may be conducted from a jack-up barge. The presence of these structures / vessels in the water column may cause a localized and temporary disturbance to current flow, much in the same way as the piled legs of the jetty. Given the extremely small spatial scale of the footprint of any plant in relation to the total foreshore platform and subtidal area, and the existing dynamic and energetic conditions of the study area, any change in flow conditions will be extremely localised and not discernible beyond the space of a few metres. Given this minor influence on hydrodynamic conditions and the temporal duration of the construction period (12-18 months), the magnitude of the effect on sediment transport processes will be negligible.

17.8.8 Installation of the piles for the jetty, through either a 'drill and drive' or a 'pre-drilled and socket' technique, will cause some release of sediment and disturbance of seabed sediments at and around each pile location. This disturbance will be very localised in extent and sediment redistribution by tidal processes, both during the construction period and following the cessation of construction, will be rapid.

17.8.9 The construction of the temporary jetty across the upper intertidal area will involve the use of heavy vehicles. Where access across the natural rocky intertidal area occurs, extensive damage may ensue. If such works were to extend to the wider rock platform that dominates the middle and lower intertidal area locally this will tend to dislocate limestone blocks from their settings, crush that material and macerate the associated shale. Erosion could rapidly occur, equivalent to several decades of natural surface degradation. Any such tracks will then form a channel for downshore drainage and sediment transport, potentially compromising the local ecological interest over a wider area of shore to the west – see Marine Ecology, **Chapter 19,**, **Volume 2**.

17.8.10 The use of jack-up rigs over the lower shore could cause similar damage to the rock surface, though over a much reduced area.

17.8.11 The proposed means for mitigation of these effects are discussed in Section 17.10 below.

ii. The Jetty Structure

17.8.12 The location of the jetty both on the foreshore and within the shallow sublittoral means that it has the potential to have a localised influence on the hydrodynamic regime and, in turn, on sediment transport.

17.8.13 The existing hydrodynamic regime as described in Section 17.5 is characterised by an extremely high tidal range (classified as 'hypertidal' – having a mean spring tidal range in excess of 6 m, in this instance of 10.7 m) and very strong tidal currents.

Local hydrodynamic conditions are thus highly energetic. The dominant influence of the tidal regime will decline in shallower water and as one moves up the shore, and the length of the jetty, wave driven processes will tend to dominate instead. This high energy system is responsible for the scouring of the rock platform across which the jetty will run. It is solely the presence of the piles supporting the proposed jetty that will have the potential to influence the currents and waves that cross its path.

17.8.14 As the jetty has been designed as an open structure, potential effects on hydrodynamic processes, notably tidal current flow, will be very much more limited in comparison to a solid structure. The main effect on hydrodynamics therefore relates to any resistance that the piles will have on tidal flow together with any consequential scour of sediments due to turbulent flows at their base (see Ref. 17.3). The pile diameters and spacings represent less than a 4% obstruction of the cross section, across the tide. While small-scale local eddies will shed off these piles, these will tend to extend for only a few radii (3-4 m) downstream and, consequently, changes to the flow regime will be localised and not extend more than 50 m from the side of the structure.

17.8.15 Given the proposed position and length of the jetty, the majority of the supports will be founded in the limestone/shale bedrock foreshore platform. Due to the relatively hard nature of the rock forming the platform, any scour that might occur will be negligible. However, at the seaward end of the jetty the bridge supports will be driven through several metres of unconsolidated sediment which is more likely to erode.

17.8.16 An expert assessment utilising both existing information on tidal bed shear forces, sediment characteristics and a knowledge of the proposed engineering design has been completed (Ref. 17.3). The scour depth predicted to occur in these relatively soft sediments is 1.3 m. This depth presumes a side to side placement of piles but for a single pile this reduces to 1.1 m where there are no group effects. The lateral extent of scour may be calculated from the angle of repose for different sediment types. For loose non-cohesive fine sand and an angle of repose of 26º, this equates to radial scour extent of 2.7 m for a paired jetty pile. For the soft mud typical of the area around the jetty head, the angle of repose would be 5-10º after slumping (or 1 in 5, as assumed for the marginal slopes of the berthing pocket, see below) and the extent of radial scour approximately 6.5 m.

17.8.17 Any eroded material will quickly be transported and incorporated into either the overall suspended sediment load or bed load. The total volume of sediment that could be eroded and transported in this manner will be extremely small and will form a negligible addition to the large volume of transported bed load and suspended sediment already present within the system.

17.8.18 There is a potential for the jetty supports located in the upper part of the foreshore to partially impede any longshore wave driven sediment transport to the east. The height at which predominantly cobble and shingle deposits are found on this length of shore suggests that they are mobilised only during episodes of severe weather and heavy seas. The jetty structure is intentionally designed to limit the hindrance to any waves, allowing them to pass between the widely spaced piles. In addition, the historical data reviewed above indicates that very little shingle from the western side of Hinkley Point is transported eastwards. Hence, the presence of the jetty supports across the intertidal area will have a negligible magnitude of effect on sediment transport to the east of Hinkley Point.

17.8.19 As the jetty will bridge across the existing cliff line there will be no direct disturbance to the cliff face itself.

17.8.20 A temporary service road will be constructed at the foot of the cliff, joining the construction corridor that will run down the flank of the jetty line itself. The increase in elevation associated with that roadbed will result in a decrease in wave energy reaching the cliff line and thus marginally reduce rates of erosion from the cliff face over the construction period.

iii. Capital Dredging of the Berthing Pocket for the Jetty

17.8.21 A berthing pocket will extend off the end of the jetty, allowing ships to maintain their berth at the jetty across the full range of tidal conditions whilst delivering construction materials for HPC.

17.8.22 The berthing pocket will be aligned with the main tidal flows. The capital dredge required to form this berthing pocket (assuming dimensions of 160 m x 27 m x 3.5 m; inclusive of a nominal 0.5 m over dredge and assuming 1 in 5 sloped sides) will generate an estimated 25,140 m^3 of material.

17.8.23 The capital dredge will have two effects: a release of suspended sediment during the dredging operation itself, and changes to local hydrodynamics caused by the localised increase in water depth.

17.8.24 The alteration in bathymetry will affect hydrodynamics (local tidal current velocities and wave climate) and in turn the local sediment transport regime. Although the increase in water depth generated by the berth will represent a significant change locally, within the scale of the wider dynamic processes operating in the Inner Bristol Channel, such a small scale change will be expected to have a negligible effect elsewhere. A small-scale decrease in current velocities over the depth of the water column facing the berth might be expected and this will tend to be greater in the lower half of the tidal cycle than the upper. This influence will be limited, predominately, to the lateral and longitudinal extent of the berthing pocket itself. There will be no consequence for the tidal regime at a wider scale.

17.8.25 It is assumed that the bulk of the sediments that will be removed from the dredge berth, to be either deposited locally (if the relevant criteria are met) or to an existing licensed disposal site (e.g. Cardiff Grounds), will be comprised of relatively recent deposits of soft mud.

17.8.26 Depending on the dredging method used, it is possible that a proportion of the sediment could be maintained within the system (i.e. through losses during dredging, or if a form of hydraulic dredging were to be utilised) and entrained into the local and potentially wider sediment transport system. Given that the volume of sediment to be dredged is relatively small (approximately 25,140m^3), when considered in the context of the Inner Bristol Channel sediment budget and the prevailing turbidity regime, these works will not have any significant effect on that budget or regime. In addition, given the volumes concerned, the potential loss from the system should the dredged material be removed elsewhere would not be significant.

17.8.27 During dredging, suspended sediment released into the water column will generate a sediment plume that will extend out from the dredge area. The extent of this plume will vary according to a number of factors, chief amongst which will be: the composition of the sediment being dredged (e.g. fine or coarse grained), the dredging technique employed and the tidal / wave conditions at the time of dredging.

17.8.28 It is expected, given the hyper-tidal and associated extreme turbidity regime, that material within the plume will become subject to the tidally driven transport, deposition and resuspension processes and thus be continuously reworked until deposited in an area of accretion. Again, given the relatively small volume involved it is not considered likely that the local or wider deposition of sediment from the plume will have any significant effect on existing bathymetry, transport processes or depositional bedforms. The potential effects on marine water quality of the suspended sediment generated during the dredging are considered in **Chapter 18**, **Volume 2**.

iv. Maintenance Dredging of the Berthing Pocket

17.8.29 The area of the berthing pocket is within a zone of mud deposition which on average appears to be accumulating at about 2 cm a year, and is thought to have a mud source to the east. There may be large variations in the magnitude and continuity of this rate, and there is little information about the resulting mud density. It is anticipated that the present thickness of mud is 1 to 2 m. High concentrations of suspended solids settle towards the bed in this area during Neap tides (Ref. 17.1), which are then wholly or partially remobilised during Spring tides when shear forces increase.

17.8.30 High concentrations of near-bed suspended sediment develop because of the gradual diminution of velocities from Spring to Neap tides, with that near-bed suspension eventually becoming stationary when the peak tidal velocity diminishes below a critical value. Because of the depth increase locally due to the dredged berth, this critical velocity will be achieved earlier in the tidal sequence within the berthing pocket than on the seabed area around it. The result of this will be that a suspension will stop moving within the pocket before it does elsewhere, providing more time for consolidation. In other words, the berthing pocket will tend to trap some material that would otherwise travel further. Similarly, the lower velocities in the pocket will delay the remobilisation of the mud as velocities increase towards Spring tides.

17.8.31 In practice, it is not possible to provide a firm estimate of the balance of the differing settlement and remobilisation rates likely to occur, as the operation of the berth itself will add a further dimension. The berth will be used frequently whilst sea conditions permit and the movement of the vessels will influence the rates of both settlement and resuspension. Untoward sea conditions, when the berth cannot be used, will generally involve larger waves and, especially over low tidal periods, will also have an influence on these sediment transport processes. There will thus be a chronic level of disturbance throughout the period of jetty operation which is likely to affect sedimentary processes in the berthing pocket itself.

17.8.32 The implication is that, with frequent vessel usage alternating with periods of bad weather, the need for any maintenance dredging will be limited. Ignoring the additional complexities associated with the operational regime described above, Reference 17.10 provides a worst case estimate of berthing pocket settlement in the range 60,000 to 200,000 $m^3.yr^{-1}$. In practice, the operator will monitor sediment densities in the berthing pocket in order to trigger a maintenance dredge, should this prove necessary.

17.8.33 Should maintenance dredging be required the nature of the sediments involved will limit the means of dredging that are practical. Of the techniques available, whilst the more conventional means will be best suited to the capital dredge (grab or bucket, backhoe or a trailing suction hopper), one or other of the hydraulic methods are likely to be better suited to the maintenance need (ploughing/bed levelling, agitation and water injection) (Ref. 17.6). Good practice will be employed to manage the dredging requirements in order to limit resultant effects.

17.8.34 Whether this material is removed to a licensed disposal point or moved aside into areas of higher tidal shear, there will be benefit in retaining it within the local sediment transport system. Any disturbance associated with this activity will be almost identical to the effects of the tidally driven semi-diurnal and Spring/Neap cycles of widespread mobilisation/deposition/remobilisation of superficial finer sediments in the locality and will, thus, be of very little consequence.

17.8.35 One of the consequences of sediment accumulation within the pocket is likely to be a limited degree of starvation of material flowing downstream along the sediment transport pathway, which is presumed to be towards the west. This could lead to a zone of reduced sedimentation to the west of the berth. This downstream effect may produce a linear disturbance in the local flow regime. The presence of a wide series of linear furrows in this area (Ref. 17.2) suggests that such a feature may propagate in an identical manner and persist for many years.

17.8.36 The jetty operator will, throughout, consult the MMO on the appropriate maintenance dredging protocol and seek licenses for any maintenance dredging activity that might become necessary in a timely and appropriate manner.

v. Jetty Dismantling

17.8.37 During the dismantling of the jetty structure, temporary plant and vessels will be present which may impede flows and cause changes to local hydrodynamic processes and associated sediment transport. The magnitude of this potential effect is assessed as negligible given the small spatial scale of the vessels. Any effects are expected to be highly localised and temporary in nature. The sensitivity of the local hydrodynamic regime is low in this context and the potential significance of any effect is, therefore, predicted to be negligible.

17.8.38 It is not considered feasible to pull out the steel tubular piles, hence they will be cut at rock head / seabed level and the main section of the pile shaft removed. In the intertidal area, where the pile locations could pose a risk to people walking and falling into holes, the remaining section of pile and internal void will be in-filled with grout. At locations on the intertidal where the holes are/restoration is visible, a natural stone slab will be placed into the concrete plug. If, in the future, exposure of pile remnants occurs on the intertidal area, a further cut to the rock head level may be required (this will be monitored). The voids left within the sea bed beyond the intertidal area will not be plugged with concrete but allowed to infill naturally with marine deposits.

17.8.39 The removal of piles and jetty uprights will remove any impedance to flows and those factors with the potential to cause scour (discussed above). Following these works it is anticipated that (within a relatively short timeframe) the sea bed sediments and geomorphology will return to conditions similar to those prior to the construction of the jetty.

17.8.40 The removal of the temporary jetty will also involve vehicle access from landward and marine operations from seaward. Where access across the natural rocky intertidal area occurs, extensive damage to the cross shore rock platform may again ensue.

d) Sea Wall Construction

17.8.41 The design specification and drawings of the proposed sea wall are provided in **Chapter 2** of this volume and Reference 17.11. The sea wall will rise to 13.5 m ODN and be constructed immediately landward of the current cliff line, replacing the existing cliff face along the 760m frontage of the HPC development site itself. The wall will incorporate a layer of toe armouring to counter wave scour with the pre-existing beach profile being replaced. The armour layer is to be 2.5 m thick and 5 m wide, inset into the beach by about 1 m, and based on a geotextile layer. The rocks filling the layer are to be of a mean size of 1.35 m diameter, each weighing 6.54 tonnes. There will thus be two layers of rocks. Following installation, the original beach profile will be reinstated over that defence toe. This is essential in order to minimize potential scouring by currents running along the bottom of the structure at the front face of the protection.

17.8.42 The base of the scour protection is at 1.5 m below the rockhead; the engineering design incorporates a precautionary estimate of beach lowering of 0.015 $m.yr^{-1}$. Further measures will be applied should routine monitoring over station life reveal a more untoward trend.

17.8.43 The porosity of the two layers of rocks will lead to pebbles and shingle penetrating into the matrix, thereby helping to stabilize the layers. However, once the tops of the rocks underlying the replaced beach become exposed to the waves, a trough is likely to develop at the junction because of water flowing through the matrix and the action of waves reflected from the rocks.

17.8.44 Additionally, the wall could produce clapotis (the localised reinforcement of incident and reflected waves) at times, and strong vertical velocities and erosion at set distances from the reflection (Ref. 17.56). It will be desirable that such waves do not occur beyond the protected zone, to avoid accelerated erosion of the beach face close to the scour protection; however this may be difficult to prevent because of their intermittent nature.

17.8.45 In front of the proposed defences, approximately 300 m west of the boundary with Hinkley Point A (HPA), there is a large infilled excavated area. This was originally the graving dock for construction of the HPA and HPB cooling water intake headworks, now positioned offshore. If beach lowering were to make this a prominent feature, exacerbated erosion between it and the wall might occur (Ref. 17.6). The shore surface associated with this feature will thus be monitored throughout the life of HPC.

17.8.46 At the western end of the HPC site the sea wall will be terminated with an element of the coastal protection system extending landward. This will permit natural cliffline erosional process to persist to the west of the site over the life of HPC without risking the integrity of that site.

17.8.47 To the east end of the site the sea wall will abut the existing sea wall of the HPA and HPB stations. A vehicular access ramp to the foreshore will be included at the extreme western end of the sea wall. Additional scour protection will be provided around the base of the access ramp area.

17.8.48 The construction of the sea wall will typically involve the following sequence of events:

- construction of a temporary haul road and foreshore access;
- establishment of a 30m wide working corridor or 'construction zone' at the top of the intertidal area fronting the existing cliff face;
- excavation of the cliff face material for sea wall alignment;
- construction of a sea wall footing and base;
- excavation of material for the toe;
- rock importation by barge to a dedicated area of the foreshore and subsequent rock placement;
- installation of a drainage system behind the sea wall;
- construction of individual sea wall sections in turn along site frontage;
- the placement of backfill behind each new concrete sea wall section in turn;
- the construction of access steps and ramps; and
- the reinstatement of footpaths and fencing.

17.8.49 The construction and installation of the sea wall have the potential to release sediment into near-shore waters due to runoff from the works, excavation of the cliff face and other allied activities. The implications of this for marine water quality and marine ecology are considered in **Chapters 18** and **19**, **Volume 2**.

17.8.50 Excavated material will be sorted for potential re-use in the construction of the sea wall itself and the associated toe, drainage system and backfill.

17.8.51 Rock armour material awaiting placement is likely to be stored along the outer perimeter of the intertidal construction zone, both demarcating that boundary and providing some shelter for the working area behind. Given this limited degree of shelter it is possible that, while present, the area will tend to trap storm-driven sediments moving in to it, or retard the loss of any such materials already present. Given the need to re-establish pre-existing cross-shore profiles in this upper intertidal area on the cessation of works, there will be a need to actively manage the sediment volumes concerned throughout. The related marine ecological assessment of the use of this intertidal sea wall construction zone is provided in **Volume 2**, **Chapter 19** and the zone itself illustrated by **Figure 19.35**.

17.8.52 A suitable area of the intertidal has been identified for the landing and unloading of barges (based on an understanding of local marine ecological sensitivities (see **Volume 2**, **Chapter 19** and **Figure 19.36**)). This area is largely coincident with the historical graving dock developed during construction of the Hinkley Point A and B Station cooling water intake headworks. Any such barges would be brought towards the shore during a high water period and allowed to ground as the tide falls; their rock armour cargo would then be unloaded by mobile crane to trucks and placed within the construction zone as described above. Given the flat-bottomed design of such vessels and the very temporary nature of their mooring, no effect on coastal geomorphological or hydrodynamic processes is anticipated.

17.8.53 The discharge of sediment loads from onshore to the adjacent littoral area will depend on site activities and will be variable throughout the construction period. The volumes involved are not expected to be significant within the context of existing sediment loads present across that littoral area. The works could result in additional volumes of sediment being introduced to the upper shore, and thus available for wave-driven transport. Fine grained sediment will be expected to be rapidly lost due to tidal action, while blocks of limestone and shale (unless removed from the site) will be expected to remain in situ or potentially be entrained and gradually transported locally (eastwards and down shore) by storm events over time.

e) Drilling of Horizontal Intake/Discharge Tunnels

17.8.54 Horizontal tunnels associated with the proposed power station cooling water system will be excavated from onshore. The construction process for the drilling of these tunnels is described in **Chapter 2** of this volume. Wastewater arising from this process will be discharged across the foreshore following appropriate treatment. This will contain suspended solid concentrations of at most 250 $mg.l^{-1}$ (equivalent to the median suspended solids level encountered in the receiving water locally – see **Volume 2**, **Chapter 18**) and be discharged at a rate of about 60 m^3 per hour.

17.8.55 Given that the concentrations estimated to be discharged through the mud-assisted drilling process are similar to the background suspended sediment concentrations recorded in the area, and that the volume and rate of discharge will be very small compared to the volume and suspended sediment load already present in the receiving water body, the effect on sedimentary processes is predicted to be insignificant. The additional loading to the Bristol Channel's sediment budget locally will simply contribute to existing trends in deposition, adding to these to a very minor degree, across a very wide area (Refs. 17.1 and 17.54).

f) Establishing the Fish Recovery and Return discharge line

17.8.56 The discharge line for the FRR system will be established by either directional drilling or 'microtunneling' from landward, under the sea wall and intertidal shore, to a point on the exposed rocky seabed below the level of the Lowest Astronomical Tide (LAT, -6.10 ODN). The tunnel diameter will be less than 1 m and its length approximately 600 m. Waste arisings will be similar in kind to those associated with the cooling water tunnelling operation (primarily water and some solids) but very much more limited in scale. The outfall structure will have minimal profile above the sea bed and thus have a negligible effect on both the sea bed itself and associated sediment and tidal dynamics.

17.8.57 One of the criteria for the outfall location is that it be placed on an area of subtidal scoured rock where no sedimentation is anticipated in the longer term, avoiding the nearby muddy bed and thus limiting the risk of blockage.

g) Drilling of Offshore Vertical Shafts

17.8.58 Six vertical wells will be drilled using a wet drill technique in the offshore zone. Four of these will be excavated with an aperture diameter of 5 m to a depth of 30 m below seabed, approximately 3.3 km offshore, and will be associated with the two horizontal intake tunnels. The two other vertical shafts, associated with the outfall tunnel, will be excavated to 2 m below the seabed, with an aperture diameter of 8.3 m.

17.8.59 Wet drilling will be undertaken from a rig platform fixed to the seabed with piles and anchors. Waste materials from the operation will be contained and transported from the working face below to the platform itself where solids and water will be separated. The processed water will be discharged back into the Bristol Channel, and solids will be transported away for disposal by barge. At the water discharge point, some suspended sediment will be released into the water column. However, the concentration of sediment in the discharge water will be constrained to a level comparable to that found in suspension locally and any effect thus rendered negligible.

17.8.60 Preparatory dredging will be required in the immediate vicinity of these six offshore locations in order to gain access to the rock head itself. As with the dredging proposals allied with the temporary jetty, both the dredging technique utilised and the means of disposal will depend on the nature of the material involved and will be subject to separate agreement with the Marine Management Organisation (MMO). Given the prevailing turbidity regime at these offshore locations and the degree of tidal mobilisation/deposition and remobilisation of superficial sediments in this environment, no significant effect is considered likely on either geomorphological or hydrodynamic processes due to these operations.

17.8.61 The presence of the rig platforms will locally alter the hydrodynamics due to change in flows around the piles and anchors. Given the negligible size of the structures relative to the extent of the surrounding seabed and the Inner Bristol Channel, the changes to the hydrodynamic processes and hence changes in sediment distribution (erosion and accretion patterns) will be limited, and within the range of natural variability. In addition, the works will be of a temporary nature and after the removal of the rig the sea bed will be expected to revert to its pre-construction condition.

17.9 Operational Effects

17.9.1 This section focuses upon those elements of the operation of HPC that will have the greatest potential to affect hydrodynamic and sedimentary processes. These elements comprise the engineered infrastructure that will be established at the top of the shore and on the seabed, being the sea wall and cooling water (CW) intake and outfall structures, together with processes of abstraction and discharge of cooling water.

17.9.2 Following construction, no new structures will be introduced to the intertidal area fronting the station site, nor will there be any modification to the intertidal area except to continue any mitigation effort (site restoration) necessary further to jetty removal.

a) Shoreline Structures: the Presence of the Sea Wall

i. Design Intent

17.9.3 As described in **Chapter 2** of this volume the purpose of the sea wall is coastal protection. Its primary function is to prevent erosion to the seaward boundary of the HPC permanent development site. Flood defence will be secured by the platform height of 14m above ODN, a height that will be attained above a slope some 50m behind the crest of the sea wall itself.

17.9.4 In anticipation of unexpected overtopping during storm events, an extensive drainage system will be incorporated into the design of the sea wall.

17.9.5 As mentioned elsewhere in this chapter, whilst the sea wall is designed to be resilient in the face of low probability external hazards over the length of station life, it is also designed to permit further modification should a trend towards more extreme climate change driven sea levels be observed.

ii. Hydrodynamic Processes

17.9.6 As both the current cliff and the proposed sea wall stand on the upper shore well above mean high tides, it is only in more extreme conditions of either tidal level or storm that there will be any hydrodynamic interaction with this structure. As the structure will simply replace the existing upper shore boundary with a very similar plan form and steepness, there will be no effect on the existing tidal regime.

17.9.7 However, the near vertical concrete face to the sea wall will present a different surface to that of the existing cliff. Although the vertical profile of the existing cliff is similar to that planned for the sea wall, the natural small-scale variations in slope and aspect along its current length present a more energy-absorbing surface than that which will be provided by the smooth concrete face of a sea wall. As a result a greater degree of wave reflection will occur during the more extreme conditions when waves interact with this structure. The engineered scour protection that will be introduced at the base of that wall will serve to mitigate this effect. The predicted effect on sediment transport of both the sea wall and the associated scour protection is discussed below.

iii. Sediment Supply and Transport

17.9.8 The sea wall will eliminate any further contribution of sediment (via erosion and weathering) from the length of cliff that it will replace. Erosional trends on this frontage are estimated, at worst, to have been 0.2 $m.yr^{-1}$ over the last century (Refs. 17.9 and 17.21). If this same trend were presumed to continue this would suggest a retreat of this cliff line of 20 m over the next 100 years. Assuming an erosion rate of an 8 m high cliff at a rate of 0.2 $m.yr^{-1}$ over a length of 760 m, and a proportion of limestone to shale of 25%, this would release 300 $m^3.yr^{-1}$ of pebbles. Assuming a rate of dissolution of 1 $mm.yr^{-1}$, an attrition rate of 10% per yr, and a travel time of five years around Hinkley Point to the east, this suggests only about 150 $m^3.yr^{-1}$ of supply to the gravel complexes of Catsford and Wall Commons (Ref. 17.56).

17.9.9 Thus the fixing of the shoreline will prevent the erosion of sediment from the cliff face. The material that would otherwise have been eroded consists mostly of limestone and marly shale, which would normally degrade relatively quickly. The effect of the establishment of the sea wall and any associated loss of input to the sediment regime is thus predicted to be of low magnitude.

17.9.10 Cliff exposures of potential coarse sediment sources (again largely shales and limestone) to the marine sediment transport regime extend for approximately 20 km to the west, with cliff heights reaching 30 m. On the basis of section length alone, the 760 m cliff section that will be lost on the development site frontage represents a small proportion of the total cliff length within this coastal area. When taking into account the greater height of many of the cliff sections to the west of the site and the extensive rocky foreshore platform fronting this length of coast, which will also provide very similar material to littoral sediment transport pathways, this would suggest that the significance of the loss of potential sediment input from this 760 m cliff section will be even smaller.

17.9.11 As discussed previously, and (for example) in References 17.1, 17.17 and 17.56, studies suggest that although the existing HPA and HPB sea walls are not acting as a barrier to longshore shingle transport, very little new sediment reaches the shingle complexes from the west. This suggests that even if a small reduction in available coarse sediment were to occur, as a result of the sea wall to HPC this will be unlikely to have implications for the integrity of coastal landforms to the east.

17.9.12 The scour protection that will form the toe of the new sea wall will tend to absorb and retard the movement of materials along the top of the shore during more extreme conditions.

17.9.13 There are no cross-shore structures associated with the sea wall that could interfere with long-shore sediment transport processes.

iv. Coastal Squeeze Associated with the Establishment of the Sea Wall

17.9.14 The fixing of the shoreline along the HPC frontage, which might otherwise retreat, together with relative sea level rise and down-cutting of the Blue Lias rock shore platform, will result in a narrowing of the intertidal area over time.

17.9.15 As noted above, the sea wall will be fixed within the existing line of the cliffs bordering the upper shore and no other engineering structures will extend across the shore itself during the operational phase. In addition, the scour protection element that will be introduced at the toe of the sea wall will be finished to match the pre-existing cross shore profiles. Thus, the sea wall and associated scour protection will not themselves, when completed, themselves cause an immediate narrowing of the intertidal area.

17.9.16 The precautionary estimate of cross-shore platform down-cutting employed in developing the sea wall design (Ref. 17.11) is 1.5 m over 100 years. Likely Relative Sea Level (RSL) rise in the Bristol Channel will be 1 m or less by 2100 (Ref. 17.22).

17.9.17 A typical cross section of the intertidal frontage of the development site has a width, between Mean High and Low Water Spring tide levels, of 256 m (Profile P9, Ref. 17.9). A simple graphical analysis shows that adding a RSL rise of 1 m will reduce this width to ~190 m. If the entire profile is then dropped by 1.5 m to simulate cross-shore platform down-cutting, this reduces that width further to ~170 m.

17.9.18 A consequence of the continuing downcutting of the tidal flats will be a lowering of the whole beach profile. However, the rate is unlikely to be uniform. The new sea defences and the scour prevention close to high water will prevent recession of the high water line, but increasing water depth over the mid and lower shore will increase wave height and move the wave break-point towards the upper shore. This will ensure that the highest erosion will occur on the upper shore – with the mid and lower shores undergoing reduced erosion. Thus, although the width of the shore will decrease through downcutting, it will be at a lower narrowing rate than if the profile were uniformly lowered.

17.9.19 A range of estimates of cliff line erosion exist, varying from 0.1-0.5 $m.yr^{-1}$ (Ref. 17.17, on the basis of 30 months data) to 0.13 $m.yr^{-1}$ (Ref. 17.21, on the basis of a GIS analysis of historical records from 1888-2009) and 0.06 $m.yr^{-1}$ (Ref. 17.9, on a similar basis). Given the length of the baseline involved, a rate of 0.2 $m.yr^{-1}$ may be selected as a reasonable worst case, although this does not take account of the possibility of higher rates of erosion that might develop due to wave attack following sea level rise.

17.9.20 As the sea wall will be introduced at a height on the shore above Mean High Water Spring tide level along the full length of the HPC frontage, the imposition of that structure will not contribute directly to the foreshortening of the width of shore described above, but it will inevitably prevent any landward progression of that cross-shore profile with time.

17.9.21 As noted previously, the reflection of storm waves from the sea wall may accentuate erosional trends in the upper shore area and this may, by locally increasing the level of downcutting, cause an alteration in the cross-shore profile itself. The consequence of this potential effect and of the foreshortening of the intertidal area as a result of cross-shore platform down-cutting and RSL rise are discussed further in **Chapter 19**, **Volume 2**.

b) Seabed Structures: The Cooling Water Intake and Outfall Headworks

17.9.22 Due to their location on the seabed, the intake and discharge headworks will have the potential to affect hydrodynamic and sediment transport properties.

17.9.23 Four separate intake structures will be established on the seabed and two outfall structures.

17.9.24 As noted earlier, the connections between these headworks and the power station itself will be a series of vertical shafts connected to tunnels bored under the shore and seabed from landward. Apart from the headworks themselves and the very much smaller outfall structure associated with the FRR System, there will be no other structures introduced to the seabed or shore that will either disturb that seabed or, potentially, cause any impediment to flow.

17.9.25 The four seabed intake structures, each of which will be approximately 10 m x 40 m in plan view, will occupy an area of 1200 m^2 of the seabed; the two outfall structures will occupy some 200 m^2. As the Inner Bristol Channel in the vicinity of the structures is approximately 20 km wide, the footprint that will be occupied by these structures will be negligible. Similarly, in terms of any potential impediment to tidal flows, the cross section presented by these structures in relation to that of the Inner Bristol Channel will have a negligible effect. While the structures will inevitably, in their immediate vicinity, be associated with alterations in tidal flow, any such change will not be discernible beyond a few tens of metres from the structures themselves.

17.9.26 An expert assessment of the level of scour that will be associated with these structures has been completed (Ref. 17.3). This assessment assumed a worst-case approach, where the structures are presumed to occupy the majority of the water column, which would be the case for the two outfall structures alone but only during extreme low tidal periods.

17.9.27 For the outfall headworks the total scour depth associated with the structures themselves (as opposed to the high volume effluent streams) is predicted to be 2.2 m. In practice, as the depth of mud locally is variably 2 m to 4 m over bedrock, that depth could be curtailed and the bedrock itself exposed immediately around each structure. Assuming an angle of 26° for a loose non-cohesive fine sand this equates to a (precautionary) radial extent of scour of 4.3 m. Mud would have an angle of repose in the range 5-10º after slumping, suggesting a radial extent of scour in the range 12-25 m. In other words, the bedrock could be exposed immediately around the structure and beyond this there would be a shallow upward slope of mud.

17.9.28 The flow of water around the proposed heads will be complex (see below). Some local field measurements of water velocity have been higher than the locally averaged values predicted from modelling studies. These higher observed values of 1.89 m/s were adopted for the scour assessment (Ref. 17.3). The predicted total scour depth around the intake head is 0.6 m, leaving approximately 1.4 m depth of soft silts overlying the bedrock. This translates into a lateral extent of scour of 1.2 m to 4.1 m, with the higher figure assuming 2 m of overlying silt.

17.9.29 Given that the propagation of these alterations in hydrodynamic and sediment transport conditions will be highly localised, the overall effect of these structures on physical processes is predicted to be negligible.

c) Seabed structures: the FRR outfall

17.9.30 As noted above for the construction phase, the FRR discharge headworks will be positioned within an area of tidally scoured rock below the level of Lowest Astronomical Tide (-6.10 m ODN). The outfall structure itself will be minimal and of low profile. No interruption to either the local hydrodynamics or the sediment transport regime is predicted and there will be no localised scour as the surrounding sea bed will be rock. As a result, the effect of this structure on physical processes is predicted to be negligible.

d) Intake and Discharge of Cooling Water

17.9.31 The power station’s cooling water supply will be abstracted from the Bristol Channel via a series of intake headworks that will be placed atop the vertical shafts described above, approximately 3.4 and 3.5 km offshore and at a depth of 9.2 m below ODN. The intakes headworks will stand proud of that depth by about 3 m.

17.9.32 Whilst HPC is operating, precisely the same volume will be discharged as abstracted. No suspended solids will be removed. There will thus be no effect upon the tidal prism of the Inner Bristol Channel and no loss of sediment from the system as a result of this process.

17.9.33 The intakes at Hinkley Point are described as following the Low Velocity Side Entry (LVSE) model, designed to maintain a low intake port velocity of approximately 0.3 $m.sec^{-1}$ across all tidal conditions for fish protection purposes. In order to secure this LVSE design for HPC, the detail of these structures has been driven by the use of detailed numerical hydrodynamic models of both the surrounding tidal current regime and internal flow patterns. As noted above, each LVSE intake structure will be approximately 10m x 40m in plan view, with the long axis lying in parallel to the direction of both ebb and flood tidal streams. Seawater will be abstracted through the longitudinal ports located on each flank of these structures. With the intake ports raised off the seabed by more than 1 m, and the intake head itself supported on a narrower plinth, there will be a degree of isolation between bed processes and associated potential turbulence and scour and the abstracted cooling water volume.

17.9.34 The cooling water will be discharged at a rate of approximately $125m^3sec^{-1}$, with this flow being split between two outfall headworks. Each will discharge the cooling water horizontally in an offshore (cross-tidal) direction at mid depth towards times of low tide, or in the lower part of the water column at all other tidal states. Given the relative difference in temperatures between this discharged volume and the local receiving water, the discharged effluent will tend to rise to the sea surface, whilst also being advected by tidal currents, forming a tidally oscillating buoyant thermal plume.

17.9.35 It is likely that at times of low water, particularly during Spring tides, the large volume discharges at each outfall will cause scour of local soft sediments. This effect is likely to be confined to the immediate vicinity of the outfall itself and will most likely serve to resuspend materials accumulated during the previous Neaps and also the sediment deposited at the previous slack water. As described earlier, the nature of the Inner Bristol Channel is that soft sediments are subject to continuous processes of tidal resuspension. Erosion to the bedrock is common during Spring tides. The element of scour caused by the outfall plume is likely, therefore, to enhance the natural process of periodically removing sediment to that bedrock surface, which locally is at shallow depth. Modelling results of the thermal plume (see **Chapter 18** of this volume on Marine Sediment and Water Quality), with and without a lateral discharge momentum applied offshore, suggest no effect upon bed shear forces beyond 2 grid cells (i.e. a maximum distance of 100 m).

17.9.36 Due to its reduced density relative to the cooler receiving water, the tidally oscillating thermal plume will tend to impose a degree of thermal stratification within its midfield area, potentially extending several kilometres downstream on the tide. Salinity stratification does occur locally after heavy rain, but is limited to the plume of the Parrett Estuary, which can occasionally be an extensive feature extending out towards the HPC site following periods of high river flow. The effect of stratification on the suspended solids regime will be to reduce vertical mixing to some degree and thus reduce the likely vertical exchange of these materials through the water column. As no suspended material will be removed from the water taken into the cooling water system and what is then discharged will be virtually identical to the surrounding water, the effect on the receiving water's turbidity regime will be negligible. The light climate, governed by turbidity and suspended matter, will not be altered significantly for the same reason.

17.9.37 The local wave climate will not be altered by the thermal plume itself.

17.10 Mitigation of Construction Effects

a) Introduction

17.10.1 This section describes the proposed mitigation measures to manage and reduce, wherever possible, effects on the sediment transport regime and the hydrodynamics of the local coastal environment during the construction of the site.

17.10.2 Given the very high suspended sediment concentration of the Inner Bristol Channel, the marine waters and the physical habitats associated with them have a particularly low sensitivity to potential releases of sediment-laden water during the construction and operation phases. Similarly, as stated previously, the extremely dynamic nature of the Inner Bristol Channel (i.e. an extreme hyper-tidal range, associated with high current speeds), its physical scale and the level of temporal and spatial variance that are already the norm, due primarily to tidal processes, strongly suggest that in order for any significant change to occur a human intervention in the system would, itself, have to be very significant indeed. Within this context, the main marine infrastructure components considered as a part of this development are, in comparison, either of a very small scale (e.g. the intake-outfall structures) or designed so as to offer little hindrance to coastal processes (e.g. the temporary jetty).

b) Means of Mitigation

17.10.3 The primary means of mitigating effects on the sediment transport regime and the hydrodynamics of the local coastal environment during the construction of HPC is through appropriate engineering design and good practice in construction methodology.

17.10.4 Works on the sea wall will be limited to a defined 30 m wide corridor at the head of the shore and all associated works managed so as to prevent more widespread disturbance to the physics of the shore and, in particular, the loss of control of any solid or liquid arisings from the works. A limited barge landing area has been defined (see **Volume 2**, **Chapter 19**) in the vicinity of the historical Hinkley Point A and B graving dock, should it prove necessary to land rock armour materials for this sea wall from seaward.

17.10.5 Appropriate management arrangements will be developed and agreed with the Environment Agency regarding the potential for the area protected by the rock armour awaiting placement to tend to trap storm-driven sediments moving in to it or retard the loss of any such materials already present.

17.10.6 Works to construct the temporary jetty are likely to cause disturbance to the limestone and shale fabric of the cross-shore rocky platform. The extent of this effect will be limited by restricting the works to within a predefined corridor flanking the line of the jetty, but there is likely to be a need to make good the microtopography of the shore through reinstatement of longshore drainage channels, should localised damage occur. As a consequence, piles will be introduced from seaward rather than landward as far as it is practicable to do so. In addition, damage to the superficial geology will be limited by use of an appropriate temporary roadbed established within the access corridor.

17.10.7 The use of jack-up rigs over the lower shore could cause a similar effect to the rock surface, though over a much reduced area. Where works pass across the area of the limestone platform that dominates the middle and lower intertidal areas, any alteration to the existing microtopography and the associated long-shore drainage routes will be restored by remodelling after both construction and removal of the jetty.

17.10.8 As noted when describing the dismantling of the jetty, above, piles will be cut to rock head level across the intertidal area and the exposed voids filled and plugged. Those in the sub-tidal area would likewise be cut to seabed level, and the resultant voids allowed to backfill naturally.

17.10.9 The use of a berthing pocket allied with the jetty will give rise to localised effects upon the sediment transport regime but these will be confined to the subtidal area and be of limited extent. Good practice will be employed in managing both capital and maintenance dredging requirements in order to limit resultant effects.

17.10.10 The FRR discharge line will not be driven across the shore surface but introduced by microtunneling or similar means from landward under the sea wall and intertidal shore to reach a small low-profile seabed outfall. Thus, aside from the temporary jetty, no cross-shore works will be engaged and no cross-shore structures will persist.

17.10.11 The connection between the development site itself and the offshore cooling water intake and outfall headworks will be via tunnels bored under the shore and seabed from landward and, aside from these headworks themselves and the FRR outfall structure, there will be no structures on the seabed.

17.10.12 The construction and installation of the sea wall have the potential to release sediment into near-shore waters due to runoff from the works, excavation of the cliff face and other allied activities. This release will be constrained by application of best practice in the design of any temporary construction roadbeds and the management of the works themselves.

c) Residual Effects

17.10.13 Measures set out to mitigate the effects of construction associated with the jetty upon the cross-shore rocky platform, longshore drainage and microtopography will reduce the predicted magnitude of these effects to low.

17.10.14 The application of good practice in the management of both capital and maintenance dredging allied with the jetty berthing pocket and the introduction of the offshore intake and outfall structures will reduce the predicted magnitude of the effect to low.

17.10.15 The application of good practice in the construction of the sea wall and, should it prove necessary, to land rock armour components from seaward will reduce the predicted magnitude of any effects to low.

17.11 Mitigation of Operational Effects

17.11.1 The primary means of mitigating effects on the sediments and hydrodynamics of the local coastal environment during the operational phase will be through the engineering design incorporated into the project.

17.11.2 The sea wall will fit within the current plan form of the existing cliff line. During the operational life of the development site no structures, such as groynes or discharge lines, will extend across the intertidal shore, thus avoiding constraints on longshore sediment transport.

17.11.3 The FRR outfall structure headworks will be positioned in the near subtidal within an area of exposed rock and will not have a significant effect on either sediment transport or the tidal regime.

17.11.4 The cooling water intake and outfall headworks will be positioned well offshore. Although limited areas of scour will occur around these structures, these will have no more than a negligible effect on the local tidal and sediment regimes.

17.12 Cumulative Effects

17.12.1 This section determines whether any of the identified effects associated with individual components of the HPC development itself could be additive or combine in such a manner that they could lead to a change (e.g. increase in effect or alteration in an area affected) that would be different to that determined for the individual components alone. The potential for cumulative effects with other components of the HPC Project, namely Combwich Wharf, as well as other proposed and reasonably foreseeable projects are considered in **Volume 11** of this ES. With respect to the HPC Project it should be recognised, however, that because of the spatial separation between project components, their temporal extent and the localised effects predicted on hydrodynamic and sediment transport processes, the potential for any interaction and therefore for cumulative effects to occur is very limited.

a) Hydrodynamic Flows

17.12.2 The berthing pocket for the temporary jetty will not result in any reduction of the tidal prism as the pocket lies below the low water mark and will never be exposed. The relatively small size of the berthing pocket relative to tidal height and the open water area means that only very localised changes in flow will arise, and any such alteration will not propagate beyond a few tens of metres from that feature itself. No significant hindrance or alteration to sediment transport is expected.

17.12.3 The intake and outfall structures will lead to localised changes in current flows which will cause some scouring of sediment around the structures. However, these effects will be confined to within a few metres of the structures themselves and no wider propagation of these effects is considered likely. The structures will not have any effect on sediment transport processes within the Inner Bristol Channel as there will be no loss in sediment availability; the small-scale alteration in current velocities around the structures will be negligible in the context of the wider tidal current flows generated as a result of the hyper-tidal regime. Given that regime, there is very limited potential for interaction between the effects generated by the individual structures and any cumulative effect will thus be negligible. Therefore, overall, HPC will not have a discernible effect on the hydrodynamics of the Inner Bristol Channel.

b) Sediment Transport

17.12.4 Calculation of scour around the intake and outfall structures (Ref. 17.3) indicates that they will not significantly affect either the suspended sediment or bedload transport regimes. The sea wall, as previously discussed, will have a negligible effect on this regime and even then only potentially upon storm driven sediment transport along the upper foreshore. Hence no significant cumulative effect on sediment transport is predicted as a result of the interaction of different HPC components.

17.13 Monitoring Requirements

a) Introduction

17.13.1 Monitoring will be undertaken to inform the need for adjustment to the mitigation measures proposed and to inform the requirement for maintenance dredging.

17.13.2 Monitoring of the marine environment local to HPC will also be undertaken in order to maintain an understanding of long term trends of potential significance to engineering design.

17.13.3 The proposals below are indicative; detailed monitoring and allied contingency protocols will be subject to further development.

b) Dredging

17.13.4 For operational reasons, there will be a need to establish and maintain monitoring of vertical profiles of mud density within the temporary jetty berthing pocket. Maintenance dredging is anticipated only when densities increase to a magnitude that will permit this activity to be both needful and effective.

c) Cross-shore Profiles

17.13.5 Although an estimate of downcutting local to the sea wall has been derived on the basis of experience elsewhere, there is a risk that actual lowering may be more rapid than expected leading to premature exposure of the toe of sea wall. There is also a risk of an increased rate of lowering over the historical graving dock area with sea level rise.

17.13.6 An appropriate monitoring programme will thus be applied to secure an understanding of actual rates of cross shore profile change over the life of the site. The information that arises will be relevant to the Periodic Safety Review (PSR) process (the periodic review of trends in external hazards is a routine procedure allied with civil nuclear operations in the UK; the provision of site specific observational data is a key means of supporting this adaptive process) that will be applied by the site operator, permitting a routine review of the nature of the external hazards relevant to continued safe operation and directing forward engineering plans appropriately if any trend in these hazards is found to be outwith prior expectations.

d) Sea Level, Tidal Height and Waves

17.13.7 Climate change has introduced an element of uncertainty in future predictions of extreme sea level. Although a series of plausible extreme values have been taken into account in designing the sea wall, this uncertainty underlines the need to monitor the rates of change that will be observed over the life of HPC. The periodic review of trends in external hazards is a routine procedure allied with civil nuclear operations in the UK, termed Periodic Safety Review, and the output of such a review will lead to alterations to plant design or management procedure should this be shown to be necessary. The provision of site specific observational data is a useful means of supporting this adaptive process.

17.13.8 A 'Class A' long term Mean Sea Level tide gauge is maintained at the Hinkley Point site as a component of the Permanent Service for Mean Sea Level (PSMSL) network, maintained by the UK Proudman Oceanographic Laboratory. This instrument is currently mounted on the HPB station cooing water intake headworks. It is recognised as a long term installation. Data are available on-line at: http://www.psmsl.org.

17.13.9 A 'Waverider' directional wave and temperature recording buoy has been established in 10m of water off Hinkley Point since December 2008. This buoy is maintained as a part of the BEEMS project, although it has also been adopted as a component of the national WaveNet wave monitoring network, managed by Cefas. This deployment will be maintained throughout the construction period of HPC both to continue to secure a baseline of local wave conditions and provide management information for operations associated with the temporary jetty. The need for longer term maintenance of this deployment will be dependant on operational safety case considerations at HPC. Data are available on line at: http://www.cefas.defra.gov.uk.

e) Sediment Transport

17.13.10 On the basis of both specific studies and expert advice, evidence has been gained in the course of in this assessment that the rate of longshore transport of gravel and cobble sized material along the top of the shore and towards potential sinks to the east of Hinkley Point is limited. Given the relative sparsity of data on this sediment transport regime, the cross-shore profiling activity described above will be combined with an assessment of mobile sediment load and distribution on the Hinkley Point frontage, utilising ground based remote sensing techniques.

f) Cross-shore Platform Integrity

17.13.11 The possibility of enhanced erosion of the cross-shore rocky platform has been identified, allied with the construction and dismantling of the temporary jetty. To guard against untoward effects on the longshore drainage regime and the sensitive habitats associated with these, monitoring will assess both the establishment of the remedial measures involved and the longer term consequence of these activities, prompting further efforts in mitigation if shown to be required.

g) Scour

17.13.12 A limited degree of seabed scour will be associated with the offshore components of the temporary jetty, the cooling water intake structures, the cooling water outfall structures and the discharges arising from these latter structures. Likewise, there is the possibility of linear bathymetric features developing in association with the jetty berthing pocket.

17.13.13 The areal extent of scour associated with these structures and features will be monitored by sidescan and/or swathe sonar survey following station commissioning, and the need to revisit this effort reviewed on the basis of initial findings.

h) Technical Review Procedure

17.13.14 In consultation with the relevant regulatory bodies EDF Energy will establish and maintain a technical working group to:

- maintain active stewardship of the monitoring objectives described both above and in **Volume 2**, **Chapters 18** and **19**;
- elaborate upon the long term management strategy for the Hinkley Point frontage and, with the aid of the monitoring activities listed above, establish a Hinkley Point Coastal Monitoring Plan;
- advise upon the appropriate level of detail of these efforts; and
- review outcomes, advising on any necessary consequent action.

17.13.15 The technical working group will be made up of a number of recognised technical specialists, an independent chairman and be supported by a secretariat, all operating under agreed Terms of Reference. An interface with regulatory technical nominees will be maintained throughout and their active involvement as observers of the technical review process encouraged.

17.13.16 The group will report to EDF Energy. It is envisaged that this technical review procedure will continue to operate throughout the period of HPC construction and into the early years of generation.

17.14 Conclusions

17.14.1 The estuarine and marine environment local to Hinkley Point is dominated by an extreme, hyper-tidal regime, resulting in continuous processes of suspension/deposition/resuspension of available fine sediments and, thus, equally extreme turbidity. The primary sediment transport regime within this estuarine system is consequently tidally driven, although wave driven processes become proportionately more significant in shoaling and intertidal areas.

17.14.2 The intertidal area fronting the development site is dominated by a wide rock platform which will be subject to gradual erosion. Sediment supply from the cliff margin at the head of this and other local shores is very limited and long-shore transport of sediments to adjacent shores equally so.

17.14.3 The jetty, by design, will be open pier structure and provide limited hindrance to waves and tides. It will bridge the existing cliff line and thus have no direct effect upon it. Construction and removal activities may have an effect on the rock cross-shore platform, but appropriate means of mitigation such as limiting access from landward, employing a temporary roadbed and biasing the works towards those from seaward, have been identified to deal with this.

17.14.4 A berthing pocket will be established in connection with the temporary jetty. Dredging will be required to establish this pocket and maintenance dredging, potentially at intervals, thereafter. The consequence of these operations for the local hydrodynamic and geomorphological regimes will be negligible.

17.14.5 A series of cooling water intake and outfall structures will be established on the seabed offshore. Although a very limited area of scour will develop around these structures, as well as the more offshore pile supports of the jetty, no more than a negligible effect on either the hydrodynamic or geomorphological regimes is foreseen.

17.14.6 The sea wall will be constructed within the line of the current cliff line and, aside from the temporary jetty, no structures will extend across the shore itself. Although this sea wall will deny some sediment supply to the sediment transport regime the quantity involved will be very small. With time the intertidal area will narrow due both to progressive downcutting of the shore and relative sea level rise; the only influence of the sea wall will be to retard the landward evolution of the cross-shore profile.

17.14.7 In this context, and with the application of appropriate engineering design, the development proposals described here will not have a significant effect on existing coastal, estuarine and marine hydrodynamic and geomorphological processes within the area concerned.

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CHAPTER 18: MARINE WATER AND SEDIMENT QUALITY

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18. MARINE WATER AND SEDIMENT QUALITY

18.1 Introduction

18.1.1 This chapter of the Environmental Statement (ES) provides an assessment of the potential impacts to marine water quality during the construction, commissioning and operation of the proposed Hinkley Point C (HPC) power station (see **Chapters 2**, **3** and **4** of this volume of the ES for details). The assessment also considers sediment quality characteristics that could affect marine water quality. Freshwater systems are considered within **Volume 2**, **Chapter 16**. The assessment proposes suitable mitigation to manage any potential adverse impacts that are identified.

18.2 Scope and Objectives of Assessment

18.2.1 The scope of the assessment has been determined following consultations with statutory consultees and feedback from the Stage 1, 2 and 2 Update consultation processes. The assessment has been undertaken adopting the methodologies described in Section 18.4 below.

18.2.2 The objectives of the assessment are to:

- identify all water quality receptors within the study area that may be affected by the HPC development;
- characterise the baseline environmental conditions for marine water and sediment quality within the study area;
- detail the impacts associated with HPC's construction, commissioning and operation on marine water quality receptors;
- recommend mitigation measures, if determined necessary, to reduce the impacts of the HPC development on marine water quality receptors; and
- assess the residual impacts of the HPC development on marine water quality.

18.2.3 The study area and baseline conditions for the assessment are described in Section 18.5. In the absence of adequate historical data, the baseline conditions are based on the results of a series of marine water monitoring and sediment core sampling campaigns undertaken in 2009. Section 18.5 also identifies existing and possible future receptors.

18.2.4 Section 18.6 assesses changes HPC might cause to the baseline marine water quality of the site and potential impacts generated by these changes are identified. The potential exists for a period of overlapping generation involving both Hinkley Point B (HPB) and HPC, which is relevant to this assessment. The assessment methodologies applied within this chapter, therefore, reflect this.

18.2.5 The elements of the development during the construction phase that could lead to marine water quality being affected are:

- surface drainage and groundwater discharges to the foreshore;
- construction of the construction outfall;
- construction of the temporary jetty;
- treated sewage effluent from the temporary sewage works;
- drilling of the cooling water tunnel;
- installation of the cooling system head structures;
- operation and dismantling of the temporary jetty;
- construction of the sea wall; and
- hydrocarbons from plant.

18.2.6 The elements of the development during the commissioning phase that could lead to marine water quality being affected are the:

- surface drainage and groundwater discharges to the foreshore (until the cooling water system becomes available, which would then become the route of discharge);
- treated sewage effluent from the temporary sewage works (until the permanent treatment works are in place and the cooling water system is made available, which would then become the route of discharge); and
- discharge of commissioning test waters (to the foreshore for 'cold' tests, and to the subtidal via the cooling water outfall once available for 'hot' tests).

18.2.7 The elements of the development during the operational phase that could lead to marine water quality being affected are the:

- surface drainage and groundwater discharges via the cooling water tunnel;
- groundwater discharge to the foreshore via the percolated sea wall drainage system;
- discharge of the operational cooling water (including operational chemical contributions) to the Bristol Channel; and
- treated sewage effluent, from an on-site sewage treatment works, via the cooling water tunnel.

18.2.8 Consideration is also given to the potential impact of unplanned (accidental) events and incidents.

18.2.9 Appropriate mitigation measures aimed at preventing, reducing or off-setting any potential adverse impacts of the proposed development that are identified to be of significance in Section 18.6 are identified in Section 18.7 and any residual impacts following implementation of the mitigation measures are assessed.

18.3 Legislation, Policy and Guidance

18.3.1 This section identifies and describes legislation, policy and guidance of relevance to the assessment of potential marine water quality impacts associated with the construction, operation and post-operational phases of the proposed development.

18.3.2 As stated in **Volume 1, Chapter 4**, the Overarching National Policy Statement (NPS) for Energy (NPS EN-1), when combined with the NPS for Nuclear Power Generation (NPS EN-6), provides the primary basis for decisions by the IPC on applications for nuclear power generation developments that fall within the scope of the NPSs.

18.3.3 Notwithstanding this, the IPC may consider other matters that are both important and relevant to its decision-making. This could include Planning Policy Statements (PPSs), Planning Policy Guidance Notes (PPGs), regional and local policy documents, although, if there is a conflict between these and the NPS, the NPS prevails for the purposes of IPC decision making.

18.3.4 Further, the Planning Act 2008 provides that the IPC must, in making its decision on an application, have regard to any Local Impact Report (LIR) prepared by relevant local authorities. It is anticipated that the LIRs will rely in part on PPSs, PPGs, regional and local policy to provide a context for their assessment. On this basis, regard has been given to these documents (where relevant to the technical assessment) since they are likely to inform the LIRs prepared by the relevant local authorities.

a) International

18.3.5 Many standards for water quality are regulated at EU level through a range of environmental directives. The most relevant of these to the proposed development are:

- Water Framework Directive (2000/60/EC) (Ref. 18.1).
- Priority Substances Directive (2008/105/EC) (Ref. 8.2).
- Dangerous Substances Directive (76/464/EEC) (Ref. 18.3).
- Birds Directive (Directive 2009/147/EC – this is the codified version of Directive 79/409/EEC as amended) (Ref. 18.4).
- Habitats Directive (92/43/EC) (Ref. 18.5).
- Marine Strategy Framework Directive (2008/56/EC) (Ref. 18.6).
- Urban Waste Water Treatment Directive (91/271/EEC) (Ref. 18.7).
- Freshwater Fish Directive (2006/44/EC - this is the codified version of Directive 78/659/EEC as amended) (Ref. 18.8).
- Revised Bathing Waters Directive (2006/44/EC) (Ref. 18.9).
- Shellfish Waters Directive (2006/113/EC – this is the codified version of Directive 79/923/EEC) (Ref. 18.10).

i. Water Framework Directive

18.3.6 The Water Framework Directive (WFD) is a key piece of legislation relating to the protection of water quality and the ecological status of fresh and coastal waters.

18.3.7 The WFD provides a mechanism by which disparate regulatory controls on human activities that have the potential to impact on water quality may be managed effectively and consistently. In addition to a range of inland surface waters and groundwater, the WFD covers transitional waters (estuaries and lagoons) and coastal waters up to one nautical mile from mean low water (baseline from which territorial waters are measured). Existing regulations that will eventually be subsumed by the WFD include the Freshwater Fish Directive (consolidated as 2006/44/EC) (Ref. 8.8), Shellfish Waters Directive (consolidated as 2006/113/EC) and the Dangerous Substances Directive (76/464/EEC) (Ref. 8.3). The WFD is implemented in England and Wales primarily through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (known as the Water Framework Regulations) (Ref. 8.11).

18.3.8 UK surface waters have been divided into a number of discrete units termed ‘water bodies’, with meaningful typologies that relate to their physical and ecological characteristics. Based upon ecology and water quality, these water bodies have been classified as falling into different status classes. The WFD requires that all inland and coastal waters must reach at least ‘good’ status by 2015 and that the status of all surface water bodies should not deteriorate. Individual water bodies that have been modified by man to the extent that it will not be possible for them to meet the WFD targets are categorised as Heavily Modified Water Bodies and need to reach ‘good’ potential.

18.3.9 Member states have the option to defer meeting WFD objectives by 2015 if it is considered technically unfeasible and/or financially disproportionate to do so. In the UK, a number of water bodies have had meeting their objectives deferred until 2027, including some of those around Hinkley Point.

18.3.10 Implementation of the WFD is primarily achieved through a system of river basin management planning. The water bodies of England and Wales have been allocated to river basin areas depending on catchment areas and a management plan has been drawn up for each. The plans contain a programme of measures tailored to each catchment and designed to ensure the constituent water bodies achieve and maintain the appropriate status in accordance with the timelines set out in the WFD.

ii. Dangerous Substances Directive

18.3.11 The Dangerous Substances Directive (DSD) (76/464/EEC) (Ref. 8.3) and its ‘daughter’ directives are concerned with controlling the level of discharges that may contain dangerous substances that may reach inland, coastal and territorial waters. The Directive identified substances for which limit values and Environmental Quality Standards (EQS) were established at European Level (List I). Some of these EQS have now been superseded by no less stringent standards established by the Priority Substances Directive 2008/105/EC (Ref. 18.2) for substances identified in Annex X of the WFD. Where this is not the case, limit values and environmental quality standards set by the DSD ‘daughter’ Directives listed in Annex IX of the WFD remain in force.

18.3.12 The DSD also defined substances where standards were to be set by the Member State (List II). For marine waters these were implemented by the Surface Waters (Dangerous Substances) (Classification) Regulations 1997 (Ref. 8.12). Again, some of these standards have already been superseded by standards set by Member States for specific pollutants defined in defined in Annex VIII of the WFD.

18.3.13 The River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) (England and Wales) Directions 2010 (Ref. 8.13) complete the transposition of the Priority Substances Directive in England and Wales.

iii. Priority Substances Directive

18.3.14 The Priority Substances Directive (PSD) (Ref. 8.2) replaces the Dangerous Substances Directive (Ref. 8.3) and establishes environmental quality standards (EQS) for an initial 33 priority and priority hazardous substances. Compliance with these standards forms the basis of Good surface water chemical status under the WFD.

18.3.15 The PSD (Ref. 8. 2) is a daughter directive of the WFD. It establishes environmental quality standards for a first list of 33 priority substances and priority hazardous substances or groups of substances which now form Annex X of the WFD. Compliance with these standards forms the basis of good surface water chemical status under the WFD.

18.3.16 Birds Directive The codified Birds Directive (2009/147/EC) (Ref. 8.4) provides a comprehensive scheme of protection for all wild bird species naturally occurring in the European Union. The Directive recognises that habitat loss and degradation are the most serious threats to the conservation of wild birds. It emphasises the protection of habitats for endangered and migratory species (listed in Annex I) via the establishment of a coherent network of Special Protection Areas (SPAs) comprising all the most suitable territories for these species.

18.3.17 Since the implementation of the Habitats Directive in 1994, all SPAs form an integral part of the Natura 2000 conservation network, and in UK law are offered protection via the regulations applied under the Habitats Directive (Conservation of Habitats and Species Regulations 2010) (Ref. 8.14).

iv. Habitats Directive

18.3.18 The Habitats Directive (92/43/EC) (Ref. 8.5) is designed to promote biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species. The Directive is transposed into UK law under the Conservation of Habitats and Species Regulations 2010 (Ref. 8.14).

18.3.19 The Habitats Directive requires Member States to:

- maintain or restore European protected habitats and species listed in the Annexes at or to a favourable conservation status as defined in Articles 1 and 2; and
- contribute to a coherent European ecological network of protected sites by designating Special Areas of Conservation (SACs) for habitats listed on Annex I and for species listed on Annex II.

18.3.20 Together with SPAs designated under the Birds Directive (Ref. 8.4), SACs form an integral part of the Natura 2000 conservation network.

18.3.21 Under the Habitats Directive, it is necessary to consider whether an activity is likely to have a significant impact alone or in combination with other plans, projects and activities. For an activity to be approved, the assessment should conclude that there will be no adverse affect on the integrity of a European site, otherwise it is necessary to show that there are no alternatives and that the project is necessary for reasons off overriding public interest. Further information regarding the Habitats Directive is presented in **Volume 2**, **Chapter 19** (Marine Ecology) and the **Habitats Regulations Assessment Report** (Ref. 8.15).

18.3.22 For significant discharges to a water body it is necessary to assess whether any hazard identified is likely to affect the interest features of the European site. Where possible the aim should be to avoid rather than reduce any adverse impact on the integrity of the European Sites. Natural England and Environment Agency guidance lists the following types of hazards for habitats, species and birds:

- toxic contamination;
- pH;
- siltation;
- turbidity;
- nutrient enrichment;
- physical damage;
- salinity;
- thermal regime; and
- organic enrichment.

v. Marine Strategy Framework Directive

18.3.23 The objective of the Marine Strategy Framework Directive (MSFD) (Ref. 8.6) is to achieve ‘good environmental status’ in Europe’s seas by 2020, enable the sustainable use of the marine environment and to safeguard its use for future generations.

18.3.24 The MSFD establishes a comprehensive structure within which EU Member States are required to develop and implement the cost effective measures necessary to achieve or maintain “good environmental status” in the marine environment.

18.3.25 The Directive establishes European Marine Regions and requires Member States to apply an ecosystem based approach to the management of human activities. The timetable for implementation of the strategy is from July 2010 through to December 2016. In the UK, the Directive is implemented via the Marine Strategy Regulations 2010 (Ref. 8.16) and the Regulations will ensure the definition of environmental targets and indicators for marine waters by July 2012.

18.3.26 In coastal waters out to one nautical mile, both the WFD and the MSFD apply. However, in these areas the MSFD only applies for aspects of good environmental status that are not already addressed by the WFD. These include issues such as the impacts of marine noise and litter, and certain aspects of biodiversity but not water quality.

vi. Urban Waste Water Treatment Directive

18.3.27 The Urban Waste Water Treatment Directive (Ref. 8.7) seeks to protect the environment from the adverse effects of discharges of sewage and some industrial effluents of a similar nature. It sets treatment levels on the basis of size of discharge and the sensitivity of the receiving waters.

vii. Freshwater Fish Directive

18.3.28 The Freshwater Fish Directive (Ref. 8.8) is concerned with protecting and improving the quality of rivers and lakes to encourage and sustain healthy fish populations. The Directive is the source of many of the EQS (particularly those that are not specified by the WFD) that are used within this assessment as screening thresholds in the absence of appropriate saltwater limits.

viii. Bathing Waters Directive

18.3.29 The revised Bathing Waters Directive (2006/44/EC) (Ref. 8.9) is concerned with protecting and improving the quality of designated bathing waters. Bacterial and visual quality objectives are set and monitoring is required for designated bathing waters. The Directive includes public information requirements and procedures for management of bathing waters in the light of monitoring results.

ix. Shellfish Waters Directive

18.3.30 The Shellfish Waters Directive (2006/113/EC) (Ref. 8.10) is concerned with protecting and improving the quality of designated shellfish waters. Physical and chemical water quality objectives are set and monitoring is required for designated areas.

18.3.31 The Directive was originally adopted in 1978 and consolidated in 2006, but it will be repealed in 2013 by the WFD.

b) National

i. Water Quality and Resources

18.3.32 The Environment Agency is the principal regulator of water quality in England and Wales, and has regulatory authority under the following water-related legislation:

- Environmental Permitting (England and Wales) Regulations 2010 (Ref. 8.17).
- Environment Act 1995 (Ref. 8.18).
- Water Resources Act 1991 (Ref. 8.19).
- Environmental Protection Act 1990 (Ref. 8.20).
- Pollution Prevention and Control Act 1999 (Ref. 8.21).
- Surface Waters (Dangerous Substances) Regulations 1989 (Ref. 8.22).
- Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (the Water Framework Regulations) (Ref. 8.23).
- Marine Strategy Regulations 2010 (Ref. 8.16).
- The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2009 (Ref. 8.13).
- Marine and Coastal Access Act 2006 (Ref. 8.24).
- Water Act 2003 (Ref. 8.25).

ii. Environmental Permitting (England and Wales) Regulations 2010

18.3.33 The Environmental Permitting Regulations 2010 (Ref. 8.17) provide a consolidated system for environmental permits, and exemptions, for activities which include discharges to surface waters. It also sets out the powers, functions and duties of the regulators. The Environmental Permitting Regulations repeal parts of the Water Resources Act 1991 (Ref. 8.19).

iii. Environment Act 1995

18.3.34 The Environment Act 1995 (Ref. 8.18) established basic terms of reference for the Environment Agency. The Act provides the Environment Agency with a duty to take action when necessary to conserve, enhance and secure the proper use of water resources in England and Wales. In terms of land drainage and flood defence functions, the Act places a duty on the Environment Agency with respect to the conservation of natural beauty and sustainable development.

iv. Water Resources Act 1991

18.3.35 The Water Resources Act 1991 (Ref. 8.19) (as partly amended by the Water Act 2003 (Ref. 8.25)) sets out the regulatory controls and restrictions that provide protection to the water environment through controls on abstraction, impounding and discharges as well as identifying water quality and drought provisions. This Act set the framework for surface water management over the past two decades in the UK, but elements of the Act have now been superseded by the Environmental Permitting (England and Wales) Regulations 2010 (Ref. 8.17).

v. Environmental Protection Act (EPA) 1990

18.3.36 Part IIA of the Environmental Protection Act 1990 (Ref. 8.20) describes a regulatory role for Local Authorities in dealing with contaminated land, including assessment of any resulting pollution of controlled waters.

vi. Pollution Prevention and Control Act 1999

18.3.37 The Pollution Prevention and Control Act 1999 (Ref. 8.21) provides a legal framework under which pollution prevention and control for emissions to air, land and water is regulated.

vii. Surface Waters (Dangerous Substances) (Classifications) Regulations 1989

18.3.38 The Surface Waters Regulations (Ref. 8.22) prescribe a system for classifying the quality of inland freshwaters, coastal waters and relevant territorial waters with a view to reducing the pollution of those waters by dangerous substances (as defined by the Dangerous Substances Directive (Ref. 8.3)). The Regulations require the Environment Agency to monitor the effect of discharges containing dangerous substances.

viii. Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (the Water Framework Regulations)

18.3.39 The Water Environment Regulations 2003 (Ref. 8.23) make provision for the purpose of implementing the WFD (Ref. 8.1). The Environment Agency is required to carry out detailed monitoring and analysis in relation to each river basin district. The results of the Environment Agency's technical work, the environmental objectives and proposals for programmes of measures are brought together in a River Basin Management Plan (RBMP) for each river basin district. The South West RBMP covers the study area for the surface water assessment (see paragraph 18.3.62 below).

ix. Marine Strategy Regulations 2010

18.3.40 The Marine Strategy Regulations 2010 (Ref. 8.16) make provision for the purpose of implementing the MSFD (Ref. 8.6). The regulations require the competent authority (undecided at present, but likely to be one of the Environment Agency, Natural England or the Marine Management Organisation) to make an assessment of the current state of English and Welsh seas, and develop a detailed description for Good Environmental Status for those waters by July 2012. A monitoring programme will be developed and implemented by July 2014, with the aim of establishing a programme of measures for achieving Good Environmental Status by July 2016.

x. Marine and Coastal Access Act 2009

18.3.41 The Marine and Coastal Access Act 2009 (Ref. 8.24) aims to enable better protection of marine ecosystems and prevent a decline in marine biodiversity. The Act sets out provisions for more coherent planning in the marine environment in terms of issuing consents and permits for activities in the marine and coastal environment (Marine Licences; see 'Marine development' below). The Act also contains provisions to allow for the designation of Marine Conservation Zones (MCZs) and the creation of a network of Marine Protected Areas (MPAs).

xi. Water Act 2003

18.3.42 The Water Act 2003 (Ref. 8.25) is the regulatory framework for the management and regulation of surface and groundwater resources in England and Wales. The Act provides a legislative framework to facilitate both sustainable water resources management and economic growth through its provisions.

18.3.43 For the purpose of the HPC development the key piece of water quality legislation is the Environmental Permitting Regulations 2010 (Ref. 8.17). The Environmental Permitting Regulations supersede the Water Resources Act, 1991 (Ref. 8.19) in this regard. Discharges of cooling water to the Bristol Channel and surface drainage waters to the foreshore area would both be subject to environmental permit control.

18.3.44 Statutory port and harbour authorities also have important roles in managing some aspects of water quality. For example, the Port of Bridgwater has in place an oil spill contingency plan.

Marine Development

18.3.45 The Marine Management Organisation (MMO) is the principal regulator for development below the level of mean high water spring tides (MHWS) in English waters and exercises control on such development (including marine works, dredging and dredgings disposal) through the issue of marine licences under the Marine and Coastal Access Act 2009 (Ref. 8.24).

18.3.46 The proposed construction and operation of the HPC Power Station is a nationally significant infrastructure project under the Planning Act 2008 and is required to be authorised by a Development Consent Order (DCO). However, the marine works aspects of the development (including construction below MHWS and dredging at sea) also require separate Marine Licences from the MMO. Marine licences replace, *inter alia*, those formerly issued under the Food and Environment Protection Act (FEPA) 1985 (Ref. 8.26).

Wildlife Conservation

18.3.47 The Wildlife and Countryside Act 1981 (Ref. 8.27) (as amended) provides for notification of areas down to low water mark as sites of special scientific interest and for their protection, as well as affording protection to particular species listed in the 1981 Act wherever they are.

18.3.48 Similar protection will be applied to MCZs that can be designated at sea under the Marine and Coastal Access Act 2009 (Ref. 8.24).

18.3.49 Proposals that affect the intertidal zone are regulated by the Environment Agency in accordance with Shoreline Management Plans. Further regulatory powers are also extended to Natural England and the Countryside Council for Wales as statutory consultees, particularly where development proposals fall within designated (Natura 2000) European Marine Sites.

c) National Planning Policy

i. Planning Policy Statement 1 (PPS1): Delivering Sustainable Development (2005)

18.3.50 PPS1 (Ref. 8.28) was published in 2005 and sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system.

18.3.51 Paragraph 22 of PPS1 advises that regional planning authorities and local authorities should promote, amongst other things, the sustainable use of water resources and the use of sustainable drainage systems in the management of run-off.

ii. Planning Policy Statement 23 (PPS23): Planning and Pollution Control (2004)

18.3.52 PPS23 (Ref. 8.29) is intended to complement the pollution control framework under the Pollution Prevention and Control Act 1999 (Ref. 8.30) and the Pollution Prevention and Control Regulations 2000 (Ref. 8.31). The statement advises of the importance of the planning system in determining the location of developments that may give rise to pollution, either directly or indirectly. The statement also ensures that other uses and developments are not, as far as possible, affected by major existing or potential sources of pollution.

18.3.53 PPS23 (Ref. 8.29) advises that, amongst other things, the following matters may be material in the consideration of individual planning applications where pollution considerations arise:

- *"…the possible adverse impacts on water quality and the impact of any possible discharge of effluent or leachates which may pose a threat to surface or underground water resources directly or indirectly through surrounding soils; and*

- *the need to make suitable provision for the drainage of surface water…"* (Page 12)

iii. Technical Advice Note 5: Nature and Conservation Planning (2009)

18.3.54 As material dredged from the offshore developments may be disposed to the Cardiff Grounds, Welsh Planning Policies also need to be taken into consideration. Planning Policy Wales (2011) (Ref. 8.32) provides the policy framework for land-use planning and development in Wales, and is supplemented by 21 topic-based Technical Advice Notes (TANs).

18.3.55 Technical Advice Note 5: Nature and Conservation Planning (2009) (TAN5) (Ref. 8.32) provides advice on how the land-use planning system should contribute to protecting and enhancing biodiversity and geological conservation. The TAN provides advice for local planning authorities on:

- the key principles of positive planning for nature conservation (water quality is an important contributor to the diversity and ecological status of aquatic ecosystems);
- nature conservation and local development plans;
- nature conservation in development management procedures;
- developments affecting protected internationally and nationally designated sites and habitats; and
- developments affecting protected and priority habitats and species.

iv. Environment Agency Guidance to New Nuclear Build

18.3.56 In response to recent government commitments to nuclear power generation, and the expectation of a number of planning and permitting applications for new nuclear power stations, the Environment Agency has produced specific guidance to developers relating to their discharges. Guidance papers are available on:

- Numerical modelling (for cooling water discharges) (Ref. 8.33);
- Temperature thresholds for TRaC waters receiving thermal discharges (Ref. 8.34); and
- Discharges during the construction phase (Ref. 8.35).
- Guidance on permitting non-nuclear discharges (Ref. 18.36).

d) Regional Planning Policy

18.3.57 The Government's revocation of regional strategies was quashed in the High Court on 10 November 2010. However, on that same date the Government reiterated in a letter to Chief Planners its intention to revoke regional strategies through the Localism Bill. This letter was also challenged but, on 7 February 2011, the High Court held that the Government's advice to local authorities that the proposed revocation of regional strategies was to be regarded as a material consideration in their planning development control decisions should stand. The decision of the High Court was upheld by the Court of Appeal on 27 May 2011. Therefore, the regional strategies remain in place but in the case of development control decisions it is for planning decision makers to decide on the weight to attach to the strategies (see

Volume 1, Chapter 4 for a full summary of the position regarding the status of regional planning policy).

ii. Regional Planning Guidance 10 for the South West 2001 – 2016 (RPG10) (2001)

18.3.58 RPG 10 (Ref. 8.37) sets out the broad development strategy for the period to 2016 and beyond. Policy RE1 (Water Resources and Water Quality) states that to achieve the long term sustainable use of water, water resources need to be used more efficiently. The policy also states that the quality of inland and coastal water environments must be conserved and enhanced.

iii. The Draft Revised Regional Spatial Strategy (RSS) for the South West Incorporating the Secretary of States Proposed Changes 2008 – 2026 (July 2008)

18.3.59 Chapter 7 of this strategy (Ref. 8.38) deals with Enhancing Distinctive Environments and Cultural Life. Policy RE6 (Water Resources) states that the region's network of ground, surface and coastal waters and associated ecosystems will be protected and enhanced; surface and groundwater pollution risks must be minimised so that EQS are met (and, where possible, bettered); local planning authorities must ensure that rates of planned development do not exceed the capacity of existing water supply and wastewater treatment systems; and local planning authorities allow developments to proceed ahead of essential planned improvements to these systems wastewater treatment systems.

iv. Somerset & Exmoor National Park Joint Structure Plan Review 1991-2011 (2000)

18.3.60 The Somerset & Exmoor National Park Joint Structure Plan (Ref. 8.39) was adopted in 2000 with relevant policies saved from 27 September 2007. All policies have been saved with the exception of Policy 53 which is unrelated to marine water quality impacts. The Plan provides a strategic base for all land use planning within the plan area for the period up to 2011.

18.3.61 Policy 59 (Safeguarding Water Resources) states that protection will be afforded to all surface, underground and marine water resources from development which could harm their quality or quantity.

v. River Basin Management Plan, South West River Basin District (2009)

18.3.62 The South West River Basin Management Plan (SWRBMP) (Ref. 8.40) has been prepared for the South West River Basin District's rivers and coastal areas under the requirements of the WFD. The plan describes the river basin district and the pressures that the water environment faces. It shows what this means for the current state of the water environment, and what actions will be taken to address the identified pressures. It sets out what improvements are possible by 2015 and how the actions will make a difference to the local environment – the catchments, the estuaries and coasts, and the groundwater.

18.3.63 The plan sets out that development planning plays a key role in sustainable development and that the Environment Agency will continue to work closely with planning authorities to ensure that planners understand the objectives of the Water Framework Directive and area able to translate them into planning policy (page 29).

18.3.64 The plan presents current and future water body status objectives (Annex B) and thus site specific Environmental Quality Standards (EQS) can to be derived.

18.3.65 For the Bridgwater Bay and the River Parrett WFD water bodies, achievement of objectives has been deferred until 2027.

e) Local Policy

i. West Somerset District Local Plan (2006) (Policies 'saved' from17 April 2009).

18.3.66 The West Somerset Local Plan forms part of the development plan for West Somerset. The Local Plan (Ref. 18.41) was adopted in April 2006 (with relevant policies 'saved' from 17th April 2009). The Proposals Map indicates that the site is not subject to any specific marine water quality designations. The site lies outside of the defined Development Boundary.

18.3.67 The following saved policies are considered to be potentially relevant:

18.3.68 Policy W/2 (Surface Water Protection) states:

> *"Development which would adversely affect the quantitative and quality aspects of surface, underground or coastal waters will only be permitted where acceptable mitigating works are undertaken as an integral part of that development."*

18.3.69 Policy CO/1 (The Coastal Zone):

> *Development proposals in any part of the Coastal Zone, including those areas of existing developed coast, will only be permitted where:*
>
> *i) the development and its associated activities are unlikely to have an adverse affect, either directly or indirectly on:*
>
> *a) heritage features;*
>
> *b) landscape character areas;*
>
> *c) nature conservation interests, including sub-tidal and marine habitats; and*
>
> *d) residential amenities.*
>
> *ii) the development is unlikely to have an adverse affect on the character of the coast and maintains and where possible, enhances, improves or upgrades the environment particularly in derelict and/or despoiled coastal areas; and*
>
> *iii) the development requires a coastal location.*

ii. West Somerset District Local Development Framework (LDF) Core Strategy (Options Paper) (January 2010)

18.3.70 The West Core Strategy (Ref. 8.42) is at a preliminary stage of preparation and the Options Paper does not include any specific policies relating to surface water impacts. The paper does however identify the types of policy that WSC considers could be included in the Core Strategy, including a requirement that new developments incorporate measures to mitigate flood risk and manage surface water runoff through appropriate use of SUDS (sustainable drainage systems) (page 15).

iii. Supplementary Planning Guidance

18.3.71 Sedgemoor District Council and West Somerset Council have jointly prepared draft supplementary planning guidance in relation to the HPC Project. Public consultation on the Consultation Draft version of the Hinkley Point C Project Supplementary Planning Document (the draft HPC SPD) commenced on 1 March 2011 and concluded on 12 April 2011. EDF Energy has submitted representations which object to the draft HPC SPD. See Volume 1, Chapter 4 for a full summary of the position regarding the status of the draft HPC SPD.

18.3.72 Box 10 in the draft HPC SPD sets out the approach to Masterplanning and Design of the Main Site. In relation to marine water quality, Box 10 states that the HPC project promoter will be expected to, amongst other things:

> *"…identify appropriate mitigation measures for impacts on protected species or Biodiversity Action Plan Priority Species and nature conservation interests, including:*
>
> *…Effects on water quality and migratory fish populations."*

18.3.73 Further planning policy context is provided in the Legislative and Planning Policy Context chapter (**Volume 1**, **Chapter 4**) and the Introduction chapter for this volume (**Volume 2**, **Chapter 1**).

f) Best Practice Guidance

18.3.74 A range of best practice guidance is of relevance to this assessment including the following (only those specifically referred to in the assessment of impacts are included in the reference list):

- Environment Agency Pollution Prevention Guidance notes (PPG) (Ref. 8.43), including:
  - PPG 1 General guide to the prevention of water pollution;
  - PPG 2 Above ground oil storage tanks;
  - PPG 3 Use and design of oil separators in surface water drainage systems;
  - PPG 4 Disposal of sewage where no mains drainage is available;
  - PPG 5 Works in, near or liable to affect watercourses;
  - PPG 6 Working at construction and demolition sites;
  - PPG 8 Safe storage and disposal of used oils; and
  - PPG 21 Pollution incident response planning.
- Construction Industry Research and Information Association (CIRIA) Report C532: Control of Water Pollution from Construction Sites (Ref. 8.44);
- CIRIA Report C650502: Environmental Good Practice on Site (Ref. 8.45).

- CIRIA Culvert Design and Operation Guide (C689) (Ref. 8.46).
- CIRIA: The SUDS Manual (C697) (Ref. 8.47).
- Designing for Exceedence in Urban Drainage – Good Practice, C635 (2006) (Ref 8.48). This has been used in the determination of an appropriate drainage strategy for the HPC development site HPC.

18.4 Methodology

18.4.1 The assessment and supporting surveys have been conducted in accordance with relevant best practices and standard methodologies. The survey programme was undertaken in accordance with standard protocols for sampling set out in the British Standard for Water Quality Sampling BS EN ISO 5667: 2006 (Ref. 8.49). Samples from the baseline surveys were analysed at MCerts and UKAS accredited testing laboratories. **Volume 1**, **Chapter 7** presents the EIA methodology framework within which this assessment has been carried out. A summary of the work undertaken, and the methodologies adopted to assess the significance of potential impacts, is provided in the following sections.

a) Study Area

18.4.2 The geographical extent of the area under consideration is shown in **Figure 18.1**, and comprises:

- the foreshore and intertidal area receiving existing and proposed surface drainage freshwater discharges; and
- the marine waters offshore from Hinkley Point to a radial distance of 5km, as this encompasses the furthest modelled physical extent of the cooling water discharge plume.

b) Baseline Assessment

18.4.3 Baseline characterisation of the marine water quality and sediments was identified through:

- collection and analysis of marine water samples from within the study area offshore of Hinkley Point (see paragraphs 18.4.5 – 18.4.13);
- chemical analysis of sediment collected from within the study area offshore of Hinkley Point (see paragraphs 18.4.5 – 18.4.13);
- numerical modelling of the cooling water plume from Hinkley Point B (HPB);
- review of the scientific literature relating to the water and sediment quality of the Bristol Channel;
- review of marine water quality assessments, modelling and reporting undertaken by British Energy Estuarine and Marine Studies (BEEMS); and
- consultation with appropriate statutory bodies (e.g. Environment Agency, Natural England, Countryside Council for Wales, MMO); see paragraph 18.4.16.

18.4.4 The Environment Agency has only limited historical data available for the waters off Hinkley Point. Data held by the Centre for Environment, Fisheries and Aquaculture Science (Cefas; a Defra body) are reviewed in BEEMS (2011) (Ref. 8.50). Given the limited data available, a marine water quality programme was developed and undertaken during 2009 (Ref. 8.51). A brief summary of this programme is provided here.

Marine Water Quality Survey

18.4.5 The sampling approach adopted for the study was to obtain seasonal 'snap shots' of water quality conditions from four sampling visits. The sampling visits were carried out in January, May, June and September 2009. The dates for each campaign were selected so that the complete data set contains data collected across a range of tidal conditions (e.g. neap and spring tides) and during different seasons.

18.4.6 The sampling approach, and proposed suite of parameters, was discussed and agreed with the Environment Agency (confirmed by email) in December 2008 on the understanding that historical data would also be reviewed. The field sampling was conducted on the following dates:

- 27-28 January 2009: spring tide;
- 1-2 May 2009: neap tide;
- 27-28 June 2009: spring tide; and
- 12-13 September 2009: neap tide.

18.4.7 The location of sampling points was originally defined in late 2008 to reflect initial engineering design assumptions on proposed locations for the HPC cooling water intake and outfall structures. One sampling zone was established within a polygon around a point approximately 2.5km offshore, and another around a point approximately 5km offshore. The locations of the sampling areas are shown in Figure 18.2.

18.4.8 Within each of the two sampling zones, ten water quality sampling point locations and eight water profiling point locations were identified. Following the final decision on the locations of intake and outfall, additional sampling points were added to show spatial differences and gradients across the offshore sampling area.

18.4.9 At each monitoring location, three water samples were collected; one from approximately 0.5m below the surface, one at mid-depth and one just above the sea bed.

18.4.10 The full suite of chemical parameters and minimum reporting values (MRV) are presented in **Table 18.1**.

18.4.11 *In situ* water quality parameter profiling through the water column was undertaken at five stations in the offshore sampling area, at five stations in the near shore area, and an additional four intermediate locations added after the first sampling campaign. Water temperature, dissolved oxygen and salinity were measured using a pre-calibrated multi-probe sonde.

18.4.12 During all campaigns a replicate set of samples was collected from one location selected at random. A blank sample was also submitted for analysis to act as further quality assurance of sample handling and analysis. There was good agreement between the main and replicate samples.

Table 18.1: Suite of Chemical Determinands Tested During Marine Water Quality Sampling

Determinand	MRV	Units	Accreditation?
Aluminium	5	µg/l	Y
Ammonium as NH4 (mg/l)	0.03	mg/l	N
Arsenic (total and dissolved)	1	µg/l	Y
Biochemical Oxygen Demand	2	mg/l	N
Boron (total and dissolved)	5	µg/l	Y
Cadmium (dissolved)	1	µg/l	Y
Cadmium (total)	1	µg/l	Y
Chemical Oxygen Demand	2	mg/l	N
Chloride	1	mg/l	Y
Chloroform	1	µg/l	N
Chromium (total and dissolved)	1	µg/l	Y
Copper (total and dissolved)	1	µg/l	Y
Detergents	100	µg/l	N
Dibromo acetic acid	1	µg/l	N
Dibromoacentonitile	1	µg/l	N
Dibromochloromethane	1	µg/l	N
Dichlorobromomethane	1	µg/l	N
Dichloromethane	1	µg/l	N
Ethanolamine	0.01	mg/l	N
Free Chlorine	100	µg/l	Y
Hydrazine	0.1	mg/l	N
Iron (total and dissolved)	5	µg/l	Y
Lead (total and dissolved)	1	µg/l	Y
Lithium	10	µg/l	N
Manganese	5	µg/l	Y
Mercury (dissolved)	0.1	µg/l	Y
Mercury (total)	0.1	µg/l	Y
Morpholine	0.01	mg/l	N
Nickel (total and dissolved)	1	µg/l	Y
Nitrate	1	mg/l	Y
Nitrite	0.05	mg/l	N
Ortho Phosphate as PO_4	0.02	µg/l	N
pH	0.1	units	Y
Phosphates	5	mg/l	N
Salinity	1	ppt	N
Silicates	5	µg/l	N
Sodium	1	mg/l	Y

Determinand	MRV	Units	Accreditation?
Sulphate	1	mg/l	Y
Total Petroleum Hydrocarbons (C8 – C35)	10	µg/l	Y
Total Suspended Solids	5	mg/l	N
Trihalomethanes	1	µg/l	N
Turbidity	2	mg/l	N
Zinc (total)	1	µg/l	Y

18.4.13 Additional water samples were taken during Cefas BEEMS surveys in December 2010 to investigate hydrazine concentrations further using techniques with lower limits of detection than used previously. Samples were taken at the HPB outfall and at a reference location to the northwest. Hydrazine was not detected at all, using a limit of detection of approximately 0.1µg/l.

Marine Sediment Quality Survey

18.4.14 During November and December 2009, sampling of the sea bed sediments in the vicinity of the proposed temporary jetty and cooling water intake and outfall locations was undertaken by Fugro Seacore Ltd. This sampling was primarily intended for sub-seabed geophysical appraisal, but advantage was taken of this in order to obtain sediment samples for chemical analysis both at surface and depth (**Figure 18.3**).

18.4.15 It is proposed that material dredged for the offshore infrastructure, including the jetty berthing pocket and arisings from drilling the vertical shafts, would be disposed of at sea within the study area if doing so would not significantly affect the sub-tidal ecology. If disposal within the study area is not acceptable, dredged material and/or drilling arisings would be removed to an existing licensed marine disposal site (e.g. Cardiff Grounds). A licence for the disposal of dredged material at sea would be sought from the appropriate authorising body (either the MMO if material is dispersed locally, or the Welsh Assembly if the material is removed to the Cardiff Grounds).

c) Consultation

18.4.16 Extensive consultation has been undertaken throughout the EIA process to discuss all stages of the assessment, including specific aspects of the development. Details of these consultations are given below and further information may be found in the **Consultation Report**.

18.4.17 A range of informal consultations was undertaken with stakeholders prior to publication of the Stage 1 consultation document; these are summarised in **Table 18.2.**

18.4.18 In particular, prior to the commencement of sampling campaigns, consultations were undertaken with local Environment Agency personnel in December 2008 to agree the sampling locations, approach and analytical test parameters for the marine sampling programme.

18.4.19 A number of other consultation meetings (in addition to the formal consultation reports produced) have taken place as part of the EIA process and these are also included in **Table 18.2**.

18.4.20 Meetings were held with the Marine Authorities Liaison Group (MALG) to discuss all elements of the HPC development that might influence the marine environment, including specific elements of engineering and construction design.

18.4.21 MALG members include Cefas, the Countryside Council for Wales (CCW), Natural England, the Environment Agency, the MMO, Somerset County Council, West Somerset Council and Sedgemoor District Council. Minutes were produced for each of the MALG meetings but formal written consultation responses were not provided by the attendees.

Table 18.2: Summary of Marine Water and Sediment Consultations

Date of Consultation	Consultees Attending	Issues Discussed Relating to Marine Water Quality
15/12/2008	Environment Agency	Discussion and agreement of water quality monitoring strategy
28/4/2009	Environment Agency, Natural England, Sedgemoor District Council	Discussion of need for collection and analysis of offshore sediment samples
11/5/2009	Environment Agency	Discussion of discharges and consenting
19/5/2009	MALG	Discussion of offshore sediment investigation studies
24/6/2009	MALG	Discussion of offshore sediment survey and analysis Discussion of the jetty development Discussion of application for discharge consents Presentation of terrestrial and marine water quality monitoring results Discussion of proposed discharge strategy
28/7/2009	MALG	Further discussion of offshore borehole investigations Discussion of proposed dredging and piling works for the temporary jetty
2/9/2009	MALG	Design discussion of the temporary jetty Discussion of dredging and FEPA licensing Discussion of information required on discharge consents during construction
30/9/2009	MALG	Discussion of temporary jetty design
14/10/2009	Environment Agency	Discussion of drainage strategy and culverting of Holford Stream
1/12/2009	MALG	Discussion of temporary jetty development
6/1/2010	MALG	Discussion of licensing required for jetty development and disposal of dredging waste
2/3/2010	MALG	Discussion of jetty berthing pocket and design to reduce maintenance dredging needs
21/1/2010	Environment Agency	Discussion of preliminary works discharge consenting Discussion of Holford Stream culvert Discussion of drainage discharge strategy
14/4/2010	MALG	Discussion on foreshore discharges Discussion of two stage approach for the jetty development

Date of Consultation	Consultees Attending	Issues Discussed Relating to Marine Water Quality
		Discussion of jetty scour studies
24/05/2010	Environment Agency, Internal Drainage Board, Natural England	Discussions of drainage strategy during site preparation including foreshore discharges
18/11/2010	MALG	Discussion of possible chlorination strategy as part of Fish Recovery and Return discussions
3/03/2011	Environment Agency, Natural England, Countryside Council for Wales, Marine Management Organisation	Discussion of numerical modelling of thermal and chemical plumes
18/03/2011	Environment Agency, Natural England, Countryside Council for Wales, Marine Management Organisation	Discussion of sensitivity analysis of near-field numerical modelling of thermal and chemical plumes
7/06/2011	Environment Agency, Natural England, Countryside Council for Wales, Marine Management Organisation, West Somerset Council	HRA workshop. Thermal and chemical modelling session.
20/0602011	Environment Agency	Discussion of construction discharges
13/07/2011	Environment Agency	Discussion of operational discharges

18.4.22 Three public consultations have been undertaken: Stage 1, Stage 2 and a Stage 2 Update in November 2009, July 2010 and February 2011, respectively, and a range of comments were received from the consultees. Responses to these comments, including an indication of how they were accounted for within the studies, are provided in the **Consultation Report**. The subsequent marine water quality assessment and reporting have taken the comments received into account.

d) Assessment Methodology

18.4.23 **Volume 1**, **Chapter 7** of this ES describes the assessment methodology adopted for this EIA. In addition, the following specific methodology was applied for the determination of receptor value and sensitivity (see **Table 18.3)** and impact magnitude (see **Table 18.4**) with respect to marine water quality.

Value and Sensitivity

18.4.24 The marine water quality off Hinkley Point contributes towards the status of nationally and internationally important features (e.g. in the Bridgwater Bay SSSI and the Severn Estuary SAC). To this end it has an explicit importance. However, for the purposes of this chapter and determining the significance of impacts on water quality, the sensitivity of the receptor to change is considered to be more relevant because of the dynamic nature and buffering capacity of the system (see below)..

18.4.25 As described in **Volume 2**, **Chapter 17**, the Inner Bristol Channel is extremely dynamic in nature (i.e. it has an extreme hyper-tidal range, associated with high current speeds), has a large physical scale and a high degree of temporal and spatial variance. In addition, as a result of the very high suspended sediment concentration of the Inner Bristol Channel, the marine waters and the physical habitats and assemblages associated with them have a particularly low sensitivity to localised disturbances to the sediment regime. Essentially, the area off Hinkley Point, and the inner Bristol Channel, is a very large and highly dynamic environment, that naturally experiences a very high level of variation in physico-chemical parameters.

18.4.26 **Table 18.3** sets out the generic criteria used in defining the sensitivity of the marine water quality receptor. Where a receptor could reasonably be assigned more than one level of sensitivity, professional judgement has been used to determine which level is applicable.

Table 18.3: Criteria Used to Determine the Sensitivity of Marine Water Quality Receptors

Sensitivity	Guidelines
High	The water quality of the receptor supports or contributes towards the designation of an internationally or nationally important feature and has a very low capacity to accommodate any change to current water quality status, compared to baseline conditions.
Medium	The water quality of the receptor supports high biodiversity and has low capacity to accommodate change to water quality status.
Low	The water quality of the receptor has a high capacity to accommodate change to water quality status due, for example, to large relative size of the receiving water and capacity for dilution and flushing. Background concentrations of certain parameters already exist.
Very low	Specific water quality conditions of the receptor are likely to be able to tolerate proposed change with very little or no impact upon the baseline conditions detectable.

18.4.27 No specific sediment receptors have been identified as part of this assessment, because changes or disturbances to marine sediments affect water quality status. For example, disturbance of bed sediments as a result of construction activities may cause the mobilisation of potential pollutants into the water column and increase in suspended solid concentrations, with associated effects upon water quality status. Investigation and assessment of marine sediment quality thus forms an important part of this EIA and this chapter.

Magnitude

18.4.28 Prediction of the magnitude of potential impacts has been based on the consequences that the proposed HPC development might have upon the marine water quality status (see **Table 18.4**).

18.4.29 These descriptions of magnitude are specific to the assessment of marine water quality impacts and are considered in addition to the generic descriptors of impact magnitude presented in **Volume 1**, **Chapter 7**. Potential impacts have been considered in terms of permanent or temporary, adverse (negative) or beneficial (positive) and cumulative effects.

18.4.30 Where an impact could reasonably be assigned more than one magnitude, professional judgement has been used to determine which rating is applicable.

Table 18.4: Criteria Used to Determine the Magnitude of Marine Water Quality Impacts

Magnitude	Guidelines
High	Very significant change to key characteristics of the water quality status of the receiving water feature, e.g. modelled as significant under the Environment Agency H1[1] assessment. Water quality status degraded to the extent that permanent change and inability to meet (for example) EQS is likely.
Medium	Significant changes to key characteristics of the water quality status taking account of the receptor volume, mixing capacity, flow rate, etc. Water quality status likely to take considerable time to recover to baseline conditions.
Low	Noticeable but not considered to be significant changes to the water quality status of the receiving water feature. Activity not likely to alter local status to the extent that water quality characteristics change considerably or EQS are compromised.
Very low	Although there may be some impact upon water quality status, activities predicted to occur over a short period. Any change to water quality status will be quickly reversed once activity ceases.

[1] The H1 Assessment is a risk assessment methodology developed by the Environment Agency to be used by developers to ensure that they do not harm the environment (Ref. 8.52)

18.4.31 Many aspects of the HPC project have been designed to mitigate environmental impacts. These are included in the assessments of magnitude; that is mitigation by design is considered when determining magnitude. Legislative compliance (which includes discharges to marine waters under an environmental permit) is assumed in the determination of impact magnitude.

Significance of Impacts

18.4.32 The significance of impacts is assessed by relating the magnitude of an effect to the sensitivity (or value) of the resource. This relationship is presented as an Impact Assessment Matrix in **Volume 1**, **Chapter 7**.

18.4.33 In addition to the predominantly qualitative assessment criteria defined in **Table 18.3** and **Table 18.4**, the description of baseline conditions and the assessment of potential impacts has also included comparison with water quality assessment criteria. The most recent, and relevant, statutory environmental standards for transitional and coastal waters are those of the WFD. These are given in the River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010 (Ref. 8.19). Where no statutory environmental standard is available, comparison has been made with the existing baseline concentrations, or ecotoxicological effect levels as appropriate.

18.4.34 Where relevant, the description of the baseline conditions provided and the assessment of potential impacts includes comparison to relevant water quality assessment criteria. A hierarchical approach was adopted to the criteria used, as follows:

- Where a substance has an EQS defined under WFD, that EQS was the standard against which the assessment was made.
- Where there is no WFD EQS available, the pre-WFD EQS was the standard against which the assessment was made.
- Where there is no EQS available, then a Probable No Effect Concentration (PNEC) was used as the assessment criterion.

- Where there is neither a WFD EQS nor a PNEC available, comparison was made to the existing baseline concentrations determined from the sampling programme undertaken in 2009 (Ref. 8.42).

Assessment Criteria for Marine Water Quality

18.4.35 The majority of environmental standards used to assess the marine water quality offshore of Hinkley Point are those provided within the Directions for Transitional and Coastal ('TRaC') Waters (see **Table 18.5** for those relevant to the development) as determined for the WFD (Ref. 8.19).

Table 18.5: Water Quality Standards Used to Assess Marine Surface Waters and Proposed UK EPR Reactor Discharges at Hinkley Point

Determinands	Units	MRV	Pre-WFD Saltwater EQS Values	WFD TRaC Waters EQS Values[4]	Ecological Risk Standard[6]
Acetic Acid[D]	(µg/l)	Calc	-	-	-
Acrylic acid[D]	(µg/l)	Calc	-	-	30[10]
ATMP[D] Amino(tris)methylenephosphonic acid)	(µg/l)	Calc	-	-	7400[11]
BOD[D]	(mg/l)	2	-	-	1.2[7]
Cationic Detergents	(mg/l)	0.1	-	-	-
Chloride[D]	(mg/l)	1	-	-	14275[7]
Chloroform	(µg/l)	1	12[3]A	2.5A	-
COD[D]	(mg/l)	2	-	-	14.1[7]
Dibromo Acetic Acid	(µg/l)	1	-	-	-
Dibromoacetonitrile	(µg/l)	1	-	-	-
Dibromochloromethane	(µg/l)	1	-	-	-
Dichlorobromomethane	(µg/l)	1	-	-	-
Dichloromethane	(µg/l)	1	-	20A	-
Dissolved Aluminium[D]	(µg/l)	5	-	-	15[7]
Dissolved Arsenic	(µg/l)	1	-	25AD	-
Dissolved Boron	(µg/l)	5	-	-	-
Dissolved Cadmium	(µg/l)	1	-	0.2AD 1.5MAC	-
Dissolved Chromium	(µg/l)	1	15[1]AD	0.6A, 32MAC (P95) for CrVI	-
Dissolved Copper[D]	(µg/l)	1	5[1]ad	5A	-
Dissolved Inorganic Nitrogen	(µg/l)	Calc	-	180 – 270(P99)[5]	-
Dissolved Iron[D]	(µg/l)	5	1000[1]AD	1000A	-
Dissolved Lead[D]	(µg/l)	5	25[1]AD	7.2A	-
Dissolved Lithium	(µg/l)	10	-	-	-

Determinands	Units	MRV	Pre-WFD Saltwater EQS Values	WFD TRaC Waters EQS Values[4]	Ecological Risk Standard[6]
Dissolved Manganese[D]	(µg/l)	5	-	-	3.5[7]
Dissolved Nickel[D]	(µg/l)	1	30[1]AD	20A	-
Ethanolamine	(mg/l)	0.01	-	-	0.160[9]
Free Chlorine[D]	(mg/l)	0.1	10[2] (TRO) MAC	10[2] (TRO) MAC (P95)	-
HEDP[D] 1-hydroxy ethylidene-1,1-diphosphonic acid	(µg/l)	Calc	-	-	10000[12]
Hydrazine[D]	(µg/l)	0.1	-	-	0.0004
Lithium Hydroxide[D]	(µg/l)	10	-	-	114[7,8]
Morpholine[D]	(mg/l)	0.01	-	-	0.017[9]
Nitrogen as N (excluding hydrazine, morpholine and ethanolamine)[D]	(µg/l)	Calc	-	2520A	-
Non-ionic Detergents	(mg/l)	0.1	-	-	-
pH	units	-	6 – 8.5[1](P95)	-	-
Phosphate[D]	(mg/l)	0.02	-	-	0.03[7]
Phosphoric Acid[D]	(µg/l)	Calc	-	-	-
Sodium polyacrylate[D]	(µg/l)	Calc	-	-	5.6[13]
Sodium[D]	(mg/l)	0.01	-	-	8545[7]
Sulphate[D]	(mg/l)	1	-	-	1924[7]
Suspended Solids[D]	(mg/l)	5	-	-	264[7]
Total Boron	(µg/l)	5	7000AT	-	-
Total Petroleum Hydrocarbons	(µg/l)	10	-	-	-
Total Zinc	(µg/l)	1	40[1]AD	40 A	-

Table notes:

A *Annual Average; (P95) – 95 Percentile; (P99) – 99 percentile; MAC – Maximum allowable concentration; TRO – As total residual oxidants; D – Expected marine discharge chemical during commissioning or operational phases.*

Table references:

1 *National Environmental Quality Standards (EQS) – For List II substances DoE Circular 7/89 (Ref. 8.53)*

2 *Surface Waters (Dangerous Substances) (Classification) Regulations 1997 (Ref. 8.12).*

3 *Surface Waters (Dangerous Substances) (Classification) Regulations 1989 (Ref. 8.22).*

4 *River Basin Districts Typology, Standards and Groundwater Threshold Values (Water Framework Directive) England and Wales) Directions 2010 (Ref. 8.13).*

5 *Standard is for winter dissolved inorganic nitrogen for WFD good status for medium to high turbidity coastal waters. (Ref. 8.53).*

6 *Standard or threshold used to assess ecological risk within the Environment Agency H1 style assessment (Ref. 8.52).*

7 *Mean background value determined by 2009 sampling campaigns (Ref. 8.52). For statistical purposes, results below the MRV have been treated as zero.*

8 *Mean background value of dissolved lithium determined by 2009 sampling campaigns (Ref. 8.52).*

9 *Chronic Predicted No Effect Concentration, PNEC (Ref. 8.52).*

10 NOEC (72hrs) Freshwater alga. (Ref. 8.52).
11 NOEC(14 days) Freshwater alga (Ref. 8.52).
12 NOEC (28 days) Freshwater crustacean (Ref. 8.52).
13 NOEC (21 days) Freshwater crustacean (Ref. 8.52).

Assessment Criteria for Marine Sediment Quality

18.4.36 There are no quantitative EU or UK EQS values for sediments. The only pertinent guidance for sediment quality is given for most of the EC Dangerous Substances Directive List 1 substances and is defined as 'standstill (no deterioration)' though this is not carried through into the Water Environment Regulations (Ref. 8.23). In the absence of any quantified UK standards, common practice for characterising baseline sediment quality conditions is to compare against two separate criteria sets:

- Cefas Guideline Action Levels for the disposal of dredged material (Ref. 8.54);
- Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (Ref. 8.55).

18.4.37 Cefas Guideline Action Levels are used as part of a 'weight of evidence' approach to assessing suitability of material for disposal at sea, but are not themselves statutory standards. The majority of the materials assessed against these standards arise from dredging activities. These Action Levels are used in conjunction with a range of other assessment methods (e.g. bioassays) and other data to assess risk to the environment. Current Action Levels are set out in **Table 18.6.**

Table 18.6: Cefas Guideline Action Levels for the Disposal of Dredged Material

Cefas Action Levels		
Contaminant/Compound	**Action Level 1**	**Action Level 2**
	mg/kg Dry Weight (ppm)	
Arsenic	20	100
Cadmium	0.4	5
Chromium	40	400
Copper	40	400
DBT (dibutyltin)	0.1	1
DDT (dichlorodiphenyltrichloroethane)	0.001	None
Dieldrin	0.005	None
Lead	50	500
MBT (mono-butyltin)	0.1	1
Mercury	0.3	3
Nickel	20	200
PCB's, sum of 25 congeners	0.02	0.2
PCB's, sum of ICES 7	0.01	None
TBT (tributyltin)	0.1	1
Zinc	130	800

Table notes:
Action levels taken from Cowes Outer Harbour Project (Ref. 8.56). Consistent with those action levels presented within a report on Flamborough Head cSAC (Ref. 8.54

18.4.38 Cefas guidance indicates that, in general, contaminant levels below Action Level 1 are of no concern and are unlikely to influence the licensing decision. Material with contaminant levels above Action Level 2 is generally considered unsuitable for disposal at sea. Dredged material with contaminant levels between Action Levels 1 and 2 requires further consideration and testing before a decision can be made. The action levels should not be viewed as pass/fail thresholds.

18.4.39 The Canadian Interim Sediment Quality Guidelines (ISQGs) were developed by the Canadian Council of Ministers of the Environment for evaluating the potential for adverse biological effects in aquatic systems. They have been derived from available toxicological information, reflecting the relationships between sediment concentrations of chemicals and any adverse biological effects resulting from exposure to these chemicals. ISQGs exist for only a few metals.

18.4.40 Again, the ISQGs are not statutory standards and should be used with caution, with the findings being treated only as indicative. They were designed specifically for Canada and are based on the protection of pristine environments. But, in the absence of suitable alternatives it has become commonplace for these guidelines to be used by regulatory and statutory bodies in the UK, and elsewhere, as part of a 'weight of evidence' approach.

18.4.41 The Canadian guidelines are presented in **Table 18.7**, and comprise two assessment levels. The lower level is referred to as the threshold effects level (TEL) and represents a concentration below which adverse biological effects are expected to occur only rarely (in some sensitive species for example). The higher level, the probable effect level (or PEL), defines a concentration above which adverse effects may be expected in a wider range of organisms. The three ranges of chemical concentrations (<TEL, between TEL and PEL, and >PEL) indicate those concentrations that are rarely, occasionally and frequently associated with adverse biological effects, respectively.

Table 18.7: Selected Interim Marine Sediment Quality Guidelines (ISQG)

Contaminant	ISQG/TEL	PEL	Incidence of Adverse Biological Effects		
	mg/kg Dry Weight		% ≤ ISQG	% Between ISQG and PEL	% ≥ PEL
Arsenic	7.24	41.6	3	13	47
Cadmium	0.7	4.2	6	20	71
Chromium	52.3	160	4	15	53
Copper	18.7	108	9	22	56
Lead	30.2	112	6	26	58
Mercury	0.13	0.7	8	24	37
Zinc	124	271	4	27	65

Table notes:All values taken from the Canadian Council of Ministers of the Environment (2002) (Ref. 8.55).

18.4.42 A discussion of the marine sediment radiochemical results is presented in **Volume 2**, **Chapter 21**.

Assessment of Cooling Water Discharge Plume

18.4.43 The most significant impacts on the marine environment associated with a direct-cooled power station tend to be associated with cooling water abstraction and subsequent discharge. The primary characteristic of the discharge from such a station is its elevated temperature and, when introduced to coastal waters such as those at Hinkley Point, this discharge will tend to form a buoyant tidally oscillating, progressively diluting plume. A secondary characteristic is that this plume will also transport any chemical residuals or wastes discharged within that same cooling water flow.

18.4.44 To assess the impact of the cooling water discharge plume, a mixing-zone approach was used. In a regulatory context, as defined by in the 2010 European Commission Technical Guidelines (Ref. 8.57), a mixing zone is described as *"... the part of a body of surface water which is adjacent to the point of discharge and within which the concentrations of one or more contaminants of concern may exceed the relevant Environmental Quality Standard (EQS), provided that compliance of the rest of the water body with the EQS is not affected"*. The mixing zone is set by the competent permitting authority (the Environment Agency in England and Wales).

18.4.45 The most appropriate method for estimating the extent of an existing cooling water plume is direct field observation, either by remote sensing or extensive field survey. Where such a plume already exists at a site where further development is being considered, observations of the behaviour of that existing plume provide very considerable advantage in terms of supporting the development, validation and calibration of the numerical hydrodynamic models used to predict behaviour of the new plume.

18.4.46 Adequately calibrated numerical models can be used to predict the behaviour of plumes from new cooling water discharges for a range of possible intake and outfall configurations. Used at the design stage, such modelling allows the design to be configured such that recirculation to both existing and new plant (and the associated thermal efficiency losses) is minimised, as well as limiting the influence of that plume on potentially sensitive receptors.

18.4.47 Once established, the same models that simulate heat transport can be modified or supplemented to examine the dispersion of chemical contaminants, as well as other evolutions in the water quality regime, including potential impacts on DO.

18.4.48 In accordance with Environment Agency guidance (Ref. 8.33), two different hydrodynamic models (Delft3D and the General Estuarine Transport Model (GETM)) were used to model temperature changes off Hinkley Point when HPC is running with an average cooling water flow of $125m^3/s$. **Appendix 18A** presents a summary of model development in line with the requirements of the Environment Agency (Ref. 8.33). For a more detailed assessment of the two models, and description of how they differ, refer to BEEMS Technical Reports 186 (Ref. 8.50), 182 (Ref. 8.58) and 177 (Ref. 8.59).

18.4.49 Discussions with the Environment Agency highlighted differences between the two models, particularly with regard to the behaviour of the plume at the initial discharge point. It was agreed that outputs from GETM underestimate the initial thermally-related buoyancy of the plume near the outfall, and that this increases the predicted area of the total plume. In comparison, the Delft model underestimates the extent of the plume (BEEMS 2011; Ref. 8.50).

18.4.50 GETM outputs are, therefore, considered precautionary and used in the plume assessments. GETM is likely to overestimate water temperature outputs (by approximately 0.5-0.75°C).

18.4.51 An upper range temperature of 20.4°C (98 percentile Hinkley Point based on 32 years of Cefas data) was also used as the basis for a precautionary assessment.

18.4.52 Hourly model outputs, plotted against a selected set of variables, were used to produce time series means and averages. Five runs, A to E (described in **Table 18.8**), were used to produce detailed thermal predictions from both models in order to establish baseline conditions (i.e. HPB operating alone) and to represent a range of potential operational conditions in the future (i.e. HPC operating alone and HPC operating simultaneously with HPB).

18.4.53 For temperature assessments, any areas of water predicted to exceed an increase of 2.6°C above the 98 percentile background value of 20.4^{o}C at the surface and seabed (i.e. which would cause temperatures to rise above 23°C; UKTAG standard) are considered to constitute the mixing zone.

18.4.54 GETM was also used to model chemical dispersion within the cooling water discharge plume for dissolved oxygen (DO), un-ionised ammonia, total residual oxidants (TRO; the active agents following chlorination of seawater for anti-fouling purposes), chlorination by-products (CBPs) and hydrazine.

Table 18.8: Description of Numerical Modelled Operational Scenarios ('Model Runs')

Run ID	Description
Run A	HPB operating at 70% output
Run B	HPB operating at 100% output
Run C	HPC operating at 100% output
Run D	HPB operating at 70% output + HPC operating at 100% output
Run E	HPB operating at 100% output + HPC operating at 100% output

Water Framework Directive and Habitats Regulations Assessment

18.4.55 This chapter of the ES considers the implications of the proposals for the water quality status of the study area within the context of the relevant EQS, PNECs or baseline concentrations (as indicators of general water quality health). This is in line with the approach adopted across the EIA in considering predicted effects of the HPC Project on the study area as a whole (within the zone of potential influence) as well as on individual receptors within it. Compliance with the WFD and the Habitats Directive has not been assessed herein, because the assessment approaches recommended with respect to these Directives differ from the standard method applied for EIA. In addition, they are only concerned with a subset of the wider resource that has the potential to be affected (e.g. WFD water bodies or relevant designated interest features). The requirement to undertake WFD and Habitats Regulations Assessments has not been ignored, however, and separate assessments, or information required to make the assessments, have been prepared. See Ref. 18.15 for information to support the Habitats Directive assessment, and **Appendix 18B** (associated with this chapter) for the assessment against WFD.

Cumulative Effects

18.4.56 Cumulative effects potentially arising from the interaction of the different elements of the HPC development, for example the land clearance works, the sea wall construction and the dredging associated with the jetty, are considered within this chapter (i.e. additive and interactive effects between impacts generated within the site boundary and HPC study area). Cross reference is made, where necessary, to other assessments that are closely linked to the assessment of marine water quality, such as marine ecology, **Volume 2**, **Chapter 19**.

18.4.57 **Volume 1**, **Chapter 7** details the methodology adopted for the assessment of cumulative effects. HPC Project-wide cumulative impacts (i.e. activities and impacts generated at distance from the site and study area), and in-combination impacts with other proposed or reasonably foreseeable projects are presented in **Volume 11**.

e) Limitations, Constraints and Assumptions

18.4.58 Given the limited specific historical information on marine water quality, baseline conditions have been primarily derived from monitoring campaigns established for this project. The characterisation of local marine systems provided by these campaigns is adequate for undertaking this impact assessment.

18.4.59 Samples were taken to reflect a range of typical tidal conditions, but other conditions may be exhibited following extreme events (e.g. storms).

18.4.60 Where HPC-specific data are not available, for example certain discharges during the operational phase, surrogate data have been sourced from the Flamanville 3 site, in Manche, north-western France as they are representative of twin EPR operation.

18.4.61 Where uncertainties have been identified with respect to chemical discharge concentrations, a precautionary approach has been adopted.

18.4.62 All relevant assumptions and uncertainties are described alongside calculations and impact assessments.

18.5 Baseline Environmental Characteristics

a) Introduction

18.5.1 This section describes the marine water and sediment quality baseline for the proposed HPC development. The development site is bordered immediately along its northern edge by Bridgwater Bay, which forms part of the Inner Bristol Channel.

18.5.2 Current understanding of the key physical features of the Inner Bristol Channel and Severn Estuary is detailed in **Volume 2**, **Chapter 17**. The bathymetry and dynamics of the Inner Bristol Channel, and the immediately associated Severn Estuary, make it unique in the UK. It is a highly turbid system, although much of the seabed itself is bare of soft sediment. There appears to be no modern source of sand and gravel within the system and small grain fractions of sediment are constantly reworked in suspension. What sediment there is on the seabed is strongly affected by the

Spring/Neap tidal cycle and is highly mobile. Where subtidal sediment is found, its depth and composition change significantly over time. The main elements that are relevant to water quality are summarised in **Table 18.9**.

Table 18.9: Key Physical Features of the Bristol Channel and Severn Estuary that are Relevant to Marine Water and Sediment Quality (see **Volume 2, Chapter 17**)

Key Physical Features	Comment
Large branching estuary with freshwater inputs	The sub-estuaries within the Bristol Channel and Severn Estuary absorb energy at tidal frequencies, but input energy at longer frequencies because of river flow variation. The Parrett, Usk and other sub-estuaries contribute a relatively significant freshwater influx.
High salinity variation	There is a high salinity variation as a result of the seasonal and tidal variation. The discharge from the Parrett significantly adds to this variation in the Hinkley Point area.
Estuary controlled by geological constriction with influences mixing	The geological constriction in the area of the Holm Islands, between Cardiff and Brean Down (constraining the Estuary in terms of both width and depth) is the key large scale physical feature. To landwards, the waters of the Severn Estuary are generally vertically mixed (in terms of salinity). To seawards, the waters of the Inner Bristol Channel are less uniform and may at times be density (by salinity) stratified. The constriction also acts to divide different suites of physical sedimentary processes, regarding waves, currents and sediment transport.
Hypertidal	This area experiences one of the highest tidal ranges in the world and is classified as hypertidal, being > 6 m. The range at Hinkley Point, between mean high and low water Spring tides, is 10.7m. This regime has direct consequences for physical mixing and flushing of water and sedimentary processes and sediment transport.
Periodic energy inputs	Spring to Neap changes are very large, with Spring tides having a mean value of 10.7m and Neaps 4.8m, resulting in a system with a major component of fortnightly change (as well as other tidal periods). Long periods of low winds reduce the suspended solids concentrations, at least in surface waters. The sedimentary system is thus periodic, directly impacting upon the light regime (hence production), the benthic habitats and the benthos.
Waves dominant in shallow water	In shallow areas, waves are dominant over the effects of tidal currents. Most important in the Hinkley Point area are the intertidal and shallow 'flats' where it is waves that are mostly responsible in terms of mobilising and/or changing the physical environment and thus affecting the biota.
Sediment starved and mud in suspension	The vast majority of the seabed in the Bristol Channel and Severn Estuary system is rock or coarse gravel; there is relatively little sand, and most (though not all) of the mud is in suspension or is intermittently mobilised.
Physics makes change in subtidal habitats the norm, not the exception	Changes to the sediment transport system have the potential to induce major changes in habitat. Changes in sediment distribution (natural and man made) are likely and these will affect habitats.
Highly turbid environment (unique in UK)	High concentrations of sediment are present within the water column (in both permanent and temporary suspension and is intermittently deposited) but there is relatively little contribution from the rivers or from the outer Bristol Channel.
Existing Parrett plume affects the intertidal area	Existing freshwater runoff peaks are significant in that they affect the extent of the plume across Bridgwater Bay.
Periodic major changes in bed elevation	Erosion/deposition cycles occur naturally and periodically, especially in outer Bridgwater Bay.

Key Physical Features	Comment
Residual circulation	Tidal averaging of flows shows strong outward residual flow from Flat Holm to the south side of the Channel off Kilve. Recirculation cells occur to north and south. This could trap both persistent contaminants and effluent, however, given the small magnitude of any residual circulation compared to the regular tidal flows the significance of this feature is uncertain.

18.5.3 Information from the scientific literature has been used to characterise the wider marine environment of the Bristol Channel and upstream Severn Estuary.

18.5.4 Results from the offshore water quality sampling campaigns undertaken in 2009 offer a complementary source of localised water quality data offshore of Hinkley Point.

b) Study Area Description

i. Suspended Sediment

18.5.5 A detailed description of sediment distribution and dynamics is provided in Section 17.6, **Volume 2**, **Chapter 17**. However, a summary of the key issues relevant to suspended sediment is provided here.

18.5.6 Due to the large tidal range and strong currents operating in the Bristol Channel and Severn Estuary the sedimentary regime is very dynamic. Deposits of fine sediments in the Bristol Channel are highly mobile and a large amount of mobile fine sediment is present in the system at any one time. Suspended sediment concentrations are relatively high and the process of bedload sediment erosion, transport and deposition is complex, with many areas subject to continual or periodic reworking. The majority of fine sediment in the Severn Estuary and Bristol Channel is material eroded originally from the surrounding catchments and supplied via rivers. The hard bedrock and coastal cliffs are not a major source of fine sediment.

18.5.7 The dynamic processes operating in the Bristol Channel and Severn Estuary, in particular the strong tidal currents, lead to erosion of intertidal and shallow subtidal deposits and active re-suspension of muddy seabed sediments. The suspended sediment levels in the Inner Bristol Channel can be exceptionally high. A field campaign, recorded suspended sediment concentrations in the Inner Bristol Channel within the range of less than 100mg/l to approaching 200,000mg/l (fluid mud) (Ref. 8.60).

18.5.8 Surveys have found strong variation in surface to bed values for suspended sediment between Spring and Neap tides in the study area; with the greatest concentrations recorded close to the seabed. Concentrations are strongly linked to tidal current velocity, with levels being greater on the flood than the ebb, greater during Spring tides than Neaps and generally proportional to tidal range. Overall, and for the purposes of this assessment, background suspended sediment concentrations within the Inner Bristol Channel are considered to be in the order of 1g/l within 5m water depth.

18.5.9 Given the very high suspended sediment concentration of the Inner Bristol Channel, and its variability, the marine waters and the physical habitats associated with them have a particularly low sensitivity to changes in suspended sediment levels or additional inputs from terrestrial sources.

ii. Marine Water Quality Contaminant Inputs

18.5.10 The River Severn is the major freshwater input to this estuarine and coastal system, providing approximately a quarter of the total flow to the Severn Estuary and Bristol Channel (Ref. 8.61). A number of other major rivers (e.g. Avon, Usk, Parrett, Taff and Wye) flow into the Severn and Bristol Channel, and it is estimated that sewage and industrial inputs contribute approximately 3% and 1% of the freshwater flow, respectively (Ref. 8.62).

18.5.11 The bulk of the contaminant input to the Bristol Channel is reported from the early scientific literature (Ref. 8.63) to be from discharges upstream of the River Parrett, i.e. upstream of the proposed HPC development. In addition to point source contaminant inputs, diffuse chemical inputs to the Severn and Bristol Channel arise from runoff from agricultural land to tributaries such as the Avon, Usk and Parrett (Ref. 8.64), runoff from urban centres, and deposition from aerial emissions.

18.5.12 The Severn Estuary has historically received large loadings of contaminants from sewage and industrial inputs. Historical contaminants are highly varied in type and include metals, organo-metals, hydrocarbons, nutrients, mineral acids, solvents, biocides, fungicides, PCBs, pesticides and radionuclides.

iii. Dissolved Contaminants

18.5.13 Combined industrial and sewage inputs have historically contributed the larger proportion of the mercury, cadmium, unionised ammonia and orthophosphate, and riverine inputs accounted for most of the total inorganic nitrogen (Ref. 8.48).

18.5.14 BEEMS (2010) (Ref. 8.61) reports a decreasing concentration trend for the majority of dissolved metals measured (arsenic, cadmium, chromium, copper, iron, nickel, lead, zinc, mercury) for various sites from the Severn through to the Bristol Channel. Most metal concentrations were below EQS as defined by the Dangerous Substances Directive (Ref. 8.3). Some individual samples from inner Severn Estuary sites were reported in Langston et al (2003) (Ref. 8.63) to have occasionally exceeded the EQS levels for arsenic, cadmium, copper, nickel, lead, zinc and mercury, but in all cases average values were below the respective EQS. Data for 2005 to 2008 for an outer Severn site (Langston et al., 2007) (Ref. 8.65) indicate that dissolved cadmium and mercury concentrations are one to two orders of magnitude below their respective EQS values. Although the datasets indicate that the concentrations of some metals show a marked decrease from values reported in the 1970s, Langston et al. (2007) (Ref. 8.65) suggest that the high variability in measured dissolved concentrations of metals may be attributable to sediment remobilisation and the degree of re-suspension at the time of sampling.

iv. Summary of 2009 Marine Water Quality Monitoring Surveys

18.5.15 In the absence of adequate historic water quality information for the area adjacent to Hinkley Point, a marine water quality sampling programme was undertaken during 2009.

18.5.16 The dates of the monitoring campaigns and the tidal state are shown in **Table 18.10** below. The results of this monitoring work have been summarised and reported in Ref. 8.51. A brief summary of the monitoring programme is provided in here.

18.5.17 The programme was designed to assess the water quality characteristics of the local marine environment and specifically to define the baseline concentrations for those chemicals that may be expected within planned discharges from the EPR units. Chemical analysis of the marine water samples were compared with the marine water quality standards presented in **Table 18.5**.

Table 18.10: Sampling Dates, Tidal State and the Number of Individual Samples that were Found to Exceed the Dissolved Copper and Dissolved Mercury EQS Thresholds

Marine Water Sampling Campaign	Tidal State	Dissolved Copper *Individual* Exceedances of the Annual Average EQS	Dissolved Mercury EQS Exceedances
Campaign 1 (27 and 28 January 2009)	Spring	13	3
Campaign 2 (1 and 2 May 2009)	Neap	17	1
Campaign 3 (27 and 28 June 2009)	Spring	8	0
Campaign 4 (12 and 13 September 2009)	Neap	1	0

18.5.18 *In situ* water quality parameter profiling was also undertaken at 14 locations across the offshore sampling area, as shown on **Figure 18.2**. At each location water temperature, dissolved oxygen and salinity were measured throughout the water column.

18.5.19 Several chemicals expected to be present in the discharges during the commissioning and operational phases have no saltwater EQS or Environmentally Acceptable Level (EAL) value, so a hierarchical approach is adopted (Ref. 8.52). The EQS is used if available, followed by a background mean ambient concentration for naturally non-toxic substances, and finally a Predicted No-Effect Concentration (PNEC) for potentially toxic substances.

18.5.20 **Table 18.11** lists the parameters that have been included in the analysis of samples from the 2009 monitoring campaign for which PNEC values have been developed (see Ref. 8.52).

Table 18.11: Proposed PNEC Values for Chemical Parameters Based on Review of Ecotoxicity Studies (Ref. 8.52)

Chemical Parameter	Acute Marine PNEC	Chronic Marine PNEC
Hydrazine	0.004µg/l	0.0004µg/l
Ethanolamine	160µg/l	160µg/l
Morpholine	28µg/l	17µg/l

v. Marine Water Quality Monitoring Results

18.5.21 The key findings from the marine water quality monitoring results are:

- All chemicals, for which there are WFD EQS, had mean values below the EQS.
- Concentrations of the organic chemicals expected to be discharged from HPC were all below the laboratory's 'Minimum Reporting Values' (MRV)', but it should be noted that some of those MRVs are greater than the relevant environmental threshold values.
- The waters off Hinkley Point are characterised by high concentrations of suspended solids increasing with depth. The mean value was 264mg/l with a maximum of 1,795mg/l. These high suspended solids concentrations arise from sediment mobilisation under bed-scouring flows associated with the high tidal range (and associated tidal currents). There is a corresponding low water transparency which restricts light penetration and limits primary productivity by marine algae.
- There was a general trend of increasing total metals concentrations with depth. This is likely to result from metal adsorption on sediment particles which display a corresponding increase in concentration with water depth.
- Although the mean value of dissolved copper (3.95µg/l) was below the EQS (5µg/l annual average), it was not uncommon to find an individual sample above 5µg/l (**Table 18.10**).
- The EQS for dissolved mercury is expressed as both a Maximum Acceptable Concentration (MAC) and an Annual Average (AA). The MAC of 0.07µg/l was exceeded on a limited number of samples but the mean value for all samples (0.02µg/l) was below the Annual Average EQS threshold value of 0.05µg/l.
- Free chlorine was recorded in collected samples up to values of 0.3 mg/l. However, there are no known sources of chlorinated discharges in the vicinity of Hinkley Point (therefore these results are considered to reflect analytical interference by manganese than actual values).
- pH values were typical of seawater, with a range of 7.04 to 8.05.
- Salinity varied among the sampling campaigns reflecting the position in the spring/neap cycle and seasonally-based variations in freshwater flow. The range of salinity values recorded during the sampling campaigns was 23.5 to 33.5 with a mean of 30.4. The first *in situ* sampling campaign (January 2009) had somewhat lower salinity conditions (range of 23 to 25) compared with the later campaigns, presumably due to increased winter river flows.
- Under WFD, the assessment of dissolved inorganic nitrogen status is based on the mean winter concentration calculated from samples collected between the 1st November and the 28th February. Although only one of the four sampling visits (January 2009) fell within this period, 60 samples were taken which is sufficient for a valid assessment
- The WFD EQS for dissolved inorganic nitrogen in TRaC waters varies with salinity and turbidity. The EQS for 'Good' dissolved inorganic nitrogen status in very turbid waters is 270µM/l, expressed as the 99th percentile. The 99th percentile value for dissolved inorganic nitrogen in the January 2009 campaign was 130.1µM/l, representative of 'Good' status.

18.5.22 Analyses were undertaken to determine if there were significant spatial or tidal differences in the mean concentrations of tested parameters. Comparison of the overall mean concentrations at each site was made using an 'F-test' to determine if there was a significant difference in the variances of the two data sets. Following this initial testing, an appropriate two-tailed 't-test' (i.e. for equal or unequal variances depending upon the results of the F-test) was used to determine if there was a significant difference between the mean values for inshore and offshore sampling areas, or for neap or spring tide conditions.

18.5.23 Full details of the campaigns are reported in Ref. 8.51, but the paragraphs below report the key findings.

18.5.24 The key findings from the comparison of inshore and offshore water chemistry are:

- **General water quality parameters**: These results showed a degree of variability across the sampling area and with depth. Statistical comparison of the overall mean values across the range of parameters indicated that the only significant difference occurred for chemical oxygen demand (COD) which was higher in the inshore sampling area.
- **Metals**: There was spatial (inshore and offshore) and depth variability for the range of total and dissolved metals that were analysed. However, the only significant difference was for total lead for which higher concentrations were recorded within the inshore sampling area.
- **Organic chemicals**: No results above laboratory minimum reporting values were recorded at any of the sampling sites across all four sampling campaigns.

18.5.25 The comparison of the data for inshore and offshore water quality indicates a high degree of homogeneity when considered as a whole across all sampling sites and campaigns. Some local spatial and depth variations are evident within data collected for each campaign. The high degree of homogeneity is likely to be associated with the high tidal flow velocities creating well mixed water quality conditions in the marine waters off Hinkley Point.

18.5.26 The key findings from the comparison of water chemistry over neap and spring tide are:

- **General water quality parameters:** Seven general water quality parameters differed significantly between neap and spring tide periods. During neap tide periods higher overall mean levels of pH and concentrations of orthophosphate were recorded. On spring tides, higher mean values of nitrate, phosphate, suspended solids, BOD and COD were found. There was a significant difference in suspended solid concentrations during neap and spring tide periods with respective mean concentrations of 185 and 351mg/l.
- **Metals:** Statistical analysis of the data sets comparing overall mean concentrations from neap and spring tide periods found four total metal and two dissolved metal parameters that showed significant differences. Higher mean concentrations of total copper, iron and boron were found during neap tides (boron was only analysed in samples during sampling campaigns 3 and 4). Higher mean concentrations of total chromium, dissolved nickel and dissolved boron were recorded during spring tide periods.

- **Organic chemicals**: No results above laboratory minimum reporting values were recorded.

18.5.27 Water quality parameters exhibited greater significant variability between neap and spring tide periods than between inshore and offshore sampling areas.

vi. *In situ* Monitoring Results

18.5.28 *In situ* data from the 2009 water quality monitoring campaign indicate that dissolved oxygen levels, temperature and salinity were within the expected range for coastal waters. There was no evidence of thermal, saline or dissolved oxygen stratification, indicating a well-mixed system.

18.5.29 The WFD defines threshold values for dissolved oxygen in transitional and coastal water bodies. For marine waters the 'Good' category threshold is defined by:

Dissolved Oxygen (mg/l) = 5 – (0.028 x salinity)

18.5.30 The most precautionary EQS threshold indicative of Good status, therefore, is calculated using the lowest monitored salinity (23.5), which produces a value of 6.13mg/l. The 5^{th} percentile calculated for the entire monitoring data set was 6.40mg/l, which is in fact representative of High status.

vii.Marine Sediment Chemistry

18.5.31 The chemistry of marine sediments in the vicinity of Hinkley Point is relevant because activities associated with the HPC development, such as dredging and construction of marine infrastructure, may lead to mobilisation of sediments and any associated contaminants. The disturbance of sediments may, therefore, lead to localised affects on water quality conditions.

18.5.32 The sediments of the Severn Estuary and Bristol Channel have been the subject of past research (Refs. 8.65, 8.66 and 8.67) and these studies have been reviewed. To supplement previously published information, sediment samples were collected for chemical analysis during offshore geotechnical surveys in the vicinity of Hinkley Point undertaken in November and December 2009 (described above).

viii. Association between Metals and Suspended Particulate Matter

18.5.33 Contaminants from anthropogenic sources may become associated with particulates (in particular the fine fractions) through adsorption and complexation; dissolved metals tend to be sequestered from the water by fine grained particulate material in suspension or bed sediments. Sediment type and distribution thereby influence the distribution of particulate bound contaminants and associated water quality.

18.5.34 A variety of sea bed sediments is found in the Bristol Channel ranging from fine clays (<20 µm diameter) to pebbles (>100 mm diameter). Exposed bedrock covers extensive sections of the channel bottom, particularly across the central channel. Tidal velocity is an important factor influencing the distribution of sea bed sediment and respective grain size within the Bristol Channel and large areas of the channel are characterised by thin veneers of sand and gravel that are mobile on the bed. Reference should be made to **Volume 2**, **Chapter 17** for specific discussions regarding sediment distribution.

18.5.35 The high tidal range and strong tidal currents ensure that the bed sediment is subject to much reworking. For this reason, the spatial distribution of contaminants is often associated with the sediment distribution patterns within the Severn Estuary and Bristol Channel. A consequence is that, rather than forming distinct hotspots, contamination tends to be widely dispersed at relatively low concentrations.

18.5.36 Total metal concentrations in the water column vary with tidal conditions, higher concentrations being expected during spring tide periods through mobilisation of bed sediments and reduced settlement under higher flow velocities.

ix. Sediment Chemistry Data

18.5.37 Langston et al. (Refs. 8.64, 8.65 and 8.68) provide a thorough overview of sediment contaminant trends in the Severn Estuary and Bristol Channel. Most of the studies that these reports are based upon were undertaken during the 1970s and 1980s. More recent data to characterise contaminant status, incorporated in the Langston et al. reports (Refs. 8.64, 8.65 and 8.68) are from Environment Agency surveys undertaken in the autumn and winter of 2004 that included a sampling location in Bridgwater Bay to the east of Hinkley Point.

18.5.38 Langston et al. (Refs. 8.64, 8.65 and 8.68) reviewed historic contamination of the Severn Estuary for cadmium and zinc from industrial discharges in the Avonmouth area, to the north-east of the Hinkley Point site. This is well documented in a number of studies (e.g. Little and Smith; Ref. 8.66). Langston et al. (Refs. 8.64, 8.65 and 8.68) also quote studies reporting contamination of finer sediment fractions with lead, copper, silver and mercury. Although the majority of metal contamination is associated with clay particle fractions, aluminium (not necessarily of anthropogenic origin) is associated with coarser sand fractions (Ref. 8.66).

18.5.39 Results from Environment Agency surveys undertaken in 2004 indicated correlations between total metal concentrations and total suspended solids concentrations for copper, iron, mercury, lead, zinc, chromium and nickel. For dissolved metals the relationship with suspended sediments is less clear although elevated concentrations of dissolved cadmium and iron in the lower water column of Bridgwater Bay have been reported and associated with re-suspension of particulates (Ref. 8.67). Similar effects were implied by the results of the Environment Agency assessment in 2004 for dissolved iron, zinc and chromium.

x. Sediment Chemical Analytical Results and Interpretation – Metals

18.5.40 As set out above, to supplement existing knowledge, sampling of the marine sediments at 22 locations in the vicinity of the proposed temporary jetty was undertaken during November and December 2009 (Ref. 8.69). Recovered core samples were subject to chemical analysis for a wide range of determinands, to provide the necessary information available for the grant of the necessary licences for dredging activities under the marine licensing regime. Due to the highly dynamic conditions, and extensive tidal movement of sediments, in the Bristol Channel, results from these samples are considered representative of sediments in the wider Hinkley Point area.

18.5.41 A summary of the sediment contamination data compared to the relevant threshold values (see **Table 18.6** and **Table 18.7**) is provided below. Further analysis of these data, with regard to metals entering the dissolved phase and comparison with marine water EQS values, is provided in Section 18.6.

Results of Sediment Chemistry Analysis

18.5.42 A number of samples were extracted from each individual core to get a representative measurement and identify contaminant 'hot-spots' within each core. However, it is most appropriate to review the average concentration for each core against relevant benchmarks, because any sediment plume caused as a result of offshore works (piling, dredging, etc.) would consist of disturbed sediment from all depths.

18.5.43 Comparison of data with Cefas action levels and Canadian ISQGs found elevated metal concentrations to be widespread, but very few of the metal concentrations recorded could be considered highly contaminated. None of the average concentrations for any of the sediment cores was found to exceed either the CEFAS Action Level 2 or the Canadian PEL. When analysis of individual spot samples (rather than core averages) is considered, four individual samples were found to be above the Canadian PEL. **Table 18.12** summarises data from each core.

Table 18.12: Number of Sediment Guideline Value Exceedences Found (x/y = x out of y Average Core Concentrations > the Relevant Standard)

Metal	Cr	Ni	Cu	Zn	As	Cd	Pb	Hg
CEFAS Action Level 1	6/15	13/15	0/15	6/15	1/15	2/15	5/15	1/15
CEFAS Action Level 2	0	0	0	0	0	0	0	0
Canadian TEL	1/15	n/a	8/15	8/15	15/15	0/15	13/15	8/15
Canadian PEL	0	n/a	0	0	0	0	0	0

18.5.44 Concentrations of nickel were found to be above the CEFAS Action Level 1 in 13 of the 15 cores (average concentration data). The concentrations of nickel are relatively consistent across all samples and are likely to be the result of historical contamination. The mean nickel concentration was 32mg/kg, with a standard deviation of 10.9mg/kg.

18.5.45 For arsenic, all average core concentrations exceeded the Canadian TEL threshold, but use of the Cefas Action Level 1 threshold shows only one core (VCJ18) with an exceedence (and 10 individual exceedences out of a total of 57 samples). This result demonstrates the more precautionary nature of the Canadian threshold.

18.5.46 Some individual core samples had chromium concentrations above CEFAS Action Level 1 and the Canadian TEL, but the mean values were below both levels.

18.5.47 All other samples were below CEFAS and Canadian thresholds.

18.5.48 Seven of the locations (VCJ10, VCJ17, VCJ18, VJC21, VC33, VCJ6 and VCJ7) had generally decreasing contamination with depth. At these locations, highest contaminant concentrations were found within the top metre of sediment.

18.5.49 As the upper portion of the sediment is known to be highly mobile and constantly reworked, surficial sediments disturbed by dredging (for example) would have metal concentrations that are no different to those mobilised on an almost continual basis within the Bristol Channel due to tidal currents. Deeper material, disturbed during construction, is likely to have lower metal concentrations (Ref. 8.69).

xi. Sediment Chemical Analytical Results and Interpretation – Organic Contaminants

Polycyclic Aromatic Hydrocarbons (PAHs)

18.5.50 PAHs occur throughout the environment and may be derived from natural sources (e.g. coal) but are usually associated with anthropogenic activity. PAHs are usually associated with sediments because of their affinity for particulates (particularly higher molecular weight PAHs). Lower molecular weight PAHs are toxic to marine organisms and the metabolites of higher weight PAHs sometimes exhibit carcinogenic properties. Langston et al. (Ref. 8.64) found PAH concentrations in the Severn Estuary often exceeded ISQG TEL and occasionally PEL. The primary source for PAHs in the Severn Estuary is considered to be anthropogenic (Refs. 8.64, 8.65 and 8.68), and their source offshore of Hinkley Point is thought to be coal dust (Ref. 8.70).

18.5.51 Elevated concentrations relative to the CEFAS Action Level 1 of all selected PAHs were found in the surface sediments but no elevated concentrations were found below approximately one metre.

18.5.52 PAH concentrations in some surface sediments exceeded the more precautionary Canadian threshold for both the TEL and the PEL. PAH concentrations did not exceed either of the Canadian thresholds in samples taken from below approximately one metre.

Organotins

18.5.53 Organotin substances, such as tributyltin (TBT) and dibutyltin (DBT) are endocrine disruptors, and at higher concentrations act as immunosuppressants. They are highly toxic and, even at low concentrations, may cause mortality of marine planktonic larvae. Until recent years, organotins were extensively used as antifouling coatings on ships and are still found in a variety of other industrial applications. From the literature (Refs. 8.64, 8.65 and 8.68), analyses of sediments in dredge disposal sites around the Severn Estuary suggest that there may be localised reservoirs of elevated TBT concentrations near major ports such as Newport and Cardiff.

18.5.54 All results from offshore Hinkley Point showed organotin concentrations below CEFAS Action Level 1 and were, therefore, not investigated further.

Polychlorinated Biphenyls (PCBs)

18.5.55 PCBs have low water solubility and a high affinity for suspended solids, particularly those with high organic carbon content. PCBs are one of the most persistent environmental contaminants and, due to their high solubility in fats, can bioaccumulate. In marine organisms, PCBs generally lead to chronic (rather than acute) effects on the endocrine system and suppression of the immune system. Royal Haskoning (2008) (Ref. 8.71) report that PCB concentrations in the Severn Estuary are amongst the highest in the UK, and that PCBs are homogenously distributed throughout the estuary with levels only slightly above the TEL.

18.5.56 For some years, most routine PCB analysis has concentrated on a representative subset of 7 PCB congeners (PCB congeners 28, 52, 101, 118, 138, 153 and 180) as recommended by the International Council for the Exploration of the Sea (ICES) (Ref. Ref. 8.72). A CEFAS action level exists for the sum of 'ICES 7' and also the sum of a larger subset of 25 congeners (including the ICES 7).

18.5.57 At no location did the average PCB level in cores exceed the CEFAS 25 threshold; but 6 cores did exceed the CEFAS Action Level 1 threshold for the ICES 7 congeners. Analysis of individual spot sediment samples found several in excess of the CEFAS Action Level 1, all of which were from the top metre of each core.

18.5.58 A single spot sample (1 of 57) was found to have a PCB concentration in excess of the CEFAS Action Level 2, this being sampling location VCJ9. However, as this same sample (VCJ9-1.0m) also showed relatively high metals, total hydrocarbons and PAH concentrations, it appears to be an isolated pocket of relatively high contamination and atypical of sediment in the area.

Organochlorine Pesticides (OCP)

18.5.59 OCPs have similar properties to PCBs in that they are very persistent in the environment and can bioaccumulate. Many are toxic and some are endocrine disrupters. Dichlorodiphenyltrichloroethane (DDT), and its degradation products / metabolites, has been analysed in this study as representative of OCPs.

18.5.60 Generally, concentrations were found to be low in all samples. Three individual spot sediment samples were found to be above the Cefas Action Level 1 and the Canadian ISQG TEL for DDT. Average concentrations across the same cores are below the guideline value. No individual spot samples exceeded the Canadian PEL threshold.

xii.Thermal Plume from HPB

18.5.61 As set out in Section 18.4 above, in order to establish baseline conditions for the existing plume from HPB (and validate the numerical models), GETM runs A and B represent HPB operating at 70% and 100% (**Table 18.8**). The reasons for running variations on the HPB operating scenario relate to a reduction in HPB operating output during the modelling verification and calibration stage. It should be noted that it is not envisaged that operation of HPB at 70% reflects long term operating conditions at HPB. Modelling the operation of HPB at 70% and 100%, however, does provide the ability to assess a range of conditions under which the station could operate both now and in the future (i.e. it reflects the range of current baseline conditions). The calculated areas of the thermal plumes for HPB running at 70% and 100% are presented in (**Table 18.13**).

Table 18.13: Area of Plume (hectares) Exceeding 23°C (98%-ile) and 3°C (uplift) WFD Good Status Thresholds (Ref. 8.73)

Model Run	23°C (98%-ile)		3°C (Uplift)	
	At Bed	At Surface	At Bed	At Surface
Run A (GETM) HPB at 70%	0.4	4.1	0.03	0.8
Run B (GETM) HPB at 100%	106	197	41	86

xiii. Thermally-related Reductions in Dissolved Oxygen in HPB plume

18.5.62 DO concentrations in the baseline HPB plume were also modelled using GETM. The outputs are presented in (**Table 18.14**). These modelled data supplement the *in situ* monitoring data described earlier in this section. As can be seen, for HPB operating at 100% DO is representative of Good Status (the difference between these modelled data and the *in situ* data being that modelled data are only for the thermal plume, whereas the *in situ* data were collected from the wider study area; see Section 18.4 and **Figure 18.2**).

Table 18.14: Mixing Zones (hectares) for Thermally Induced Reductions in Dissolved Oxygen for 'High' Status (Threshold = 6.2mg/l) and 'Good' Status (threshold = 4.4mg/l).

Model run	Bed		Surface	
	High	Good	High	Good
Run B (GETM) HPB at 100%	546	0.0	631	0.0

xiv. Baseline Water Quality Sensitivity

18.5.63 With respect to marine water and sediment quality, the relevant receptor is water quality status. Three high level pressures that could affect water quality have been identified: alterations to suspended sediment concentrations, chemical discharges and the thermal discharge at Hinkley Point.

18.5.64 As described above, the marine waters off Hinkley Point are characterised by powerful and wide-ranging tidal flows that cause mixing and dissipation of inputs and mobilise sediments, resulting in high suspended solid concentrations. These physical characteristics mean that the receptor (marine water quality) has different sensitivities to different pressures.

18.5.65 In terms of the main pressures identified, the sensitivities of the water body are as follows:

- Due to the very high concentrations of suspended sediment already in the system, the receptor has a low sensitivity to changes in its suspended sediment load. Therefore, the receptor is assigned low sensitivity to changes in suspended sediment concentration.
- Due to the very high tidal movements that characterise the study area, the chemical substances entering the system are, generally, rapidly mixed and disperse quickly. This would suggest that sensitivity to chemical change would be low. However, chemical discharges may occur over a sustained time period, and

some chemicals are more persistent than others so, on a precautionary basis, the receptor has been assigned a medium sensitivity to changes in chemical quality.

- Although the system is well mixed (see above), the natural temperature is already naturally high (98%-ile is only 2.6°C below the thermal threshold for 'Good' status), and so the receptor is assigned a medium sensitivity rating for thermal change.

18.5.66 The receptor and sensitivities assessed within this chapter are summarised in **Table 18.15**.

Table 18.15: Marine Water Quality Status and its Sensitivities

Receptor	Pressure	Sensitivity
Marine water quality status	Change in suspended sediment load	Low
	Change in chemical status	Medium
	Change in temperature	Medium

18.6 Assessment of Impacts

a) Introduction

18.6.1 In this section, potential impacts on the marine water quality receptor associated with all phases of the proposed HPC development are assessed against the baseline described above (including the effect of mobilisation of sediment-bound contaminants). The assessment of impact magnitude, where relevant, takes into account design measures developed to reduce the potential for impacts to occur.

18.6.2 The key elements of HPC's construction phase for which environmental effects are assessed include:

- construction of the construction outfall;
- surface water, sewage effluent and groundwater discharges from the foreshore outfall structure;
- construction of the temporary jetty and temporary aggregates storage area;
- construction of the sea wall and drainage system;
- discharges from the sea wall drainage system;
- discharge of effluent during construction of the cooling water tunnel infrastructure and Fish Recovery and Return (FRR) system;
- disturbance to sediments during dredging for offshore infrastructure;
- disturbance to sediments during vertical drilling of offshore infrastructure;
- discharge of drilling waste;
- disturbance of sediments during the capital dredge of the berthing pocket at the temporary jetty;
- disturbance of sediments due to operation of the temporary jetty (including vessel movements and maintenance dredging); and
- dismantling of the temporary jetty.

18.6.3 Dredging is a common feature of many of the marine work aspects of the HPC Project mentioned above, and a common approach would be applied to the disposal of all dredged material. If the relevant Marine Licence criteria are met, it is proposed that any dredged material from the construction process (including from creation of the berthing pocket for the temporary jetty and installation of the cooling water infrastructure) would be disposed of locally within the sediment transport system that exists at Hinkley Point. If the criteria are not met, the dredged material would be removed for disposal at a licensed site (e.g. Cardiff Grounds). A licence for disposal of dredged material will be sought from the appropriate authorising body.

18.6.4 The key elements of HPC's commissioning and operational phase for which environmental effects are assessed include:

- discharges associated with cold and hot flush commissioning tests;
- discharges to the foreshore from the seawall drainage system;
- discharges associated with the operation of the cooling water system (including operational and domestic, e.g. sewage, discharges);
- disturbance of sediments due to scouring around the cooling water infrastructure; and
- disturbance of seabed sediments from maintenance dredging around the intake structures.

18.6.5 For all phases, the potential exists for the risk of accidents and incidents to occur which, if unmanaged, could have an adverse impact on water quality. The probability of occurrence can be reduced through the use of good engineering design and site specific monitoring and management. Furthermore, the magnitude of any impact would be managed through the implementation of the **Pollution Incident, Control Plan (PICP)** (**Annex3; Appendix 8**). In general, potential environmental impacts arising from the HPC development would be managed through a range of control measures and monitoring procedures (to be outlined in the main **Environmental Management and Monitoring Plan** (**EMMP; Annex 3**)).

b) Mitigation by Design

18.6.6 As mentioned in Section 18.4, a number of aspects of the HPC Project have been designed in such a manner that environmental impacts are reduced without the need for additional mitigation. Mitigation that is an integral part of the design, and its resulting reduction in environmental impacts is included in this section, as opposed to being considered separately.

18.6.7 The main aspects of the design that are relevant to reducing impacts on marine water quality are described in **Table 18.16** below.

Table 18.16: Features Built into the Design of the HPC Project to Mitigate Potential Environmental Impacts

Design Feature	Mitigating Benefit
Single construction outfall	Use of a single outfall for construction and commissioning discharges made to the foreshore means that only one area of the foreshore would be impacted by those discharges. Multiple outfalls, although preferable to enable discharges to be made closer to works activities, would lead to several locations along the foreshore being potentially affected. Potential environmental impacts, in terms of ecological receptors, were reduced further by using hydraulic modelling to identify the location that would least affect the intertidal ecology (see **Volume 2**, **Appendix 19A**).
Percolating design of sea wall for groundwater	The sea wall is designed to allow groundwater to percolate through and drain more naturally to the foreshore. The design essentially mimics the normal drainage pattern that presently occurs from the existing cliff face. The percolating drainage is achieved by having drainage holes placed routinely along the entire length of the sea wall.
Temporary sewage treatment plant with tertiary treatment	During the construction phase, a temporary sewage treatment plant would be used for construction staff. It is proposed that the treatment plant would have a tertiary level treatment (ultra-violet treatment) to ensure that the resulting effluent is suitable for discharge across the foreshore. Target criteria for discharge parameters (agreed with the Environment Agency) are: • Biological Oxygen Demand (BOD) ≤ 20mg/l; • Suspended solids ≤ 30mg/l • Ammonia (total) ≤ 5mg/l (to meet unionised EQS of ≤ 21µg/l).
Facility for treatment of tunnelling discharges	In the unlikely event that mud-assisted drilling is required when boring the horizontal cooling water tunnels, a treatment facility would be used to recover the bentonite, reduce (if necessary) suspended sediment concentrations and balance the pH. The treatment would ensure that the resulting liquid is suitable for discharge across the foreshore.
Facility for treatment of commissioning discharges	During the commissioning phase, a number of substances would need to be discharged during the flushing periods of the cold and hot functional tests. Before the main cooling water system is operational, discharges from cold functional tests would need to be discharged across the foreshore. To ensure that water quality is not affected by these discharges, a treatment facility would be built to treat the discharges such that when they are discharged they are compliant with their respective EQS.
Offshore locations for cooling water outfall structures	Numerical modelling was used to assess the effect of location of the cooling water intakes and outfalls on the behaviour and scale of the cooling water discharge. The reason for doing this modelling was two-fold: (1) from an operational perspective it was critical to identify the best locations to reduce re-circulation of the warm discharged cooling water back into the intakes, and (2) to ensure that, as much as possible, the cooling water plume does not impact on intertidal or nearshore subtidal ecological receptors. By placing the intakes and outfalls approximately 3km and 2km offshore, respectively, the cooling water plume is modelled to fulfil these objectives.
Risk-based chlorination strategy with intermittent dosing	It is considered extremely unlikely that chlorination would ever be required at HPC because operational experience indicates there is only a very low risk of biofouling. However, should biofouling occur a site-specific, risk-based and intermittent chlorine dosing strategy would be used. This would ensure that only the minimum levels of chlorination required to ensure safe operation of HPC would be used, thus minimising the impacts of chlorination on water quality.

Design Feature	Mitigating Benefit
Facility for treatment of hydrazine	Hydrazine is an oxygen-scavenging chemical that is used as a condition agent within the cooling water circuit. It is very toxic, however, it is also very unstable and rapidly breaks down into ammonia. The HPC EPR design has a treatment facility built in to the nuclear island such that hydrazine discharges are as low as practicable. EDF Energy is also examining ways to improve treatment further by treating hydrazine within the conventional island.
Attenuation pond (HXO facility)	All collected surface water will be discharged via an attenuation pond (or HXO building). This facility provides settlement facilities for suspended sediment and oil separators. The attenuation pond also provides a storage facility for retention of more contaminated discharges resulting from spillages or major leaks. Material held in the retention tank can either be treated (if feasible) or removed to a container for removal off-site.
Water Management Zones (WMZs)	WMZs are designated areas for managing the quality of discharges to the receiving water and minimising potential impacts on water quality. WMZs would ensure that sufficient surface water storage capacity is provided to control discharge rates and provide the opportunity for treatment prior to discharge, for example oil separation and pH adjustment. Attenuation also encourages the settlement of suspended sediment and would provide the opportunity for isolation of accidental spills or pollution during the construction phase; offering a further level of protection to the intertidal area. It has been agreed with the Environment Agency that discharges from WMZ would meet the following criteria: • suspended solids: 250mg/l; • pH: 6 to 8.5; and • no visible oils.
Sustainable Drainage Systems (SuDS)	SuDS, such as soakaway systems, are a common mitigating feature designed in to site drainage to reduce potential impacts of run-off on water quality in the receiving water.

18.6.8 In addition to the designed-in mitigation features, a number of management techniques to reduce environmental impacts are also an integral part of the construction process, including subject specific annexes of the EMMP including: the **Water Management Plan (WMP)** (**Annex 3**; **Appendix 3**) and the **PICP** (**Annex3**; **Appendix 8**) .

c) Potential Impacts during Construction

18.6.9 Initial works to the site would involve large scale changes to topography and surface drainage patterns through the removal of vegetation, excavation and reworking of soils and stockpiles, construction of haul routes and the development of construction platforms. The two key activities that may impact on marine water quality are: the large-scale earthworks to create development and construction platforms and the development of a surface water drainage system. Potential risks to water quality therefore include an increase in suspended sediment and any soil contamination present within the earthwork area. Residues of hydrocarbons are often present in surface water drainage on construction sites and result from wash-off from plant during movements and operations. Elevated pH may also be a feature as a result of leachate from concrete and washwater used for concrete manufacturing equipment. Discharge of concrete washwater is only anticipated during the construction phase until the concrete batching plant becomes operational. However, elevated suspended solids, hydrocarbons and elevated pH associated with concrete use may have an adverse impact on water quality.

18.6.10 Any surface water created by alteration to the existing landscape could potentially impact on existing surface watercourses. In terms of impacts on marine water quality, the HPC drainage ditch which drains the northern end of the development site (Built Development Area West (BDAW) and Built Development Area East (BDAE)) is the most relevant, as it discharges directly to the foreshore. Impacts on surface water discharges to freshwater receptors are considered in **Volume 2**, **Chapter 16.**

18.6.11 It is proposed that, initially, the surface water in the northern area of the site (BDAW and BDAE), including the aggregates storage area associated with the jetty development, would be collected and directed to a water management zone (WMZ) and then discharged to the existing HPC drainage ditch and across the foreshore. Subsequently, the existing drainage ditches would be backfilled and three spine drains would be installed. These spine drains would eventually combine to a single discharge point to the foreshore close to the graving dock and the existing outfall of the HPC drainage ditch (see **Figure 18.4**).

18.6.12 The location of a single discharge point has been chosen, following numerical hydraulic modelling, to cause the least impact on the existing ecology of the foreshore (see **Appendix 19A**, **Volume 2**). Additional WMZs would be developed to manage discharges into the spine drains. In addition to surface water, it is proposed that this discharge would comprise pumped ground water from the excavation works for the nuclear islands, and waste water from the tunnel boring operations.

18.6.13 The WMP (**Annex 3**; **Appendix 3**) would implement techniques to reduce sediment run-off, such as containment and location of stockpiles away from the foreshore area. Barriers to reduce sediment run off from newly excavated areas would also be considered, in addition to sediment removal techniques, should concentrations be significantly elevated. The movement of heavy vehicles around the site would be closely managed and plant access would be restricted to pre-defined corridors where access across soft sediments is required. For further details of the proposed control measures, see **Chapter 16**, **Volume 2**.

18.6.14 **Chapter 14**, **Volume 2** presents information regarding the potential for contamination within the soils of the development area. Information collated to date indicates no soil contamination, with the exception of a small isolated area in the east of the site.

IMPACT: Generation of Sediment and Discharged Waters Associated with Construction of the Construction Outfall

18.6.15 Activities associated with the construction of the construction outfall, specifically the use of concrete (and dewatering), have the potential to impact on water quality status because concrete discharges can cause sharp increases in pH. In addition, residues of hydrocarbons may be expected in surface drainage water from the working area due to wash-off of lubricants from construction plant. These pollutants may potentially impact upon the water quality status of the standing-water pools across the intertidal area under low tide conditions, although given the likely small scale of these discharges, they are not expected to have any discernible impact upon the water quality status of the wider marine environment. The location of the single discharge point has been chosen, following numerical hydraulic modelling, to cause the least impact on the existing ecology of the foreshore (**Appendix 19A**, **Volume 2**). Potential impacts would be temporary and direct.

18.6.16 Good working practices and pollution prevention techniques would be implemented during the construction of the foreshore outfall infrastructure (enforced as part of a site specific WMP (**Annex 3**; **Appendix 3**). Based on the small footprint of the proposed works, the proposed drainage management and the characteristics of the intertidal area, the potential magnitude of this effect is predicted to be very low (see **Table 18.4**). Marine water quality status has been assessed to have a low sensitivity to changes in suspended sediment concentration and medium sensitivity to changes in chemical quality (see **Table 18.15**). The impact significance for generation of sediment is thus assessed to be **negligible**, and for contaminated discharge waters is assessed to be **minor adverse**.

IMPACT: Surface Drainage Discharges to the Foreshore

18.6.17 All surface waters would be directed to the surface water drainage system. Where necessary, suspended sediment concentration would be reduced, hydrocarbons would be removed and pH would be adjusted, prior to controlled discharge to the foreshore. Design measures that are incorporated into the surface water drainage system that would minimise sediment generation, as described above, include:

18.6.18 As a result of these measures, impacts from the foreshore discharge are predicted to be of a low magnitude (see **Table 18.4**). In terms of contamination of surface drainage arising from soil excavation, the impact magnitude is predicted to be very low, based on results of the contaminated land surveys. Potential adverse impacts upon water quality status would be local and temporary in nature. The sensitivity of the marine water quality status is considered to be low for changes in suspended sediment concentration and medium for changes in chemical quality (as presented in **Table 18.15**).

18.6.19 Taking the above into account, all potential impacts associated with surface drainage discharges to the foreshore are assessed to be of **minor adverse** significance for the marine water quality receptor.

IMPACT: Discharge of Sewage Effluent to the Foreshore

18.6.20 Until the temporary discharge outfall to the old graving dock area is operational, treated sewage effluent would be collected in a sealed storage tank for off-site disposal.

18.6.21 Currently, it is proposed that there would be three package sewage treatment plants located close to the main spine drain C to the west of the site. The package treatment plants would be installed during the site preparation phase and would become operational during the main site construction phase. If the level of treatment is sufficient to meet any discharge consent, the treated effluent from these plants would discharge directly into the western spine drain and ultimately would discharge via the foreshore discharge location, otherwise it would discharge into a WMZ first. These plants would only collect and treat sewage and, therefore, their discharges would not vary according to weather conditions. Storm overflows at these plants would not be required.

18.6.22 The discharges of sanitary waste effluent may potentially have an adverse impact on intertidal marine water quality status. It is proposed that the effluent would be treated to tertiary level before discharge to reduce both microbiological and chemical parameters associated with sanitary waste (i.e. suspended solids, ammonia and BOD). Parameters agreed with the Environment Agency are: Biological Oxygen Demand (BOD) ≤ 20mg/l; suspended solids ≤ 30mg/l and ammonia (total) ≤ 5mg/l (to meet unionised EQS of ≤ 21µg/l).

18.6.23 The receptor for the discharges of treated sanitary effluent would be the marine water quality which is assigned a medium sensitivity for chemical quality (see **Table 18.15**). Design measures, including tertiary treatment, are incorporated into sanitary waste treatment to minimise the impact on marine water quality status. These measures would ensure that the impacts from the discharge of sewage effluent across the foreshore would have a very low magnitude (see **Table 18.4**). Potential adverse impacts upon water quality status would be local, temporary and direct in nature.

18.6.24 Taking into account the design measures of the treatment system, all potential impacts associated with treated effluent discharges to the foreshore are assessed to be of **minor adverse** significance for the water quality receptor through all stages of the tidal cycle.

IMPACT: Pumped Discharge from Dewatering of Groundwater

18.6.25 It is anticipated that groundwater de-watering would be required throughout the construction process. Modelling indicates a steady state discharge rate to the foreshore of 12 l/s, to be made via the surface drainage system (see **Volume 2**, **Chapter 15** and **Chapter 16**). During the initial stages of dewatering, discharge rates are expected to be higher (up to 140 l/s).

18.6.26 Discharges of contaminated groundwater from the foreshore outfall may have an adverse impact on intertidal water quality status. The worst case scenario would arise when this discharge occurs at low tide, when the intertidal area is exposed and there is no immediate dilution available to offset potential impacts on marine ecology. At low tide, this effect would be local to the intertidal area down-shore of the discharge location and short-term, because the discharge would be diluted and flushed during the next flood tide. The sensitivity of marine water quality status to changes in chemical quality is medium (see **Table 18.15**).

18.6.27 Groundwater chemical quality is discussed in **Volume 2**, **Chapters 15** and **16**. Pumped groundwater would be subject to monitoring prior to discharge and to stringent controls. Where necessary, contaminated groundwater would either undergo pre-treatment prior to discharge or be disposed of off-site. Given these design measures, the impact magnitude associated with groundwater dewatering discharges is predicted to be very low.

18.6.28 Thus the impact of groundwater discharges on marine water quality status is assessed to be **minor adverse**.

IMPACT: Surface Water Discharges Direct to Marine Waters resulting from Construction of the Jetty

18.6.29 The proposed access road to the foreshore would not have a surface water collection system and, therefore, any run-off would be directly to the Hinkley intertidal area without the benefit of pre-discharge treatment within a WMZ. Surface drainage from this access road may have elevated levels of suspended solids and residual hydrocarbons from construction plant movements. Suspended solids and hydrocarbons may potentially impact upon the water quality status of the receiving intertidal area. The potential impact associated with this would be local and temporary.

18.6.30 The marine water quality status in the area around Hinkley Point has been assigned a low sensitivity to changes in suspended sediment concentration and a medium sensitivity to changes in chemical quality (see **Table 18.15**). The magnitude of this impact is expected to be very low (see **Table 18.4**) given that the road would be constructed from roadstone, incorporating lateral soak away drainage that would reduce the volume of surface run-off reaching the intertidal area. Vehicle movements would also be limited and, therefore, it is not anticipated that significant levels of suspended solids and hydrocarbon contaminants would be present within the surface drainage.

18.6.31 Given the very low magnitude of the potential impact and the low sensitivity of the water quality status of the intertidal area to changes in suspended sediment, the significance of this potential impact is assessed as **negligible**. With respect to the potential change in chemical status a **minor adverse** impact is predicted.

IMPACT: Generation of Sediment and Discharged Waters during Construction of the Sea Wall

18.6.32 Excavation of the existing cliff face and foreshore during construction of the sea wall could lead to the generation of relatively large quantities of sediment, and consequently drainage from the working area could have high concentrations of suspended solids. The sensitivity of the marine water quality receptor to potential impacts has been assessed as low for changes in suspended sediment and as medium for changes in chemical quality (see **Table 18.15**)

18.6.33 However, given the location of the sea wall on the uppermost part of the shoreline (i.e. above MHWS level), the potential for any significant effect on water quality in the nearshore intertidal zone is low. Under high tide conditions, it is anticipated that any discharges from the construction area, even if containing relatively high suspended sediment concentrations, would be rapidly dispersed and it is likely that background conditions would be restored close to the points of discharge. Under low tide conditions, discharges across the intertidal area would infiltrate the existing permeable substrates and any fine sediment would settle into the upper beach fabric or be deposited in existing intertidal mudflat habitats.

18.6.34 If monitoring demonstrates that the water being discharged meets relevant quality criteria it would be discharged directly to the foreshore during high tide periods, when it would be subject to immediate dilution. Otherwise, it would be pumped to a shore based WMZ for treatment prior to discharge (under an environmental permit) via the construction outfall. Based on these design approaches for management of the drainage, and the baseline characteristics of the intertidal area, the impact magnitude has been assessed as very low (see **Table 18.4**).

18.6.35 Taking into account the described design measures, potential impacts associated with surface drainage discharges to the foreshore from construction of the sea wall are assessed to be of **negligible** significance in terms of suspended sediment and **minor adverse** in terms of chemical quality for the marine water quality receptor.

IMPACT: Sediment Disturbance and Mobilisation of Contaminants Resulting from Offshore Construction Works, Including Dredging

18.6.36 The design and construction details for the offshore infrastructure (cooling water intake and outfall structures and temporary jetty) are presented in **Volume 1**, **Chapters 2** and **3**.

18.6.37 Many of the predicted impacts relating to construction of the offshore infrastructure relate to increased suspended sediment or the potential for the release of sediment-bound contaminants. This could potentially result from:

- capital dredging of the jetty berthing pocket;
- disturbance as a result of piling (in the case of the jetty construction); and
- dredging of offshore areas in advance of intake and outfall head installations.

18.6.38 Dredging activities have the potential to increase sediment concentrations through sea bed disturbance, and have been subject to site-specific assessment in order to determine whether sediment-bound contaminants could be mobilised and impact marine water quality status.

18.6.39 Due to the relatively small areas to be dredged (in relation to the scale of the Bristol Channel), and the high concentrations of naturally occurring suspended solids in the area, modelling of potential impacts from suspended sediment plumes was not considered to be necessary. Additionally, any sediment suspended within the water column would be quickly dispersed into existing sediment transport processes.

18.6.40 In order to assess the potential for contamination of the water column from sediment disturbance, a detailed desk based assessment was undertaken using the information provided by the 2009 sediment quality survey. In summary the method:

- estimated the maximum increase in suspended solids concentration as a result of dredging activities;
- multiplied the maximum contaminant concentration recorded in sediment cores with the estimated concentration increase to give a concentration of pollutant released into the water column;
- used partition coefficients to estimate the concentration of pollutant that is likely to enter the dissolved phase; and
- compared estimated maximum values of dissolved contaminant with marine water EQSs.

18.6.41 Multiple depth chemical data collected during the 2009 offshore borehole sampling campaign were analysed for 14 sets of data from vibrocores taken at locations around the temporary jetty and the offshore and intake locations. **Table 18.17** presents the calculated maximum concentrations of metals entering the water column from disturbed sediment, and compares the resulting dissolved contaminant concentrations with marine water EQS. The calculations presented are based upon a worst-case scenario (i.e. although the calculation has been made, it is not realistic that all the sediment disturbed in one episode would be contaminated to the maximum concentration value).

18.6.42 The baseline mean water quality contaminant concentration values are taken from the 2009 marine monitoring campaign data (Ref. 8.51).

Table 18.17: Estimated Maximum Concentrations of Metals Entering the Water Column and the Dissolved Phase from Disturbance as a Result of Marine Sediment Dredging

Determinand	Max overall conc. (mg.kg^{-1})[1]	Total conc. in suspen. (mg.l^{-1})[2]	Total conc. in susp. (µg.l^{-1})	Partition Coeff. [3]	Conc. entering diss. phase (µg.l^{-1})	Backgnd mean conc (µg.l^{-1})[4]	Total diss conc (µg.l^{-1})[5]	WFD Marine EQS
Arsenic	30	0.015	15	10000	1.50E-03	2.3	2.3015	25 AD
Cadmium	1.5	0.00075	0.75	130000	5.77E-06	<0.01	<0.01	0.2AD
Chromium	67	0.0335	33.5	191000	1.75E-04	0.02	0.0202	0.6 AD*
Copper	51	0.0255	25.5	61000	4.18E-04	3.95	3.9504	5 AD
Lead	141	0.0705	70.5	882000	7.99E-05	0.02	0.02	N/A
Mercury	0.67	0.000335	0.335	100000	3.35E-06	0.02	0.02	0.07 AD
Nickel	59	0.0295	29.5	80000	3.69E-04	0.19	0.1904	20 AD
Zinc	307	0.1535	153.5	4860	3.16E-02	39.27	39.302	40 AD

Notes:

*A = Average; D = Dissolved; * = chromium VI;*

1 *Maximum individual metal concentration taken from Cefas testing results of sea bed sediment cores undertaken by Fugro Seacore Ltd in Nov and Dec 2009 – see Fugro (2010) (Ref. 8.69);*

2 *Assumes maximum increase in suspended solids concentration resulting from dredging to be 500mg/l (Ref. 8.74);*

3 *Partition coefficients taken from ABPmer (2010) (Ref. 8.75);*

4 *Mean values taken from 2009 sampling (Ref. 8.51);*

5 *Additional dissolved concentration + Background concentration.*

18.6.43 After the application of partition coefficients, the predicted concentrations of metal contaminants entering the dissolved phase are several orders of magnitude below the EQS set by the WFD and Dangerous Substances Directive.

18.6.44 The sensitivity of marine water quality to increases in suspended solids is considered to be low given the already high background concentrations (**Table 18.15**). The sensitivity of the local marine water quality conditions to increases in contaminant mobilisation associated with sediment disturbance is also considered to be low, given that contaminants tend to be present in the upper sediment layers which are subject to regular mobilisation under tidal flows. Potential impacts arising from disturbance of the marine sediments by these construction activities would be temporary in nature and localised.

18.6.45 Where practical, the construction techniques used for pile installation and offshore dredging would adopt techniques that cause minimal disturbance of marine sediment deposits. Given these construction approaches, the magnitude of any impacts is assessed as very low (see **Table 18.4**) for piling works and low for capital dredging activities.

18.6.46 The adoption of best practice construction techniques, the ability of the environment to accommodate such changes (maximum contaminant mobilisation scenario does not affect marine water EQS) and the temporary nature of the dredging, means that the associated significance of sediment disturbance would be **minor adverse** for capital dredging and **negligible** for piling on the marine water quality receptor.

IMPACT: Drilling of the Offshore Vertical Shafts for the Cooling Water System and Installation of Headworks

18.6.47 Six vertical shafts would be drilled using wet drill techniques in the offshore zone. Four of these would be excavated with an aperture diameter of 5m to a depth of 30m below seabed, approximately 3.3km offshore, and would be associated with the two horizontal intake tunnels. The two other vertical shafts, associated with the outfall tunnel, would be excavated to 20m below seabed, with an aperture diameter of 8.3m.

18.6.48 Wet drilling would be undertaken from a rig platform fixed to the seabed with piles and anchors. Arisings from the operation would either be discharged at sea within the study area (if doing so would not impact on the local ecology) or collected and separated for disposal at licensed marine disposal grounds (Cardiff Grounds). Whether deposited locally or at licensed grounds, a licence for disposal of material at sea would be sought from the appropriate authorising body (either the MMO if material is dispersed locally, or the Welsh Assembly if the material is removed to the Cardiff Grounds).

18.6.49 For disposal at licensed grounds, the arisings would be contained and transported from the working face below to the platform itself, where the solids and water would be separated. The processed water would then be discharged back into the Bristol Channel, and solids would be transported away by barge for disposal. At the water discharge point, some suspended sediment would be released into the water column. However, the concentration of sediment in the discharge water would be constrained to a level comparable to that found in suspension locally.

18.6.50 The presence of the rig platforms would locally alter the hydrodynamics due to change in flows around the piles and anchors. However, given the negligible size of the structures relative to the extent of the surrounding seabed and the Inner Bristol Channel, the changes to the hydrodynamic processes, and hence changes in sediment distribution and contaminant mobilisation, would be limited and within the range of natural variability. In addition, the works would be of a temporary nature and, after the removal of the rig, the seabed would be expected to revert to its pre-construction condition.

18.6.51 The sensitivity of the marine water quality receptor to changes in suspended sediment has been assessed as low (see **Table 18.15**).

18.6.52 Given that disturbance of sediments and the associated potential for contaminant mobilisation into the water column has been assessed as insignificant, when combined with consideration of the baseline conditions and design features of the drilling approach, the magnitude of this impact is assessed as very low (see **Table 18.4**). Therefore the significance of the drilling operations to the marine water quality status in the area around Hinkley Point would be **negligible**.

IMPACT: Concrete Leachate Associated with Construction

18.6.53 Concrete has the potential to impact on marine waters because it can cause a sharp increase in pH. During both the jetty and sea wall construction there are a number of activities that would require pouring of wet concrete *in-situ* or close to the marine environment, including the:

- installation of piles;
- construction of the jetty head;
- construction of the sea wall; and
- construction of drainage system foreshore outfall.

18.6.54 There would be limited opportunity for collection of concrete leachate or contaminated drainage during the direct use of concrete in the marine environment. However, there may be potential for any concrete contaminated water that accumulates in the footings excavated for the sea wall to be pumped to shore for treatment within the WMZs, rather than direct discharge to the intertidal area. This high pH water would be subject to adjustment within the WMZs prior to discharge through the foreshore outfall. Regardless, water with a high pH may impact locally upon marine water quality status. Such a potential impact would be temporary and direct.

18.6.55 In order to reduce the risk of this impact as far as possible, due regard would be paid to the Environment Agency's PPG note 5 (Ref. 8.43), and measures to control leachate spillages put in place. For example, quick set concrete would be used and concreting for intertidal structures would be undertaken during periods of low tide wherever possible, where clean up can easily occur.

18.6.56 The sensitivity of marine water quality to changes in chemical quality is defined as medium (see **Table 18.15**). Given the control measures that would be adopted, and the high dilution available in relation to low volumes of water with elevated pH, the magnitude of this impact is assessed to be very low (see **Table 18.4**). Consequently, the significance of this potential impact is assessed as **minor adverse**.

IMPACT: Hydrocarbon Residues Associated with Construction

18.6.57 Activities and movement of construction plant across the intertidal area during construction of the temporary jetty, foreshore outfall structure and sea wall would give rise to some wash-off of hydrocarbons and lubricants. Residues may also be expected from construction platforms operating in the subtidal areas during construction of the subtidal elements of the jetty, and the offshore infrastructure.

18.6.58 Hydrocarbons entering the marine environment may have an adverse impact on water quality status, although the main impacts relate to subsequent effects on marine biota.

18.6.59 The sensitivity of marine water quality in this context is assessed as medium (**Table 18.15**) The intertidal would be at its most sensitive during low tide periods, although any potential impact would be short-lived due to tidal inundation and subsequent flushing and dilution of any residual hydrocarbons.

18.6.60 Design measures would be implemented to reduce the magnitude of this potential impact, including restriction on refuelling and storage of fuels and lubricants on the intertidal area, adoption of best practice measures on handling of fuels and, where possible, the use of biodegradable lubricants. Given the very small volumes of hydrocarbons that would be lost in relation to the receiving environment, and the implementation of appropriate control measures, the magnitude of this potential impact is predicted to be very low.

18.6.61 Based on the receptor sensitivity and predicted magnitude, the significance of hydrocarbon loss during these construction activities is assessed as **minor adverse** in relation to marine water quality status.

IMPACT: Sediment Disturbance and Mobilisation of Contaminants Resulting from Operation of the Temporary Jetty

18.6.62 A potential impact upon water quality within the Bristol Channel during the operation of the jetty could result from the following activities:

- maintenance dredging;
- vessel movements; and
- scouring of sediment from the seabed around the jetty's infrastructure (e.g. piles and berthing pocket).

18.6.63 The majority of sediment disturbance would result from maintenance dredging of the berthing pocket, because this activity has the greatest potential to increase suspended solids concentrations and lead to localised mobilisation of sediment contaminants.

18.6.64 The area of the berthing pocket is within a zone of mud deposition which on average appears to be accumulating at about 2cm a year, and is thought to have a mud source to the east. There may be large variations in the magnitude and continuity of this rate, and there is little information about the resulting mud density.

18.6.65 Because of the depth increase locally due to the dredged berth and alteration of tidal velocities in relation to the tidal cycle, the berthing pocket would tend to trap some material and delay the remobilisation of mud on Spring tides. It is not possible to provide a firm estimate of the resulting balance of the differing settlement and remobilisation rates, as the operation of the berth itself would add a further factor. The berth would be used frequently whilst sea conditions permit and the movement of the vessels would influence the rates of both settlement and re-suspension. There would thus be a chronic level of disturbance throughout the period of jetty operation which is likely to affect sedimentary processes in the area of the berthing pocket.

18.6.66 The implication is that, with frequent vessel usage alternating with periods of bad weather, the need for any maintenance dredging would be reduced. Ignoring the complexities associated with the operational regime described above, it is estimated that settlement in berthing pocket settlement in the range 60,000$m^3.yr^{-1}$ to 200,000 $m^3.yr^{-1}$ could arise (see **Volume 2**, **Chapter 17**). However, in practice, the operator would monitor sediment accumulations in the berthing pocket in order to trigger a maintenance dredge should this prove necessary.

18.6.67 Of the dredging techniques available, a hydrodynamic method is likely to be better suited for maintenance dredging (ploughing / bed levelling, agitation or water injection,. Any disturbance associated with this activity would be almost identical to the effects of the tidally driven semi-diurnal and Spring / Neap cycles of widespread mobilisation/deposition/remobilisation of superficial finer sediments in the locality and would thus be of very little consequence.

18.6.68 The potential impact on water quality of any maintenance dredging or tidal scour can be determined with reference to the assessment of sediment disturbance and contaminant mobilisation during the construction of the jetty (i.e. the capital dredging and piling works). This assessment concluded that the levels of contamination recorded within the sediments are unlikely to vary from those found already within the estuary (essentially as a result of re-working of the mobile surface sediment layer).

18.6.69 The marine water quality receptor has been assessed to have a low sensitivity to changes in suspended sediment (see **Table 18.15**).

18.6.70 In assessing the magnitude of the potential impacts arising from sediment disturbance, the relatively small area of the dredging pocket, the localised nature of scour around the piled jetty, the high background concentrations of suspended solids, the dynamic nature of seabed sediment deposits under tidal flows and the low potential for partitioning of sediment pollutant into the water column has been taken into account. Accordingly, the magnitude of the potential impact associated with sediment disturbance resulting from scour and dredging is assessed to be very low (see **Table 18.4**). The impact significance is, therefore, assessed as being **negligible** for the marine water quality status around Hinkley Point.

IMPACT: Surface Water Discharge from the Jetty During Operation

18.6.71 All discharges from the temporary aggregates storage area would be collected via the proposed drainage system for the main site. Surface drainage from this area would be routed to a WMZ and treated prior to discharge via the foreshore outfall. The impacts from these discharges have been addressed above.

18.6.72 However, surface water would be discharged directly from the jetty deck to both the intertidal and subtidal areas. This drainage water may contain both suspended solids and hydrocarbon residues. Contamination of the surface drainage with cement is not expected, given the sealed delivery system proposed for unloading of cement from vessels to the silos in the temporary aggregates storage area. Potential impacts arising from the untreated drainage water would persist over the operating lifespan of the jetty. The marine water quality receptor has been assessed to have a low sensitivity to changes in suspended sediment and a medium sensitivity to changes in chemical quality (see **Table 18.15**).

18.6.73 Given that the engineering design includes for covering all conveyors, the proposed import of prefabricated materials, the small surface area of the jetty, and that the volume of surface drainage in relation to the volume of the receiving marine water quality receptor would be very low, the magnitude of this drainage impact on marine water quality status is predicted to be very low.

18.6.74 The significance of this potential impact is, therefore, assessed as **negligible** with respect to suspended sediment and **minor adverse** with respect to chemical status.

IMPACT: Re-suspension and Deposition of Sediment during Dismantling of the Temporary Jetty

18.6.75 Following an operational period of eight years, it is proposed that the jetty would be dismantled and the site restored. Compared to the dredging required during construction and operation, sediment disturbance during dismantling would be small in scale and mainly related to movement of offshore plant and removal of piles. In the case of activities in the intertidal areas, the potential for disturbance would be very limited because the large majority of the intertidal area is comprised of exposed wave-cut platforms (i.e. rock rather than sediment) and working would preferentially occur at low tide. Any potential impacts associated with sediment disturbance would be local to the jetty area, direct and temporary in duration.

18.6.76 The sensitivity of the marine water quality status to changes in suspended sediment has been assessed as low (see **Table 18.15**).

18.6.77 The magnitude of any impact associated with jetty dismantling would be dependent on the techniques adopted by the appointed contractor but, given the limited amount of plant likely to be working in the subtidal area, the limited potential for sediment disturbance in the intertidal area and the baseline conditions, impacts on marine water quality are likely to be of a very low magnitude (**Table 18.4**). A **negligible** impact is therefore predicted on marine water quality status.

IMPACT: Drilling of the Horizontal Tunnels for the Cooling Water and Fish Return Systems

18.6.78 The construction process for the drilling of these tunnels is described in **Volume 1**, **Chapters 2** and **3**. The water from these processes would be discharged across the foreshore. Given the underlying geology and tunnel boring machine working specifications, mud-assisted boring (slurry-mode) is not expected to be required; however, it potentially may be needed for the last few hundred metres of the tunnels. If mud-assisted drilling is used, the discharge would, following initial treatment, contain suspended solid concentrations of approximately $1g.l^{-1}$ (including 5% bentonite), would be of high pH (about 9.0) and contain an organic polymer. The discharge would be at a rate of about $60m^3$ per hour. This turbidity level is within the existing range in estuarine waters local to the site itself. If mud-assisted drilling is not used, the discharge would only contain water with suspended sediments and potentially elevated pH (as a result of some concrete use in tunnel construction). Mud-assisted drilling is, therefore, the worst-case scenario. Waste water from mud-assisted drilling would be subject to treatment either through a dedicated treatment plant or through routing to a WMZ prior to discharge to the intertidal area. Discharges from these operations would be subject to an environmental permit in terms of discharge flow rate and chemical quality.

18.6.79 Given that the sediment concentrations estimated to be discharged through a mud-assisted drilling (and non-mud assisted drilling) process are similar to the background suspended sediment concentrations recorded in the area, the effect on sedimentary processes is predicted to be insignificant. The additional loading to the Bristol Channel's sediment budget locally would simply contribute to existing trends in deposition, adding to these to a very minor degree, across a very wide area. Other aspects of the discharges from mud-assisted drilling, however, would impact marine water quality.

18.6.80 The sensitivity of marine water quality status is assessed as low for changes in suspended sediment concentration and as medium for changes in chemical quality (see **Table 18.15**). Given the proposed treatment of the drilling effluent the magnitude of this impact is assessed as low (see **Table 18.4**). Taking into account the sensitivity of the marine water quality receptor the significance of any impact is assessed to be **minor adverse**.

RISK: Construction Accidents and Incidents

18.6.81 There is a risk of potential impacts occurring as a result of accidents or incidents. It is not likely that accidents and incidents would arise under normal circumstances, hence these scenarios are presented as risks rather than as impacts.

18.6.82 In terms of marine water quality, the following risks have been identified during the construction phase as being of potential concern:

- failure of water management infrastructure such as pipe collapse, balancing pond breach, pump failure etc. due to an extreme rainfall event requiring emergency discharge to the intertidal area;
- accidental release of suspended sediments to intertidal area;
- failure of the sewage treatment system resulting in untreated discharges of sanitary waste to the foreshore;
- emergency discharge from horizontal tunnel operations to the foreshore;
- accidental spillage of chemicals or materials used in construction;
- accidental spills of fuels or oils;
- emergency discharges associated with firewater; and
- accidental spillage of wet concrete and/or cement.

18.6.83 These risks, and their likelihood of occurrence, would be managed and minimised through the use of good practice measures to be included in the EMMP and other associated subject-specific management plans, particularly the WMP (**Annex 3; Appendix 3**). These management plans may not influence the significance of an incident should it occur, but are a design measure to reduce the risk of occurrence to a very low level of probability.

18.6.84 In combination with the site specific management plans, a PICP (**Annex 3; Appendix 8**) is being developed by EDF Energy as a design measure to establish the response and management techniques that would be applied for a range of different incident types, should they occur. The implementation of this plan effectively acts as the mitigation to any incident through provision of measures to reduce impact magnitude, primarily through containment.

18.6.85 Routine monitoring and inspection, together with a system of efficient incident reporting, would trigger the EICP when incidents were identified. For the EICP to be effective, rapid implementation of the containment or other mitigation measures is required to reduce the potential impact to a non-significant level. The EICP, therefore, would act as the overarching mitigation measure for managing incidents and accidents and reducing their impact significance.

d) Cumulative Construction Impacts

18.6.86 Cumulative impacts on marine water quality in terms of the potential combined works at HPC are considered here. Cumulative impacts of the proposals with the wider HPC Project and other potential projects are assessed in **Volume 11**. There are two elements of the proposed development that could give rise to cumulative effects during the construction period and these are discussed below.

IMPACT: Increases in Suspended Solids

18.6.87 Each of the elements of the project that could give rise to increases in suspended solids are located some distance away from one another. For example, the jetty is located approximately 800m away from the foreshore discharge. Many of the sediment generating activities would also be separated temporally, e.g. the seawall and construction outfall would be carried out at different times to other sediment generating activities. Control measures through the WMZs would be in place to reduce the suspended solid concentrations within discharges from the land. Predicted impacts associated with the jetty dredging and cooling system drilling and dredging operations, although difficult to control, are expected to be insignificant, predominantly due to the already naturally high concentrations of suspended solids and strong tidal currents. Any temporary increases in suspended solid concentrations within the vicinity of Hinkley Point are, therefore, likely to be dispersed to background concentrations rapidly.

18.6.88 Given the temporary nature of each of the predicted impacts that may give rise to an increase in suspended solids, and the spatial extent of the impacts (i.e. localised to the source and rapidly diluted), cumulative impacts are not predicted (i.e. **no cumulative impact**).

IMPACT: Increases in Contaminants

18.6.89 All of the assessments that have considered the potential for contamination within the existing site soils have concluded that contamination is either comparable to baseline conditions or the risk of finding significant contamination is low. The risk of releasing contaminated sediment into surface water during the site works is therefore low. Additionally, control measures through the use of WMZs within the drainage system would be put in place in order to reduce the potential risk of discharging contamination to the surface water drainage system.

18.6.90 Any water quality contamination associated with sediment mobilisation resulting from dredging, offshore drilling and scour associated with offshore infrastructure is predicted to be comparable to baseline conditions. Cumulative impacts in terms of contamination and potential exceedences of EQS are, therefore, deemed to be unlikely (i.e. **no cumulative impact**).

e) Potential Impacts during Commissioning

18.6.91 In advance of operation of the EPR units there would be a period of commissioning tests and flushing. The primary purpose of this flushing is to clean and condition the pipework used within the cooling water circuits, using demineralised water with a range of chemical additives. The demineralised water used during this phase would be produced by a dedicated on-site plant that would be provided with a mains water supply. The commissioning tests have two distinct phases known as cold flush testing (CFT) and hot flush testing (HFT).

18.6.92 Due to the construction phasing of the two proposed EPR units, one would be completed and commence commissioning tests whilst construction on the second is completed. The cooling water system is not expected to be completed and operational until the commencement of the HFT phase for the first EPR unit. CFT discharges from this unit would, therefore, be directed to the construction phase spine drain system and discharged via the temporary foreshore outfall. All subsequent commissioning phase discharges would then be made through the cooling water system with offshore discharge and dispersion.

IMPACT: Cold Flush Testing

18.6.93 The main substances likely to be used/created during CFT are as follows (see also **Table 18.18**):

- Ammonia - added to the circuits to adjust the pH in the systems treated with hydrazine. Ammonia would also be present as a result of hydrazine breakdown.
- Reverse Osmosis / Demineralised Water.
- Ethanolamine - added to demineralised water to alkalinise water in steam cycles, for example.
- Hydrazine - used as an oxygen scavenger in the primary circuit. Note: the majority of hydrazine (>99.9%) would be expected to breakdown during this process.
- Iron and iron oxide – corrosion products.
- Phosphate – added to demineralised water as a corrosion inhibitor.
- Suspended solids - produced during corrosion of circuits and crud formation during construction.

Table 18.18: Estimated maximum concentrations ($\mu g.l^{-1}$) of cold-flush commissioning substances discharged across the foreshore per quarter over 2 years of commissioning

Commissioning substance	2016				2017			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Mean daily volume of reverse osmosis and demineralised water (m^3)	250	197.8	195.7	2,60.9	266.7	263.8	195.7	130.4
Ammonia (total)	3,333	1,111	1,389	1,042	1,666	1,666	2,222	2,501
Ammonia (unionised; pH7)	13	4	5	4	7	7	9	10
Ammonia (unionised; pH9)	948	316	395	296	474	474	632	711
Ethanolamine	16,667	556	1,111	833	833	833	555	834
Hydrazine	2,000	1,111	1,944	1,458	1,458	1,458	833	1,250
Iron oxide	16,667	8,333	8,331	20,831	20,831	16,663	16,663	8,336
Iron	125,000	4,167	4,166	4,166	4,166	4,166	5,554	8,336
Iron + Iron oxide	29,167	12,50	12,497	24,997	24,997	20,828	22,217	16,671

Commissioning substance	2016				2017			
		0						
Phosphate	16,667	11,111	16,663	20,831	20,831	41,657	55,542	83,356
Suspended solids	3,333	1,111	1,666	2,083	2,083	2,083	1,111	1,667
Suspended solids + Iron oxide	20,000	9,445	9,998	22,914	22,914	18,745	17,773	10,003

***Note**: Data assumes continuous discharge (over each quarterly period) based on mean daily flow rate, rather than batch discharges.*

18.6.94 Comparison of the expected discharge concentrations of chemicals in the CFT phase with EQS values for transitional and coastal waters indicates that the discharges of all substances listed in **Table 18.18** would exceed their respective EQS, with the exception of suspended solids and ammonia in pH7 flush water. Therefore, untreated discharges could impact upon the local marine water quality status. It is proposed, therefore, that wastewater from the CFT would be subject to on-site treatment in order to meet or better respective EQS concentrations prior to discharge into the spine drain system and ultimately to the foreshore. This waste stream would also be subject to an environmental permit.

18.6.95 The sensitivity of the marine water quality receptor to changes in chemical quality is assessed as being medium (see **Table 18.15**) and any potential impacts would be direct, temporary and local. Given the incorporation of a comprehensive treatment system into the design, the magnitude of this potential discharge is predicted as low. It could be argued that because immediate dilution is available at high tide the magnitude would in fact be very low, but because the discharge would also go across the foreshore at low tide, a precautionary magnitude of low is assumed (see **Table 18.4**). The significance of this impact for the marine water quality receptor is, therefore, assessed as **minor adverse**.

18.6.96 Discharges from the CFT of EPR Unit 2 would be made offshore, via the cooling water system and impacts are assessed below.

IMPACT: Hot Flush Testing

18.6.97 HFT for the first EPR unit and both the CFT and HFT for the second EPR would commence when the direct sea water cooling system is made operational. Therefore wastewater from these phases would be discharged directly into the cooling water flow, which would provide a high degree of dilution.

18.6.98 During the HFT two additional chemicals, boric acid and lithium hydroxide, would be added to the chemically dosed demineralised water used in the CFT (see **Table 18.18**). Boric acid dosed water used in the HFT for commissioning of the first EPR unit would be recycled for use with the second EPR.

18.6.99 Screening of the discharges from HFT was undertaken using a H1 type assessment based on data derived from Flamanville 3 commissioning discharges. The assessment assumed a worse-case scenario of 24 hour loading values, with both plants being subject to HFT simultaneously, together with a reduced discharge cooling flow due to only two of the four cooling water system pumps being operational. Furthermore, the assessment assumed continuous discharge and combined discharge (in reality, tests and their respective discharges would be batched for a phased discharge to the environment). Therefore, these discharges may impact upon the water quality status of the subtidal area. However, treatment facilities from the CFT would remain in place for use during HFT if required, and immediate dilution would occur at the point of discharge. Where it is determined that HFT discharge concentrations may not meet EQS, the treatment facilities (including simple dilution with seawater) or batched release would be used. Ultimately, HFT discharges would be subject to the limits defined within the operational discharge licence.

18.6.100 The receptor for these commissioning discharges into the cooling water system has been assigned a medium sensitivity to changes in chemical quality (see **Table 18.15**). Given the measures proposed above, the magnitude of this impact is assessed as being low. Subsequently the significance of this potential impact on marine water quality status has been assessed as **minor adverse**.

f) Potential Impacts during Operation

IMPACT: Discharges of Surface Water Drainage, Groundwater and Sanitary Effluent to the Marine Environment

18.6.101 The proposed surface drainage system would collect all surface water run-off and effluent from the permanent sewage treatment works. This water, along with pumped groundwater, would feed into a discharge holding pond and then would be discharged to sea via the cooling water outflow. The design of the drainage network allows for any necessary treatment (i.e. oil interceptors) to be undertaken prior to discharge. Discharges of treated sanitary effluent from the permanent treatment works would be subject to conditions, in terms of volume and chemical and microbiological quality, under an environmental permit. Since this water would be significantly diluted by the large volumes associated with the cooling water flows, impacts on the water quality status of the subtidal area are considered unlikely. Some groundwater from behind the sea wall would continue to discharge to the foreshore directly through a series of drains installed at 10m intervals at the foot of the wall. This diffuse drainage approach for the sea wall has been designed to approximate to the existing baseline condition where there is seepage of groundwater through the cliff face. No additional effects on water quality from these sources of wastewater to those identified for the construction phase above are identified.

18.6.102 The construction phase drainage system, and construction outfall, would no longer be used and would be dismantled towards the end of the construction phase (some elements may be left in position but would be redundant). In relation to the service road, surface drainage would be dispersed through lateral soakaways. Volumes from this source are expected to be very low and, therefore, large volumes of water are not predicted to be discharged across the foreshore.

18.6.103 Marine water quality status has been assessed to have medium sensitivity to changes in chemical quality and low sensitivity to changes in suspended sediment (see **Table 18.15**). However, given the design measures discussed above, and the very low volume compared with the main cooling water discharge volume, the magnitude of these discharges is considered to be less than very low magnitude and, therefore, there is predicted to be **no impact.**

IMPACT: Sediment Disturbance Associated with Cooling Water Infrastructure Operation

18.6.104 Large quantities of water would be required for cooling, with the return water being discharged at a rate of approximately 125m^3/sec. A discharge of this magnitude has the potential to mobilise and redistribute local sediment deposits through the force of the discharge flow. The mobilisation of sediment may impact upon the local marine water quality status of the subtidal area, which is assessed to have a low sensitivity to changes in suspended sediment concentrations (see **Table 18.15**). The outfall heads at the end of the discharge tunnel have been designed so that they are raised above the sea bed. This would assist in reducing the effect of scour associated with the cooling water discharge.

18.6.105 As described previously, high concentrations of suspended solids and the constant reworking of bed sediments reflect the natural conditions of the area. The majority of the sediments that would be mobilised through scour are of relatively recent origin and, while they are known to contain a range of contaminants (Ref. 8.50), these sediments are reworked on a regular basis. This leads to a constant redistribution and deposition of contaminants within the system and suggests that the release of sediment from scour associated with the discharge would be unlikely to raise contaminant levels in the water column or suspended sediment loads significantly with regard to existing EQS values. The potential impact is, therefore, considered to be of very low magnitude (see **Table 18.4**).

18.6.106 There may also be a need to periodically dredge sediments from around the cooling water intake and outfall structures during the operational period. These intermittent dredging works would lead to the temporary mobilisation of suspended sediments and associated contaminants. Again, impacts are considered to be of low magnitude as re-suspension of this sediment is considered to be within the range of natural processes.

18.6.107 Given the above, the significance of the impact on marine water quality status is predicted to be **negligible**.

IMPACT: Discharge of Cooling Water - Thermal Properties

18.6.108 The primary characteristic of the cooling water discharge would be the increased temperature relative to the surrounding water. Under normal operating conditions, the HPC EPRs' water would be discharged up to 12.5°C above ambient temperature. In line with the WFD, to ensure that all transitional and coastal waters are at least at good status by 2015, UKTAG 2008 (Ref. 8.73) has produced draft thermal standards for rivers which, in the absence of any other standards, are being used for TraC waters until such time as standards specific to TraC waters are determined. These temperature standards are recommended by the Environment Agency specifically for nuclear new build developments (Ref. 8.34) and by the BEEMS Expert Panel (Ref. 8.76); hence they were used for this assessment. UKTAG 2008 (Ref. 8.73) states that in order to achieve WFD good status, maximum temperatures at the edge of the mixing zone (as thermal impacts are largely related to point discharges) must not exceed 23°C, based on an annual 98 percentile, and that outside the mixing zone temperatures should not rise by more that 3°C.

18.6.109 Further, more stringent, temperature standards are applicable to an assessment of potential impacts on Natura 2000 designated areas and these are presented within the **Habitats Regulations Assessment Report** (Ref. 8.58).

18.6.110 Using the model runs described in Section 18.4, the three relevant scenarios for the consideration of potential impacts are runs C, D and E. These correspond to HPC operating in isolation at 100% output, HPC operating at 100% output simultaneously with HPB operating at 70% and HPC operating at 100% simultaneously with HPB at 100%, respectively:

- Run C calculates the thermal plume conditions in relation to the operation of HPC only (i.e. the effects of HPB are removed). This reflects conditions that would occur in the future when HPB ceases generation.
- Run D reflects a time whereby HPC is operating at full capacity and HPB is operating, but potentially below consented maxima (as described above). Run D thus provides the opportunity to assess impacts on the potential lower range of HPB operation.
- Run E is considered to represent the upper limit of potential combined operation, i.e. both HPC and HPB are operating at maximum consented levels.

18.6.111 For the purposes of this assessment, run E represents the worst-case scenario, i.e. HPB and HPC power stations operating in combination at maximum consented levels.

18.6.112 **Figure 18.5** presents the thermal plume model output for HPC operating at 100% in isolation and the temperature contours of the plume.

18.6.113 **Table 18.19** and **Table 18.20** present the calculated mixing zones on the basis of the output from the GETM model. Figures 18.6 to 18.8 show the modelled mixing zones for Runs C, D and E, respectively. Similar to standards for chemical substances, all thermal standards apply to the environment beyond an acceptable mixing zone. As defined in Section 18.4, in a regulatory context a mixing zone is "...the part of a body of surface water which is adjacent to the point of discharge and within which the *concentrations of one or more contaminants of concern may exceed the relevant EQS".*

Table 18.19: Area of Plume (hectares) Exceeding 23°C WFD Good Status Thresholds (Ref. 8.64)

Model run	At bed	At surface
Run C GETM	2	38
Run D GETM	936	1058
Run E GETM	1225	1424

Table 18.20: Area of Plume (hectares) Exceeding 3.0°C WFD Mean Temperature Uplift Criterion for WFD Good Status (Ref. 8.64)

Model run	At bed	At surface
Run C GETM	0.4	9
Run D GETM	390	426
Run E GETM	806	839

18.6.114 Thermal discharges clearly may impact upon marine water quality status, which is assessed to have a medium sensitivity to changes in the thermal regime (see **Table 18.15**).

18.6.115 Comparison of the plume areas that have been predicted to be greater than the WFD thresholds (i.e. the proposed mixing zones) with the definitions of magnitude provided in **Table 18.4** allows a potential worst case impact magnitude for each of the model runs to be determined. Assessment of magnitude has been based on comparison of the area of the mixing zone with the area of the receiving water. For the purposes of this assessment the 3 main bodies of water offshore of Hinkley Point have been deemed to be the receiving water: the mouth of the Parret Estuary, Bridgwater Bay, and the southern part of the inner Bristol Channel. These provide a combined area of 50,061ha.

18.6.116 **Table 18.21** presents the predicted magnitude of the potential impact associated with thermal discharges. The magnitude predicted for impacts at the surface were found to be the same as the equivalent magnitude at the bed, in all instances. It should be noted, however, that in terms of any associated impacts upon marine ecology (i.e. the ultimate environmental receptor), it is the potential impact at the bed which is of primary interest, because it is benthic organisms which are most susceptible to chronic temperature regime changes (due to relative immobility).

Table 18.21: Magnitude of Potential Thermal Discharge Impacts upon Water Quality Status

	Bed	Surface
Run C GETM	Very low	Very low
Run D GETM	Low	Low
Run E GETM	Low	Low

18.6.117 Given the very large area of the receiving water (>50,000ha), and the comparatively small area of the plume, at the bed and at the surface (2 and 38ha respectively), the magnitude of potential impacts upon marine water quality off Hinkley Point is determined to be very low for HPC operating on its own (model run C). The plumes at the bed and the surface for HPC and HPB operating simultaneously (model runs D and E) are considerably larger (1,058 and 1,424 at the surface, respectively) than for HPC operating on its own, but are still small compared to the total area of the receiving water (>50,000ha). The magnitude of thermal impacts for both stations operating simultaneously is determined to be low. Potential impacts resulting from the thermal discharge may be expected to be regional and permanent (for operational life of HPC). Given that the sensitivity of marine water quality status has been determined to be medium for changes in thermal regime, the impact significance for all operational three scenarios is predicted to be **minor adverse**.

IMPACT: Thermal effects on Dissolved Oxygen Levels under Normal Operating Conditions

18.6.118 Other issues associated with the cooling water discharge include the impacts of increased temperature on dissolved oxygen (DO). An increase in temperature directly affects the amount of oxygen dissolved in water as the solubility of gases reduces.

18.6.119 In terms of DO standards, the WFD now includes threshold values for TraC waters. For waters of varying salinity, such as those off Hinkley Point, the standards are calculated according to salinity:

- for 'High' status, the standard is: 7 – (0.037 × (salinity)); and
- for 'Good' status, the standard is: 5 – (0.028 × (salinity)).

18.6.120 Based on the baseline DO data for Hinkley Point and taking account of differing salinities (which affects oxygen solubility) in the inner and outer estuary, Hinkley Point DO concentrations are consistent with High status. However, there are occasions when DO concentrations in the Parrett Estuary are low. The Environment Agency reported DO values of around 2mg.l^{-1} in 2001, although data were based on three sites from the inner Parrett Estuary and may not reflect conditions in the outer estuary (Langston *et al*; Ref. 8.68).

18.6.121 The approach used by BEEMS in order to investigate the extent of oxygen consumption (or demand) from saturation, most appropriately in August when DO levels are likely to be close to their lowest levels and salinities would be high, is detailed in BEEMS TR186 (Ref. 8.50) and BEEMS Short Position Paper 064 (Ref. 18.77). The concentrations of DO resulting from the discharge of the cooling water plume at 12.5°C were then modelled and a figure showing DO concentration contours is presented as **Figure 18.9a**. However, in order to provide a more accurate picture of likely DO concentrations, the application of a biological oxygen demand was also applied, based on information gathered during the 2009 survey work. **Figure 18.9b** presents the revised DO concentrations.

18.6.122 For HPC operating at 100% (run C), the DO concentration in the area immediately influenced by the thermal plume is reduced to around 6.5 mg.l^{-1}. When taking in to account the biological demand, DO concentration is depressed further (to around 5.30 mg.l^{-1}). Compared with the threshold for 'High' status (6.2 mg.l^{-1} for a salinity of 22), HPC operating in isolation (run C) would have a mixing zone of 1280ha, and the mixing zone would increase if HPB was still operating at the same time (run E) (**Table 18.22** and **Figure 18.10**). Compared with the threshold for 'Good' status (4.4 mg.l^{-1} for a salinity of 22), there is no mixing zone (i.e. DO always remains above 4.4 mg.l^{-1} for all operational scenarios (**Table 18.22**).

Table 18.22: Mixing Zones (hectares) for Thermally Induced Reductions in Dissolved Oxygen for 'High' Status (Threshold = 6.2mg.l^{-1}) and 'Good' Status (Threshold = 4.4 mg.l^{-1})

	Bed		Surface	
	High	Good	High	Good
Run C GETM	1106	0.0	1280	0.0
Run E GETM	2380	0.0	2578	0.0

18.6.123 The receiving water has a very large area (>50,000ha) in comparison with the modelled mixing zones presented in **Table 18.22**. Furthermore, the assessment for DO is extremely precautionary, because in reality the low salinities against which the assessment has been made (22) only occur during the winter months when freshwater run-off is increased. The dominant forcing factor for DO, however, is temperature. Consequently, reduced DO is typically only a problem during the summer months when sea temperatures are warmer; high sea temperatures in-combination with low salinity, as used in this worst-case model scenario, do not occur in the natural environment. The real areal impact of temperature on DO is, in reality, likely to be significantly less to that presented here as a very worst case.

18.6.124 Given the large area of the receiving water, and the very precautionary nature of the assessment, the impact magnitude for DO with respect to the standard for 'High' status under WFD is deemed to be low. With a receptor sensitivity of medium for changes in chemical quality (**Table 18.15**), the impact significance is predicted to be **minor adverse** in relation to 'High' water quality status. There is **no impact** for DO on 'Good' status which is the target objective for WFD.

IMPACT: Thermal effects on Un-ionised Ammonia Levels under Normal Operating Conditions

18.6.125 In terms of ammonia, the un-ionised form of ammonia is more toxic to aquatic biota than the ionised form and the proportion of un-ionised ammonia increases with increasing temperature and pH, but decreases with increasing salinity. The equilibrium is particularly sensitive to pH values around neutral; whereas a temperature increase of 10°C (from 10°C to 20°C) doubles the proportion of un-ionised ammonia, a pH increase from 7 to 8 produces an approximately tenfold increase (Ref. 8.50).

18.6.126 There is, therefore, the potential for the increased temperature of the cooling water discharge to alter the natural equilibrium of ammonia:un-ionised ammonia, whereby concentrations of the more toxic un-ionised form would increase..

18.6.127 The GETM was based on the ammonia concentrations already present in the discharge (informed by baseline data collection and the 2009 monitoring) and also took into consideration loadings of nitrogen that would be required as part of operation of the two EPRs. Un-ionised ammonia values were then calculated using the Environment Agency calculator for seawater (Ref. 8.78) to determine the un-ionised ammonia concentrations. **Figure 18.11** presents the predicted un-ionised ammonia contours.

18.6.128 The maximum resulting un-ionised ammonia concentration contour was 11.2µg.l^{-1} for HPC operating at 100% alone (Run C). For HPB operating at 100% in addition to HPC at 100%, the maximum resulting un-ionised ammonia concentration contour was 16µg.l^{-1}. For all model runs, the maximum value is less than the EQS of 21µg.l^{-1} annual average for un-ionised ammonia.

18.6.129 Considering the un-ionised ammonia modelling results, the potential impact upon marine water quality status is predicted to have a low magnitude. The receptor sensitivity to changes in chemical quality is medium (**Table 18.15**) and so the impact significance is assessed to be **minor adverse** for marine water quality status.

IMPACT: Discharge of Cooling Water - Thermal Interaction with Background Concentrations of Contaminants

18.6.130 In the area around Bridgwater Bay and the River Parrett, the finer sediments tend to accumulate higher loads of associated contaminants. Temperature may affect availability and, therefore, the toxicity of sediment bound contaminants. In estuaries, pH and salinity are other important factors that can influence contaminant availability and toxicity. Bryan and Langston (Ref. 8.79) identified four factors that affect metals in sediments, e.g. mobilisation of metals to the interstitial water and their chemical speciation, as follows: transformation (e.g. methylation) of metals including arsenic, mercury, lead and tin; the control exerted by major sediment components (e.g. oxides of iron and organics) to which metals are preferentially bound; competition between sediment metals (e.g. copper and silver, zinc and cadmium) for uptake sites in organisms; and the influence of bioturbation, salinity, redox or pH on these processes. Potentially, therefore, interaction between elevated plume temperatures could facilitate enhanced release rates for some sediment-associated contaminants.

18.6.131 As a matter of expert judgement, it is considered that the rate of remobilisation of sediments and contaminants in this area is sufficiently high already as to make temperature-enhanced release over a localised area insignificant in degree or extent.

18.6.132 Given the above, the impact magnitude of the thermal plume on sediment contaminant remobilisation is predicted to be very low. The receptor sensitivity to change in chemical quality is medium (**Table 18.15**) and, therefore, a **minor adverse** impact is predicted upon the local water quality status.

IMPACT: Discharge of Cooling Water - Discharge of Contaminants

18.6.133 As summarised in **Table 18.23**, during the operational phase the cooling water is predicted to contain the following main contaminants:

- metals (aluminium, copper, chromium, iron, manganese, nickel, lead and zinc);
- boric acid;
- boron;
- lithium hydroxide;
- hydrazine;
- morpholine and associated breakdown products: ethanolamine, acetates, formiates, glycolates, oxalates;
- total nitrogen as N, un-ionised ammonia;

- phosphates;
- detergents;
- chemicals used for maintenance of demineralised plant reverse osmosis membranes, e.g. ATMP, HEDP, Phosphoric acid and Sodium Polyacrylate; and
- suspended solids.

Table 18.23: Operational Phase Chemical Discharges for Two EPR Units (Ref. 8.52)

Substance	Circuit conditioning ($kg.yr^{-1}$)	Sanitary waste discharge ($kg.yr^{-1}$)	Producing demineralised water ($kg.yr^{-1}$)[5]	Maximum 24-hour loading ($kg.d^{-1}$)	Maximum annual loading ($kg.d^{-1}$)
Boric Acid	14,000	--	--	5,630	14,000
Acetic Acid	--	--	14	0	14
Acrylic acid	--	--	165	1	165
Aluminium	5	--	--	1	5
ATMP	--	--	9,100	45	9,100
BOD	--	1,278	--	4	1,278
Boron[1]	2,448	--	--	984	2,448
Chloride	--	--	87,100	450	87,100
Chromium	7.8	--	--	1.7	7.8
COD	5,050	--	--	330	5,050
Copper	0.39	--	--	0.08	0.39
Detergents	3,200	--	624	270	3,824
Ethanolamine	920	--	--	25	920
HEDP	--	--	890	5	890
Hydrazine[2]	28	--	--	4	28
Iron	33	--	46,004	257	46,037
Lead	0.28	--	--	0.06	0.28
Lithium hydroxide	8.8	--	--	--	8.8
Manganese	3.1	--	--	0.67	3.1
Morpholine	1,680	--	--	95	1,680
Nickel	0.41	--	--	0.09	0.41
Nitrogen as N	10,120	1,278	--	324	11,398
Phosphates	800	--	--	200	800
Phosphoric Acid	--	--	12	0.1	12
Sodium	--	--	52,400	855	52,400
Sodium polyacrylate	--	--	8,030	40	8,030
Sulphates	--	--	98,400	2,000	98,400
Suspended solids	2,800	1,916	88,000	875	92,716
Total residual	--	--	--	--	--

Substance	Circuit conditioning (kg.yr^{-1})	Sanitary waste discharge (kg.yr^{-1})	Producing demineralised water (kg.yr^{-1})[5]	Maximum 24-hour loading (kg.d^{-1})	Maximum annual loading (kg.d^{-1})
oxidants[4]					
Unionised Ammonium (NH_3)[3]	1,184	150	--	74	1,334
Zinc	5.6	--	--	1.2	5.6

Notes:

[1] *Boron is calculated by dividing the loading for boric acid (H_3BO_3) by 5.72 to obtain loading of B alone.*

[2] *24 hour flow of hydrazine is based on input data from Flamanville EPR.*

[3] *Un-ionised ammonia was calculated as 11.7% (annual loading) or 22.9% (24 hour loading) of the total nitrogen flow (assuming all nitrogen was in the form of ammonia, NH_4^+), based on pH =8.11, salinity = 23.3psu and temperatures of 35.5^{o}C (annual loading) and 48^{o}C (24 hour loadings). For the purpose of worst-case assessment of 24 hour loadings it is assumed that only two of the four cooling water pumps are in operation. (see Ref. 18.52 for further detail).*

[4] *Total residual oxidants are assumed to have a concentration of 200µg.l^{-1} at the discharge point.*

[5] *Loadings include discharges associated with desalination and demineralisation units. Desalination plant loading values have been retained to provide bounding conditions in terms of a worst-case discharge scenario.*

18.6.134 Modelling of all process chemicals to be discharged to the marine environment via the cooling water discharge has been undertaken according to an Environment Agency H1-type assessment methodology (Ref. 8.52). The first tier of assessment screens out discharges considered to be of no environmental significance. Chemical parameters found to be at significant concentrations are then subject to more detailed analysis for a range of scenarios.

18.6.135 Waste water from the power station circuits, would be discharged initially to the attenuation pond (HXO facility). The HXO facility would hold water for testing prior to controlled release into the cooling water discharge stream for final discharge offshore. The concentration of process chemicals in the HXO facility could be very high, and in excess of EQS. Under normal circumstances, controlled pumping into the cooling water discharge water provides a very large degree of dilution, resulting in the normal operation discharge concentrations.

18.6.136 A detailed breakdown of the modelling work undertaken in this regard is presented in Ref. 8.52 and it was concluded that the resultant depth average environmental concentrations at 100m and 500m from the discharge point are below concentrations of environmental significance for all chemicals considered, with the exception of hydrazine.

18.6.137 Given the above, the magnitude of impacts from operational chemicals (other than hydrazine) is assessed to be very low (**Table 18.4**). The marine water quality receptor has medium sensitivity to changes in chemical quality (**Table 18.15**). The impact significance of operational chemical discharges, other than hydrazine and unioinsed ammonia, is, therefore, assessed to be **minor adverse**.

IMPACT: Discharge of Cooling Water – Discharge of Hydrazine

18.6.138 In order to further assess the potential impact of hydrazine on marine water quality, an extension of the modelling described for the thermal plume was undertaken (Ref. 18.50). At the mean CW flow rate of 125m^3.s^{-1} the average concentration at the discharge point is 7.1ng.l^{-1}, producing a mixing zone of 77 hectares at the seabed and 191 hectares at the surface in relation to the chronic PNEC of 0.0004µg.l^{-1}. The mixing zone for the acute PNEC is only exceeded at the surface in the model grid cells neighbouring the outfall (**Figure 18.12**).

18.6.139 Hydrazine breaks down rapidly into nitrogen and water, and so by storing it prior to discharge concentrations can be significantly reduced. Breakdown may also be enhanced by thermal degradation, which produces ammonia as a breakdown product. Storage and treatment is already part of the existing EPR design for HPC (the discharge loading stated in **Table 18.23**, and assessed in Ref. 8.50, includes that storage and treatment). EDF Energy is continuing to evaluate potential improvements to hydrazine storage and treatment. HPB does not discharge hydrazine, so the impact of hydrazine from HPB plus HPC is not assessed.

18.6.140 The hydrazine discharge plume was modelled using GETM, which allowed the area affected by a hydrazine concentration above the acute and chronic PNEC to be defined. **Table 18.24** presents the area of the cooling water plume with a hydrazine concentration greater than the chronic PNEC concentration (0.0004 µg.l^{-1}).

Table 18.24: Area of Plume (hectares) >0.0004 µg.l^{-1} Hydrazine Concentration as an Annual Average at the Bed and Surface

Area of plume >0.0004 µg.l^{-1}	Bed	Surface
HPC hydrazine discharge (0.007 µg.l^{-1})	73	191

18.6.141 The receptor has been assessed to be of medium sensitivity to changes in chemical quality (see **Table 18.15**). Given that the discharge outfall is located at a distance of 2km offshore, and the modelled discharge plume runs parallel to the shore, there is not expected to be any influence on the intertidal areas. Taking into account the proposed engineering design to reduce the concentrations of hydrazine in the cooling water discharge and the environmental degradation of hydrazine (see **Table 18.17** and **Table 18.4**), the impact magnitude is predicted to be very low. The GETM outputs for the hydrazine plume may also be viewed as conservative given that the actual hydrazine would not be continuous and thus the actual hydrazine plume may have opportunity to degrade and disperse in the environment. Based upon these impact descriptors, the impact significance is predicted to be **minor adverse** on the marine water quality receptor.

IMPACT: Discharge of Cooling Water – Discharge of Total Residual Oxidants

18.6.142 Within the General Design Assessment (GDA), under normal conditions for EPR units, worst case chlorination would involve dosing to 0.5mg.l^{-1} of active chlorine applied sequentially once every 30 minutes per cooling channel.

18.6.143 However, the review of operational information and the risk assessments undertaken for biofouling at HPB identify that, unlike other sites operated in the UK by EDF Energy, chlorination of the intake heads, shafts, tunnels and forebays is not required to control biological fouling. But this local understanding is exceptional and the standard operating procedure that applies to EDF Energy's coastal power stations

(BEOM006; Ref. 8.80) requires that a means of dosing nonetheless is maintained in case of need.

18.6.144 BEOM006 requires that the effective level for long term treatment of mussels in cooling water circuits is 0.15 $mg.l^{-1}$ TRO. Operational control is generally found to be insensitive at the ± 0.05 $mg.l^{-1}$ level, hence the normal practice is to dose at a target residual of 0.2 $mg.l^{-1}$ TRO to account for error.

18.6.145 The chlorination strategy for HPC is currently being developed. This will be a risk based, intermittent dosing regime that respects the operational needs of the plant, the WFD EQS and the Habitats Regulations thresholds.

18.6.146 Detailed analysis regarding the modelling approach used to determine the potential impacts associated with discharges of chlorine to the subtidal area is provided in BEEMS (Ref. 8.50). The GETM model outputs for the chlorination assessment were used to calculate areas of the plume at the surface and bed that exceed the chlorine EQS of 0.01 $mg.l^{-1}$ expressed as total residual oxidants (presented in **Table 18.25**).

Table 18.25: Mixing Zones (hectares) for TRO for WFD EQS (0.1 $mg.l^{-1}$)

Chlorine plume configuration at surface as a 95% >0.01 $mg.l^{-1}$	At Bed	At Surface
HPC 0.2 $mg.l^{-1}$ (Run TRO3tC)	63	159
HPC 0.2 $mg.l^{-1}$ + HPB 0.3 $mg.l^{-1}$ (Run TRO3tE)	132	251

Notes: Run TRO3tC = HPC alone at a discharge concentration of 0.2 $mg.l^{-1}$; Run TRO3tE = HPC at 0.2 $mg.l^{-1}$ TRO in combination with HPB at a discharge concentration of 0.3 mg/l TRO.

18.6.147 Results for a modelled discharge from continuous dosing to achieve 0.2 $mg.l^{-1}$ at the condensers for HPC operating alone at 100%, indicate that 63 hectares of the seabed and 159 hectares of the surface would exceed the TRO EQS of 0.01 $mg.l^{-1}$. **Figure 18.13** shows the predicted plume extent. The corresponding mixing zones at the bed and surface for HPC dosing at 0.2 $mg.l^{-1}$ plus HPB dosing at its consented 0.3 $mg.l^{-1}$ TRO, are 132 hectares and 251 hectares respectively (Ref. 8.50; **Figure 18.14**).

18.6.148 If chlorination is not used there will be **no impact**.

18.6.149 If the risk of biofouling is deemed to increase, such that chlorination is necessary, consideration of the TRO mixing zone plumes (**Table 18.26**) in relation to the very large area of the receiving water justifies an allocation of a very low magnitude in relation to potential TRO discharges. The marine water quality receptor has a medium sensitivity to changes in chemical quality (see **Table 18.15**) and, hence, a **minor adverse** impact is predicted.

IMPACT: Discharge of Cooling Water – Discharge of Chlorinated By-Products

18.6.150 In terms of formation of chlorinated by-products (CBPs), bromoform is invariably the most common in seawater cooled power station effluents, but other trihalomethanes, haloacetic acids, haloacetonitriles and halophenols are also found (Ref. 8.50). Given that chlorination has never occurred at the Hinkley Point site, the likely level of CBP production, particularly bromoform production, is unknown.

18.6.151 However, extensive monitoring around existing nuclear power plants, whilst confirming the presence of many CBPs, showed that concentrations measured in the cooling water outfalls are approximately 1,000 times lower than acute toxicity thresholds. Additionally, these CBPs are not bio-magnified in the food chain (Ref. 8.50). BEEMS (Ref. 8.50) presents all information available and concludes that the evidence for CBPs indicates that discharge concentrations are likely to be below calculated thresholds of effect and that concentrations would further decrease within 1km of the discharge. Impacts associated with CBPs are not, therefore, predicted to occur.

18.6.152 Given the above, the magnitude of the impact of chlorinated by-products on the marine water quality receptor (of medium sensitivity) is predicted to be very low, giving an impact significance is therefore predicted to be minor adverse.

IMPACT: Discharge of Cooling Water under Maintenance Conditions - Thermal Properties and Effects on DO and Un-ionised Ammonia

18.6.153 In order to consider the potential impact under the different conditions indicative of operating conditions, model simulations were undertaken on the basis of both HPC reactors operating at normal capacity but with only two out of the four cooling water pumps working. This effectively would lead to a reduced cooling water flow ($63m^3.s^{-1}$ as opposed to $125\ m^3.s^{-1}$) but at an increased temperature (25°C as opposed to 12.5°C) compared to normal operating conditions. Again full details of the modelling undertaken are provided in BEEMS (Ref. 8.50).

18.6.154 In summary, the change in operating conditions leads to a stronger thermal stratification which leads to a more rapid rate of heat loss as the hotter waters rise to the surface in the immediate vicinity of the outfall. As a consequence, temperatures in the immediate vicinity are higher than those predicted under the normal operating scenario, however, reduced temperatures occur further afield due to the quicker heat loss. Cooler seabed temperatures would also result from the increased stratification, thus the extent of the plume at the seabed would be less than that under normal operating conditions. **Table 18.26** summarises the differences in predicted mixing zones at the surface and seabed for both normal operating conditions and maintenance conditions.

Table 18.26: Thermal Mixing Zones (hectares) at Surface Calculated for Normal Operating Conditions and Maintenance Conditions

Temperature	Run C (operational) GETM	Run C (maintenance) GETM
3°C	9	18

18.6.155 **Table 18.21** presents the predicted magnitude of potential impacts associated with thermal discharges from HPC operating under normal conditions. The magnitude ratings have been assigned using the definitions presented in **Table 18.4**.

18.6.156 Under maintenance conditions the magnitude of potential impacts upon water quality status off Hinkley Point is determined to be very low. Potential impacts resulting from the thermal discharge can be expected to be regional and permanent (for the operational life of HPC). The sensitivity of marine water quality status to thermal effects is assessed to be medium (see **Table 18.15**) and, consequently, the impact is predicted to be of **minor adverse** significance.

18.6.157 Because of the increase in temperature, the potential for this operating scenario to impact on DO and un-ionised ammonia levels has been considered. Modelling indicates that the proposed DO concentrations are slightly lower than the standard operational conditions but all values are predicted to be greater than $4.4mg.l^{-1}$ (the lower boundary for 'Good' Status at a salinity of 22; see also Sections 18.6.118 – 18.6.124).

18.6.158 In terms of un-ionised ammonia, the maximum predicted concentrations were $12.4\mu g.l^{-1}$, a slight increase on the predictions for the normal operating scenario. However, again, this value is significantly below the EQS.

18.6.159 Given that the magnitude of the impact in terms of DO and un-ionised ammonia is predicted to be similar to (DO) and lower (un-ionised ammonia) than that predicted for normal operating conditions, the impact significance is predicted to be lower. Normal operating conditions are therefore considered to be the worst case scenario.

IMPACT: Discharges from the Desalination and Demineralisation Plant

18.6.160 The HPC development would not include a desalination plant, but would include a demineralisation plant for the treatment of mains water.

18.6.161 The precise composition of discharges from the demineralisation plant is unknown and, therefore, in order to carry out an assessment of the potential impacts upon water quality status, a scenario has been assessed that accommodates all likely outcomes. Data used in this scenario are taken from discharges associated with a combined desalination and demineralisation plant (based upon Flamanville 3 EPR, France) and adjusted to account of Bristol Channel sea water characteristics. The data includes maintenance chemicals known to be required for the reverse osmosis membranes in the plant.

18.6.162 Data have been assessed using the Environment Agency's H1 Environmental Risk Assessment framework, in conjunction with all other chemicals discharged within the cooling water discharge flow. The assessment found that even under the worst-case scenario (lowest discharge flow conditions and maximum loading values), there would be no significant impact on water quality status. This assessment may also be viewed as precautionary in nature, given that the actual discharge chemicals from the HPC demineralisation plant would have lower loading values, when compared to this bounding case.

18.6.163 Taking into account the H1 assessment results discussed above, the potential impact upon marine water quality status from demineralisation plant discharges is judged to have a very low magnitude. The marine water quality receptor is judged to have medium sensitivity in terms of changes to chemical quality (see **Table 18.15**) and, therefore, the potential impact significance is determined to be **minor adverse**.

RISK: Operational Accidents and Incidents

18.6.164 In terms of marine water and sediment quality, the following risks have been identified during the operational phase:

- failure of water management infrastructure, such as pipe collapse, pump failure etc., due to an extreme rainfall event;
- blockages of drainage infrastructure;
- accidental spills of fuels or oils;
- accidental spills of other chemicals;
- emergency discharges associated with firewater;
- emergency overflow from the HXO building; and
- emergency overflow from the forebay.

18.6.165 Although the risk of these accidents or incidents cannot be fully avoided, likelihood of occurrence and impacts can be managed and minimised through the use of good practice measures.

18.6.166 A **Pollution Incident Control Plan (PICP)** (**Annex 3; Appendix 8**) is to be developed that would set out the response and management techniques that would be applied for a range of different incident types, should they occur. The implementation of this plan would mitigate the extent any incident through providing measures to reduce the impact magnitude, primarily through containment.

18.6.167 The EICP would be instigated in response to routine monitoring and inspection and through a system of efficient incident reporting. To be effective, rapid implementation of the containment or other mitigation measures is required to reduce the potential impact to a insignificant level.

g) Cumulative Operational Impacts

18.6.168 Potential cumulative impacts associated with the operation of HPC on marine water quality are considered in this section. Cumulative impacts of the proposals with the wider HPC Project and other projects are assessed in **Volume 11**. There are two elements of the proposed development that could give rise to cumulative effects during the operational period and these are discussed below.

IMPACT: Increase in Suspended Solids

18.6.169 Potential inputs of suspended solids to the marine water environment during the operational phase which could produce a cumulative impact include:

- discharges of surface water drainage from the HPC operational site via the cooling water outflow;
- scour of local sediment deposits around the intake and outfall structures as a result of the cooling water flow; and
- maintenance dredging during the operational phase around the marine infrastructure.

18.6.170 There is not likely to be any cumulative impacts associated with these activities occurring in combination.

18.6.171 Discharges of surface water drainage from the HPC site during the operational phase are unlikely to contain high elevated concentrations of suspended solids because these discharges would be primarily made up of rainfall runoff from the developed site and would have been subject to management controls.

18.6.172 Scour effects around the offshore infrastructure are likely to only impact upon the immediate vicinity surrounding the structures and any measurable effect upon the local suspended solids concentrations within the Bristol Channel is expected to be highly localised. Suspended solids concentrations within the baseline environment are very high.

18.6.173 Maintenance dredging during the operational phase around the offshore infrastructure may not be required. If maintenance dredging is found to be required, it is likely that this activity would not result in elevated suspended sediment concentrations beyond those which are routinely experienced over a normal tidal cycle in the Bristol Channel. Scour effects from the discharge flow (see above) may assist in minimising the requirements for dredging and any increase in suspended sediment concentration as a result of in-combination impacts are expected to be negligible, relative to background concentrations.

18.6.174 The potential for a cumulative increase in suspended solids to occur is deemed to be minimal and would not represent an increased magnitude of potential impact beyond the magnitude of the independent impacts themselves. Hence **no cumulative impact** is predicted.

IMPACT: Increase in Contaminants

18.6.175 All surface water discharges during the operational phase would be discharged via the cooling water outflow and the screening assessments against EQS values have taken this into account. Cumulative impacts have, therefore, already been assessed as part of the discussion regarding impacts of the cooling water discharge.

18.6.176 In theory, in-combination contributions to marine contaminant concentrations from cooling water inputs and contaminants mobilised from sediment disturbance may occur. In reality, because of the high tidal energy, vigorous currents and extensive scouring of bed sediments which occurs under baseline conditions, contaminants that may be associated with local sediments would already have been captured within the assessment as part of the baseline water quality characterisation. In other words, any re-mobilisation of contaminants associated with scour activities is predicted to be similar to that already experienced under baseline conditions. The potential for a cumulative increase in water quality contaminant concentrations to occur is deemed to be minimal and would not represent an increased magnitude of impact beyond the magnitude of other independent operational impacts. Hence **no cumulative impact** is predicted.

18.7 Mitigation of Impacts

18.7.1 **Table 18.27** summarises the impacts predicted and demonstrates that they are all assessed to be of minor adverse or negligible significance. This reflects both the dynamic nature of the baseline environment, with dominant tidal flows and high levels of suspended sediment, and the mitigation measures that are built into the design (see Section 18.6 above).

18.7.2 However, additional mitigation measures are proposed on the basis of a good practice approach to protect the local environment. Mitigation techniques would be applied in a flexible manner to meet the conditions that are encountered on site. **Table 18.27** sets outs the significance of the impact predicted both prior to and with mitigation in place (i.e. the Residual Impact); however, the significance of all residual impacts are predicted to remain as predicted above.

a) Construction Phase

i. Site Drainage

18.7.3 Mitigation measures for the management of terrestrial surface water, e.g. construction site drainage, and the minimisation of suspended solids are presented in **Volume 2**, **Chapter 16**. These measures are very relevant in the context of marine water quality, given that discharges are to be made to the foreshore.

18.7.4 An **Environmental Monitoring and Management Plan (EMMP)** has been produced (**Annex 3** of this **ES**). This plan contains specific details regarding pollution prevention management and would implement many of the mitigation measures recommended for protecting surface water, including those set out in the Environment Agency PPGs. The plan covers measures such as fuel oil delivery, storage and use, procedures to deal with spillages, containment of contaminated run-off and disposal of contaminated drainage. Of specific relevance to the protection of marine water quality, there would be no stockpiling of materials or fuels on the intertidal areas.

18.7.5 A **Water Management Plan (WMP)** (**Annex 3; Appendix 3**) would also be implemented for the construction of HPC (with the objective of minimising suspended sediment, amongst others) and a **Pollution Incident Control Plan (PICP)** (**Annex 3; Appendix 8**) would be developed for the site. A full suite of equipment would be made available by the contractors for managing the range and magnitude of potential spillages. This would include emergency spill kits and equipment for containment and clean-up

ii. Discharges to Hinkley Foreshore

18.7.6 Until the foreshore discharge structure is complete, surface drainage discharges to the Hinkley foreshore would be made via the HPC drainage ditch. As part of the drainage design, the WMZs would provide an element of settlement and treatment.

iii. Discharges of Contaminated Water to Marine Environment

18.7.7 Where on-site water-treatment facilities are deemed unsuitable or inadequate to treat specific contaminants, off-site disposal to a suitable facility would be implemented.

iv. Construction of the Sea Wall

18.7.8 The construction of the new sea wall would follow PPG guidance to prevent accidental spillage of concrete in particular. Bunded casing/shuttering and the use of quick setting concrete formulas would mitigate potential marine water quality impacts. Any spillages would be contained immediately. Drainage from excavated areas would be managed to prevent water containing high suspended sediment and other contaminants entering the marine environment. No storage of waste or construction materials would be permitted on the foreshore.

v. Accidents and Incidents

18.7.9 As set out above, spillage of hydrocarbons into terrestrial watercourses and the marine environment would be minimised through the adoption of best practice working procedures. For example, fuels would be stored within bunded areas, refuelling would be undertaken in designated areas, and plant would be well maintained and regularly serviced. In addition, a **PICP** (**Annex 3; Appendix 8**) would be put in place to respond to spillage incidents (and fire water discharges, see below) swiftly and effectively. Pollution prevention/management equipment would be made available in order to minimise the severity of a potential spillage.

18.7.10 The site surface water drainage system would incorporate oil interceptors to collect hydrocarbon inputs to drainage water prior to discharge both routinely and during emergency.

18.7.11 These measures would also be applied in the operational phase.

b) Operational Phase

i. Background

18.7.12 The impact assessment determined that the operational phase of the proposed development is not likely to result in significant marine water quality related impacts (as identified in Section 18.6 and **Table 18.27**).

ii. Total Residual Oxidants (TRO)

18.7.13 Although the unmitigated impact assessment of TRO for HPC suggests the risk is minor, a more precautionary site-specific dosing strategy has been proposed to reduce impact further The following proven approach would be adopted to minimise the amount of chlorination required:

- A strategy would be implemented based on BEOM006 (Ref Ref. 8.80), which involves developing a site-specific risk-based protocol to prevent biofouling. This is an important difference from the approach described in the GDA.
- The BEOM006-based strategy involves screening, cleaning and dosing in that order of preference and is compliant with best practice (Ref. 8.81). Effective screening and cleaning are the first lines of defence, so appropriate plant and practices would be put in place at HPC to achieve these. Screening and filtration help prevent systems from becoming fouled, but eventually the systems would need to be cleaned. Chemical dosing is a means of limiting fouling but is only carried out in conjunction with screening and cleaning and would not be relied on as the sole means of preventing fouling.
- Identifying the need for chlorination would also be closely linked to monitoring protocols for fouling, including monitoring of the condenser efficiency, examination of growth in circuits and monitoring populations of organisms in the surrounding sea.

18.7.14 If this site-specific, intermittent dosing strategy is used the magnitude is predicted to be reduced to very low. However, the sensitivity of the receptor to changes in water quality is medium (**Table 18.15**) and so the significance of TRO impacts remain **minor adverse.** Although the impact assessment remains unchanged in terms of its rating according to the methodology, the impact is nonetheless reduced due to reduced magnitude.

iii. Hydrazine

18.7.15 Mitigation of hydrazine is already designed-in to the existing EPR design. However, EDF Energy is presently assessing whether further treatment is possible within the overall EPR design.

18.8 Post-construction and Operational Monitoring

18.8.1 A number of monitoring measures linked to both the performance of the infrastructure and potential environmental effects are proposed, as set out below. These measures are designed to provide useful data that could be used to modify potential management requirements and also to ensure that mitigation measures (see above) are effective and appropriate to deal with the predicted and identified environmental impacts.

a) Construction Phase

- For operational reasons, there would be a need to establish and maintain monitoring of vertical profiles of mud accumulations within the temporary jetty berthing pocket. Maintenance dredging is anticipated when densities increase to a magnitude that would permit this activity to be both needful and effective.
- Areas subject to natural freshwater discharges and areas subject to discharge from the HPC drainage system would be monitored for: pH, temperature, turbidity, dissolved oxygen, ammonia and hydrocarbons. Monitoring would be undertaken on each individual waste stream prior to discharge into the spine drain system. The scope of monitoring of waste streams would be set by the WMP (**Annex 3; Appendix 3**) and the conditions of each environmental permit. Supplementary monitoring may also be undertaken at the foreshore outfall location.

b) Commissioning

- During commissioning, monitoring of the cold and hot flush water would be undertaken in order to ensure compliance with environmental permits.

c) Operational Phase

- Continuous long-term monitoring of intake water temperature would be necessary to characterise long-term changes within larger seasonal and inter-annual variations. Measurements should include: temperature, salinity and pH.
- Monitoring of the thermal plume through the water column would be undertaken in the vicinity of the discharge point and at more remote monitoring locations. This monitoring would be combined with measurements of *in-situ* water quality measurements and the collection of samples for chemical analysis. Chemical parameters that would be proposed for the water quality testing programme include DO, un-ionised ammonia, hydrazine, dissolved nutrients, dissolved metals and selected organics used within the operational station (for example ethanolamine). The scope of these assessments in terms of sampling locations, frequency and duration of the monitoring programme and range of test parameters would be agreed with the Regulators in advance.
- Monitoring would be used to detect and assess the onset of biofouling in front of the main condenser and on the emergency cooling water system. If these

monitors remain clean, then the use of chlorine would not be justified. Evidence of biofouling may prompt the use of chlorine treatment.

- If chlorine treatment is used at any stage during the operation of HPC, the following additional monitoring would be necessary: TRO and chlorine by-products; bromoform, bromodichloromethane, chlorodibromomethane, monobromoacetic acid, dibromoacetic acid and 2, 4, 6, tribromophenol. If concentrations of these compounds are found to be low, monitoring for bromoform only may be acceptable once the effluent has been characterised.
- Fixed monitors would be installed at the outlet from the condenser and (if possible) close to the discharge for temperature, pH, DO and TRO (if chlorination is required).

Table 18.27: Summary Table of Marine Water Quality Impacts and Associated Mitigation Measures

Potential Impact	Water Quality Receptor	Magnitude	Description	Sensitivity	Impact Significance Rating (without Mitigation)	Proposed Mitigation or Good Practice	Residual Impact Assessment (after Mitigation)
Construction Phase							
Generation of Sediment and Discharges Associated with Construction of the Construction Outfall							
Discharges with elevated concentrations of suspended sediment	Marine water quality status	Very low	• Local • Temporary • Possible • Adverse • Direct	Low	Negligible	None required	Negligible
Discharges with residues of hydrocarbons	Marine water quality status	Very low	• Local • Temporary • Possible • Adverse • Direct	Medium	Minor	None required	Minor
Discharges containing concrete leachate	Marine water quality status	Very low	• Local • Temporary • Possible • Adverse • Direct	Medium	Minor	None required	Minor
Surface Water Discharges to the Foreshore							
Discharges with elevated concentrations of suspended sediment	Marine water quality status	Low	• Local • Temporary • Possible • Adverse • Direct	Medium	Minor	None required	Minor

Potential Impact	Water Quality Receptor	Magnitude	Description	Sensitivity	Impact Significance Rating (without Mitigation)	Proposed Mitigation or Good Practice	Residual Impact Assessment (after Mitigation)
Discharges with residues of hydrocarbons	Marine water quality status	Low	• Local • Temporary • Possible • Adverse • Direct	Medium	Minor	None required	Minor
Discharges containing concrete leachate	Marine water quality status	Low	• Local • Temporary • Possible • Adverse • Direct	Medium	Minor	None required	Minor
Discharges containing contamination arising from soil excavation	Marine water quality status	Very low	• Local • Temporary • Unlikely • Adverse • Direct	Medium	Minor	None required	Minor
Sewage Effluent							
Discharges of sewage effluent to the foreshore (during main site construction phase only)	Marine water quality status	Very low	• Local • Temporary • Certain • Adverse • Direct	Medium	Minor	None required	Minor
Groundwater Dewatering							
Pumped discharges from dewatering of groundwater	Marine water quality status	Very low	• Local • Temporary • Possible	Medium	Minor	None required	Minor

Potential Impact	Water Quality Receptor	Magnitude	Description	Sensitivity	Impact Significance Rating (without Mitigation)	Proposed Mitigation or Good Practice	Residual Impact Assessment (after Mitigation)
			• Adverse • Direct				
Surface water discharges associated with construction of the temporary jetty							
Discharges (e.g. from the proposed access road) with elevated concentrations of suspended sediment	Marine water quality status	Very low	• Local • Temporary • Possible • Adverse • Direct	Low	Negligible	None required	Negligible
Discharges with residues of hydrocarbons	Marine water quality status	Very low	• Local • Temporary • Possible • Adverse • Direct	Medium	Minor	None required	Minor
Construction of the sea wall							
Discharges with elevated concentrations of suspended sediment	Marine water quality status	Very low	• Local • Temporary • Possible • Adverse • Direct	Low	Negligible	None required	Negligible
Discharges with residues of hydrocarbons	Marine water quality status	Very low	• Local • Temporary • Possible • Adverse • Direct	Medium	Minor	None required	Minor

Potential Impact	Water Quality Receptor	Magnitude	Description	Sensitivity	Impact Significance Rating (without Mitigation)	Proposed Mitigation or Good Practice	Residual Impact Assessment (after Mitigation)
Discharges containing concrete leachate	Marine water quality status	Very low	• Local • Temporary • Possible • Adverse • Direct	Medium	Minor	None required	Minor
Offshore construction works							
Sediment disturbance and mobilisation of contaminants resulting from offshore construction works, specifically offshore piling	Marine water quality status	Very low	• Local • Temporary • Certain • Adverse • Direct	Low	Negligible	None required	Negligible
Sediment disturbance and mobilisation of contaminants resulting from offshore construction works, specifically capital dredging activities	Marine water quality status	Low	• Local • Temporary • Certain • Adverse • Direct	Low	Minor	None required	Minor
Wet drilling of vertical shafts and installation of headworks – generation of suspended sediment	Marine water quality status	Very low	• Local • Temporary • Certain • Adverse • Direct	Low	Negligible	None required	Minor
Other construction phase discharges							
Drainage contaminated with concrete leachate from activities such as	Marine water quality status	Very low	• Local • Temporary	Medium	Minor	None required	Minor

Potential Impact	Water Quality Receptor	Magnitude	Description	Sensitivity	Impact Significance Rating (without Mitigation)	Proposed Mitigation or Good Practice	Residual Impact Assessment (after Mitigation)
installation of piles; construction of the jetty head; construction of the seawall; and construction of drainage system foreshore outfall			• Possible • Adverse • Direct				
Drainage contaminated with hydrocarbon residues	Marine water quality status	Very low	• Local • Temporary • Possible • Adverse • Direct	Medium	Minor	None required	Minor
Surface water discharges associated with operation of the temporary jetty							
Sediment disturbance and mobilisation of contaminants, as a result of maintenance dredging; vessel movements; and sediment scour around the structure	Marine water quality status	Very low	• Local • Temporary • Certain • Adverse • Direct	Low	Negligible	None required	Negligible
Suspended sediment from surface water discharges from the jetty	Marine water quality status	Very low	• Local • Temporary • Possible • Adverse • Direct	Low	Negligible	None required	Negligible
Hydrocarbons from surface water discharges from the jetty	Marine water quality status	Very low	• Local • Temporary • Possible	Medium	Minor	None required	Minor

Potential Impact	Water Quality Receptor	Magnitude	Description	Sensitivity	Impact Significance Rating (without Mitigation)	Proposed Mitigation or Good Practice	Residual Impact Assessment (after Mitigation)
			• Adverse • Direct				
Dismantling of the temporary jetty							
Re-suspension and deposition of sediment during dismantling works	Marine water quality status	Very low	• Local • Temporary • Possible • Adverse • Direct	Low	Negligible	None required	Negligible
Tunnelling operations							
Discharges with elevated concentrations of suspended sediment from drilling of horizontal cooling water tunnels	Marine water quality status	Low	• Local • Temporary • Likely • Adverse • Direct	Low	Minor	None required	Minor
Discharges containing contaminants including drilling chemicals and concrete leachate from drilling of horizontal cooling water tunnels	Marine water quality status	Low	• Local • Temporary • Likely • Adverse • Direct	Medium	Minor	None required	Minor
Discharges with elevated concentrations of suspended sediment from drilling of Fish Return System tunnels	Marine water quality status	Low	• Local • Temporary • Likely • Adverse • Direct	Low	Minor	None required	Minor

Potential Impact	Water Quality Receptor	Magnitude	Description	Sensitivity	Impact Significance Rating (without Mitigation)	Proposed Mitigation or Good Practice	Residual Impact Assessment (after Mitigation)
Discharges containing contaminants including drilling chemicals and concrete leachate from drilling of Fish Return System tunnels	Marine water quality status	Low	• Local • Temporary • Likely • Adverse • Direct	Medium	Minor	None required	Minor
Cumulative Construction Impacts							
Cumulative effect of discharges with elevated sediment concentrations	Marine water quality status	No impact – see text justification	• N/A	N/A	N/A	N/A	N/A
Cumulative effect of discharges with elevated contaminant concentrations	Marine water quality status	No impact – see text justification	• N/A	N/A	N/A	N/A	N/A
Commissioning Phase							
Cold Flush Testing							
Discharges of chemicals associated with the CFT	Marine water quality status	Low	• Local • Temporary • Certain • Adverse • Direct	Medium	Minor	None required	Minor
Hot Flush Testing							
Discharges of chemicals associated with the HFT	Marine water quality status	Low	• Local • Temporary • Likely • Adverse	Medium	Minor	None required	Minor

Potential Impact	Water Quality Receptor	Magnitude	Description	Sensitivity	Impact Significance Rating (without Mitigation)	Proposed Mitigation or Good Practice	Residual Impact Assessment (after Mitigation)
			• Direct				
Operational Phase							
Operational drainage discharges							
Chemical discharges from surface water drainage, groundwater and sanitary effluent	Marine water quality status	No impact	• Local • Permanent (lifetime of HPC) • Possible • Adverse • Direct	Low	Negligible	None required	No impact
Sediment discharges from surface water drainage, groundwater and sanitary effluent	Marine water quality status	No impact	• Local • Permanent (lifetime of HPC) • Possible • Adverse • Direct	Medium	Negligible	None required	No impact
Cooling water infrastructure operation							
Sediment disturbance associated with cooling water flow	Marine water quality status	Very low	• Local • Temporary • Certain • Adverse • Direct	Low	Negligible	None required	Minor
Sediment disturbance associated with maintenance dredging around cooling water heads	Marine water quality status	Very low	• Local • Temporary • Certain • Adverse	Medium	Negligible	None required	Minor

Potential Impact	Water Quality Receptor	Magnitude	Description	Sensitivity	Impact Significance Rating (without Mitigation)	Proposed Mitigation or Good Practice	Residual Impact Assessment (after Mitigation)
			• Direct				
Cooling Water Discharge							
Thermal discharge, uplift and average (GETM run C)	Marine water quality status	Very low	• Regional • Permanent (operational lifetime of HPC) • Certain • Adverse • Direct	Medium	Minor	None required	Minor
Thermal discharge, uplift and average (GETM runs D to E)	Marine water quality status	Low	• Regional • Permanent (operational lifetime of HPC) • Certain • Adverse • Direct	Medium	Minor	None required	Minor
Thermal effects on dissolved oxygen concentration (precautionary 'High' status standard)	Marine water quality status	Low	• Local • Permanent (operational lifetime of HPC) • Certain • Adverse • Direct	Medium	Minor	None required	Minor
Thermal effects on dissolved oxygen concentration (precautionary 'Good'	Marine water quality status	No impact	• Local • Permanent (operational lifetime of HPC)	Medium	No impact	None required	No impact

Potential Impact	Water Quality Receptor	Magnitude	Description	Sensitivity	Impact Significance Rating (without Mitigation)	Proposed Mitigation or Good Practice	Residual Impact Assessment (after Mitigation)
status standard)			• Certain • Adverse • Direct				
Thermal effects on baseline un-ionised ammonia (all discharges of operational ammonia taken into account)	Marine water quality status	Low	• Local • Permanent (operational lifetime of HPC) • Certain • Adverse • Direct	Medium	Minor	None required	Minor
Thermal interaction with background concentrations of contaminants	Marine water quality receptor	Very low	• Local • Temporary • Possible • Adverse • Direct	Medium	Minor	None required	Minor
Discharge of contaminants within the cooling water (all contaminants other than hydrazine)	Marine water quality receptor	Very low	• Local • Permanent (operational lifetime of HPC) • Certain • Adverse • Direct	Medium	Minor	None required	Minor
Discharge of hydrazine within the cooling water	Marine water quality receptor	Very low	• Local • Permanent (operational lifetime of HPC) • Certain	Medium	Minor	Under review	Minor

Potential Impact	Water Quality Receptor	Magnitude	Description	Sensitivity	Impact Significance Rating (without Mitigation)	Proposed Mitigation or Good Practice	Residual Impact Assessment (after Mitigation)
			• Adverse • Direct				
Discharge of Total Residual Oxidants	Marine water quality receptor	Very low	• Local • Temporary • Possible • Adverse • Direct	Medium	Minor	Intermittent dosing strategy	Minor
Discharge of Chlorinated by-products	Marine water quality receptor	Very low	• Local • Temporary • Unlikely • Adverse • Direct	Medium	Minor	Intermittent dosing strategy	Minor
Discharge of cooling water under maintenance conditions - thermal	Marine water quality status	Very low	• Regional • Permanent (operational lifetime of HPC) • Certain • Adverse • Direct	Medium	Minor	None required	Minor
Discharge of cooling water under maintenance conditions – effects on dissolved oxygen concentrations	Marine water quality status	Low	• Local • Permanent (operational lifetime of HPC) • Certain • Adverse • Direct	Medium	Minor	None required	Minor

Potential Impact	Water Quality Receptor	Magnitude	Description	Sensitivity	Impact Significance Rating (without Mitigation)	Proposed Mitigation or Good Practice	Residual Impact Assessment (after Mitigation)
Discharge of cooling water under maintenance conditions – effects on un-ionised ammonia concentrations	Marine water quality status	Low	• Local • Permanent (operational lifetime of HPC) • Certain • Adverse • Direct	Medium	Minor	None required	Minor
Desalination and demineralisation							
Discharges from a demineralisation plant	Marine water quality status	Very low	• Local • Temporary • Possible • Adverse • Direct	Medium	Minor	None required	Minor
Cumulative operational impacts							
Cumulative effect of discharges with elevated sediment concentrations	Marine water quality status	No impact – see text justification	• N/A	N/A	N/A	N/A	N/A
Cumulative effect of discharges with elevated contaminant concentrations	Marine water quality status	No impact – see text justification	• N/A	N/A	N/A	N/A	N/A

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CHAPTER 19: MARINE ECOLOGY

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19. MARINE ECOLOGY

19.1 Introduction

a) Introduction

19.1.1 This chapter of the Environmental Assessment (ES) assesses the potential impacts of the construction and operational phases of Hinkley Point C (HPC) on marine ecosystems at Hinkley Point and, where appropriate, the wider Bridgwater Bay and Inner Bristol Channel environment. Details of these phases are provided in **Volume 2**, **Chapters 2, 3** and **4**.

19.1.2 The assessment of potential impacts has been undertaken in accordance with the methodology outlined in **Volume 1**, **Chapter 7**. Available published data and grey literature have been examined, which includes data derived from ongoing impingement and entrainment sampling at Hinkley Point B (HPB) intake screens. To secure the marine science base to support consideration of this development, both in terms of environmental assessment and appropriate engineering design, a range of investigations were instigated by British Energy under the umbrella of the British Energy Estuarine and Marine Studies (BEEMS) process, subsequently adopted by EDF Energy. These investigations were designed to gather baseline data across appropriate temporal and spatial scales for the key ecological components of the surrounding ecosystems.

19.1.3 Following initial assessment, if an impact has the potential to be of moderate adverse significance or greater, where possible, mitigation measures have been identified to reduce predicted impacts. In some instances, mitigation measures are an integral aspect of the initial project design (e.g. the temporary aggregate jetty design or the cooling water outfall location).

b) Study Area

19.1.4 The geographical extent of the area of interest for the marine ecological assessment is principally determined by the potential zone of effect, and especially the mixing zone (i.e. the area in which the initial dilution of a discharge occurs). Particularly sensitive habitats or species that have conservation or commercial status in adjacent areas have also been considered.

19.1.5 The extent of dedicated survey and assessment effort has also been dependent upon an understanding of the highly dynamic physical processes that govern the ecology of the Inner Bristol Channel (see **Volume 2**, **Chapter 17**).

19.1.6 For the purpose of descriptions in this chapter, the HPC Development Site is located on a rocky section of the southern shore of the Inner Bristol Channel, and marks the western limit of Bridgwater Bay, itself bound to the north and east by the promontory of Brean Down. Within Bridgwater Bay, a substantial intertidal area is split into two parts by the estuarine channel of the River Parrett, with Stert Flats and the outer Gore Sands to the south and Berrow Flats to the north. The Inner Bristol Channel extends from a line between Hurlestone Point (west of Minehead, Somerset) and

Nash Point (Glamorgan) to the west, and Brean Down (Somerset) and Lavernock Point (Glamorgan) to the east, upstream of which lies the Severn Estuary. The Bristol Channel as a whole is taken to extend as far seaward as a line running approximately between Hartland Point on the Cornish coast and Old Castle Head on the Pembrokeshire coast.

19.1.7 The HPC Development Site is located within and adjacent to a number of national and international conservation designations that cover a range of marine ecological interests (see **Figure 19.1**). These designations and the species and habitats for which they are designated have been of prime consideration for the assessment process. Ecological receptors with protected status have been identified. Where a species or habitat is of conservation or general ecological importance, but does not have protected status, it has also been discussed in more detail. Where a species is fished commercially or has been subject to similar scrutiny, potential impacts have been assessed in relation to understandings of the size of the population involved.

c) Scope of Assessment

19.1.8 To identify the scope of the issues to be covered in the assessment, an initial evaluation of the potential for interactions between defined project activities and the receiving environment was undertaken. This resulted in a number of activities being identified which have the potential, on the basis of likelihood and the known response of the ecological parameters, to cause interactions/effects. These interactions are identified and listed in **Table 19.1**. The table does not provide an exhaustive list of potential interactions, but solely those for which further assessment work was considered necessary.

Table 19.1: Marine Ecology - Sources of Potential Interactions with Defined Project Activities for a Range of Key Receptors

Receptor	Phytoplankton	Zooplankton	Epifauna	Benthic flora	Subtidal invertebrates	Intertidal habitats (including *Sabellaria*)	Fish	Marine mammals
Construction								
Physical damage to habitats (e.g. construction on the seabed, dredging etc.)			✓	✓	✓	✓	✓	
Disturbance to habitats and species			✓	✓	✓	✓	✓	✓
Changes in water quality	✓	✓	✓	✓	✓	✓	✓	✓
Noise impacts (piling and vessels)			✓				✓	✓

Receptor	Phytoplankton	Zooplankton	Epifauna	Benthic flora	Subtidal invertebrates	Intertidal habitats (including *Sabellaria*)	Fish	Marine mammals
Operation								
Loss or change in habitat caused by presence of structures			✓	✓	✓	✓	✓	✓
Entrainment and impingement impacts on intake screens	✓	✓	✓	✓	✓		✓	
Water quality - temperature, flow and chemical impacts from thermal plume	✓	✓	✓	✓	✓	✓	✓	✓
Water quality - chemical discharges	✓	✓	✓	✓	✓	✓	✓	✓
Maintenance dredging			✓	✓	✓	✓	✓	✓
Noise impacts from maintenance vessels			✓				✓	✓

19.1.9 There is a potential for a period of overlapping generation involving both HPB and HPC, relevant to this assessment. The assessment methodologies applied within this chapter reflect this understanding.

19.1.10 The potential effects of climate change on certain species and populations are touched upon but no attempt is made by this ES to predict the level of change that might occur to the mix of species that are found in the marine and estuarine waters around Hinkley over the life of HPC.

d) Consultation with Regulatory Bodies

19.1.11 Consultation in relation to marine ecological interests has been undertaken with various stakeholders throughout the development of the project. Further information may be found in the **Consultation Report**. A summary of the key meetings at which the scope of the assessment work has been discussed is provided in **Table 19.2**.

19.1.12 This summary does not represent a full account of all meetings held, only those where marine ecology and other marine issues relevant to the assessment process were discussed.

Table 19.2: Summary of Consultation Meetings Undertaken to Determine Scope and Nature of Marine Ecological Assessment and Survey Work

Date	Attendees	Consultee Discussion/Comments
20/08/08	Natural England (NE), Environment Agency and Countryside Council for Wales (CCW)	Marine ecology issues discussed – some gaps identified in initial data review. Coastal processes and coastal protection also discussed. Possible need for offshore surveys identified. Fisheries data to be requested from CCW, identification of coastal workshop attendees required, methods for offshore surveys to be discussed with NE. Such gaps in provision of data were subsequently corrected by assimilation of BEEMS programme. Environment Agency identified a lack of sufficiently detailed water quality data: see **Volume 2, Chapter 18**. Also discussed coastal monitoring and defence issues and management of discharges.
22/09/08	CCW Correspondence	Water dependent features within the assessment area should be detailed as previously suggested in consultation.
03/11/08	NE	Terrestrial ecology and marine ecology scoping meeting with the purpose to discuss and agree scope of proposed surveys. The proposed sampling design for the local scale surveys was presented at this meeting. NE confirmed it was content with range and scope of proposed surveys, but requested that a full 12 month survey period was applied for certain key species, specifically fish. It was discussed that shad (protected Annex II species under the EC Habitats Directive (92/43/EEC), see Section 19.3) abundance tends to peak in July/August and therefore likelihood of catching this species increases during these months so sampling was extended to cover this period.
16/01/09	NE and CCW	CCW comments on marine ecology methodology were received on 09/02/09. NE comments on marine ecology were received on 12/02/09. Other than extension of surveys as decided at the 03/11/08 meeting no other changes to survey design were requested.
11/03/09	CCW, NE, Environment Agency and Sedgemoor District Council (DC)	Marine Authorities Liaison Group Meeting was held to discuss consents and estuary issues.
24/06/09	Environment Agency, Royal Haskoning, NE, Somerset County Council, Marine and Fisheries Agency and West Somerset Council	Meeting held to discuss Marine Authorities. Discussed offshore investigations, shore access arrangements and Sea Protection Group. Also discussed, water abstraction and discharge, soil, groundwater and ground gas, surface and marine water.
28/07/09	Environment Agency, Marine Fisheries Agency, English Heritage, West Somerset Council, Somerset County Council, ARUP	Status presentation on studies regarding shore access, sea protection wall, abstraction and discharge, water quality, contaminated land, groundwater, ground gas.

19.2 Legislation and Policy

19.2.1 In the context of marine ecology, this section describes the main legislative and planning policy considerations in relation to the proposed development. Such legislation and policy provides controls on the types of development which can be conducted within the marine environment and sets out the measures and processes that should be implemented to protect designated sites and biodiversity interests.

a) Legislation and Policies Relevant to the Marine Biodiversity and Conservation Interests of the Study Area

i. International Conventions

The Ramsar Convention of Wetlands of International Importance 1971

19.2.2 The Ramsar Convention provides the framework for national action and international co-operation for the conservation and considerate use of wetlands and their resources. Suitable wetlands are designated for inclusion in the List of Wetlands of International Importance. In order to promote the conservation of Ramsar sites, the UK implements the Convention through the Sites of Special Scientific Interest (SSSI) system, with some overlap with Special Area of Conservation (SAC) and Special Protection Area (SPA) sites (see paragraphs 19.5.8 to 19.5.10 on EC Birds Directive and Habitats Directive). The Ramsar Policy Statement 2000 offers Ramsar Sites equivalent protection to Natura 2000 sites. Of relevance to the proposed development is the Severn Estuary Ramsar designation.

19.2.3 The Severn Estuary Ramsar site is designated due to a combination of a number of attributes including; the large tidal range, presence of Annex I habitats protected under the Habitats Directive (see paragraphs 19.5.11 to 19.5.13 for Habitats Directive), the presence of unusual estuarine communities (reduced diversity and high productivity), the run of migratory fish between the sea and river via the Severn Estuary, the fish of the whole estuarine and river system (which is one of the most diverse in Britain) and wildfowl and wader assemblages and species/populations of international importance. The Bridgwater Bay National Nature Reserve (NNR) is also designated a wetland of international importance under the Ramsar Convention.

The Convention on Biological Diversity 1992

19.2.4 This Convention focuses on the conservation of all species and ecosystems and therefore provides protection to all biodiversity. The Convention requires the development of national strategies, plans or programmes for the conservation and sustainable use of biodiversity. In accordance with this, the UK has developed Biodiversity Action Plans (BAPs). For intertidal and subtidal zones, Species, Habitat, and BAPS have been developed. These action plans provide guidance for the conservation and management of biodiversity within the natural environment. This Convention is transposed into UK law by the Countryside and Rights of Way Act (2000).

The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR)

19.2.5 Annex V of the Convention provides a framework for contracting parties to develop their own conservation measures. Article 2 requires parties to 'take necessary measures to protect and conserve the ecosystems and the biological diversity of the maritime area, and to restore, where practicable, marine areas which have already been adversely affected'.

b) European Directives

i. EC Directive on the Conservation of Wild Birds (209/147/CE) (Birds Directive)

19.2.6 The 'Birds Directive' aims to protect all wild birds, their eggs, nests and habitats within the EC. It also provides for the protection, management and control of all species of naturally occurring wild birds that are considered rare or vulnerable within the EC as listed in Annex I of the Directive. Under the Directive the most suitable areas for the conservation of these species (land and sea) are classified as SPAs. In England and Wales the Directive is implemented under the Wildlife and Countryside Act 1981 (as amended) and the Conservation (Natural Habitats, &c) Regulations 1994 (as amended). Of relevance to the proposed development is the Severn Estuary SPA.

19.2.7 The Severn Estuary qualifies as an SPA under Article 4.1 of the Birds Directive because it is classified as a wetland of international importance regularly supporting at least 20,000 waterfowl. In addition, it supports internationally important Annex I populations of over-wintering Bewick's swan *(Cygnus columbianus bewickii)*, curlew *(Numenius arquata),* dunlin *(Calidris alpina alpina),* pintail *(Anas acuta)*, redshank *(Tringa totanus)* and shelduck *(Tadorna tadorna)*, and on passage ringed plover *(Charadrius hiaticula)*.

19.2.8 The implications of HPC with respect to the designated interests of the SPA are covered in the chapter on Terrestrial Ecology and Ornithology (**Volume 2**, **Chapter 20**) and in the Habitats Regulations Assessment (HRA) Report.

ii. EC Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) (Habitats Directive)

19.2.9 Under the Habitats Directive, SACs can be designated to maintain or restore the habitats listed in Annex I and the species listed in Annex II of the Directive to 'Favourable Conservation Status'. This is defined in the context of habitats, as the establishment of conditions which will ensure that the extent and range of the habitat, and the populations of the species within that habitat, will be maintained or increased over time. In relation to species, the viability, population size and range of the species should be maintained in the long-term. In England and Wales the Directive is implemented under the Conservation (Natural Habitats) Regulations 1994 (as amended). Of relevance to the proposed development is the Severn Estuary Special Area of Conservation (SAC).

19.2.10 In 2009, the Severn Estuary was nominated as a SAC under the Directive. The designation is primarily due to the presence of the Annex I habitats: 'Atlantic salt meadows', 'estuaries' and 'mudflats and sandflats not covered by seawater at low tide'. The Annex I habitats: 'sandbanks which are slightly covered by seawater all the time' and 'reefs' are also present as qualifying features, but are not the primary reasons for the designation. The site is also designated due to the presence of the Annex II species: twaite shad, sea lamprey and river lamprey.

19.2.11 Ref. 19.158 gives the most recent guidance on the implementation of the Habitats Directive and the recent judgements regarding compensatory mechanisms where plans or projects affect the conservation objectives of a designated site. The implementation of the Habitats Regulations relies on determining the impact of the plan or project on the Conservation Objectives of the European Site. The Conservation Objectives for the European Sites and the qualifying features for the Ramsar sites are given in Ref. 19.159.

19.2.12 A report to inform the relevant Habitats Regulations Assessment (HRA) is being submitted in parallel to this ES as part of the DCO application.

iii. The Water Framework Directive (2000/60EC)

19.2.13 The Water Framework Directive (WFD) requires that all inland and coastal waters within defined river basin districts must reach at least 'good status' (or 'good potential', if considering a heavily modified water body) by 2015 and defines how this should be achieved through the establishment of environmental objectives and ecological targets for surface waters. Under the requirements of the Directive, the present water quality status must be assessed and any significant water quality issues identified. The overall aim is to enhance water resource quality, reduce pollution and promote sustainable use of water resources.

19.2.14 The WFD is implemented in the UK under The Water Environment (England and Wales) Regulations 2003. Coastal and estuarine waters have been split up into water bodies by the "competent authority" (Environment Agency for England and Wales) and these bodies are assessed individually. Bodies are grouped according to a type defined by hydromorphological assessment, physico-chemical criteria and are designated as coastal or transitional. The area of the Inner Bristol Channel under consideration is regarded as a coastal water from the English shore across to the Welsh shore and the Parrett is a transitional (estuarine) water.

19.2.15 WFD prioritises ecological assessment as a way of classifying water bodies but also includes physico-chemical assessment and the use of environmental chemical standards for priority substances and specific pollutants, as well as an assessment of defined hydromorphological criteria.

19.2.16 Five biological groups of metrics (quality elements) are used to assess ecological status in transitional waters: phytoplankton, macroalgae, angiosperms, benthic invertebrate fauna and fish, and three quality elements for coastal waters: phytoplankton, macroalgae plus angiosperms and benthic invertebrate fauna. Macroalgae and angiosperms are combined for coastal waters but not for transitional waters. Angiosperms cover both sea grasses and salt marshes.

19.2.17 A WFD assessment is provided in Appendix 18B.

iv. EU Marine Strategy Framework Directive

19.2.18 The objective of the EU's Marine Strategy Framework Directive is for EU marine waters to achieve good environmental status by 2021 and to protect the resource base upon which marine-related economic and social activities depend. This Directive constitutes the environmental component of the EU's future maritime policy which has been designed to achieve the full economic potential of the oceans and seas while conserving the marine environment.

19.2.19 Under the Directive, each Member State within a marine region is required to develop strategies for their marine waters. These strategies must contain a detailed assessment of the state of the environment, a definition of "good environmental status" at a regional level and the environmental targets and the establishment of monitoring programmes. Cost-effective measures must be drawn up which include an impact assessment which details a cost-benefit analysis of the proposed measures.

19.2.20 The overall goal of the Directive is in line with the objectives of the Water Framework Directive which requires surface freshwater and ground water to be ecologically sound by 2015 for which the first review of the River Basin Management Plans should take place in 2020. It has been agreed that where the Marine Strategy Framework Directive (MSFD) overlaps with the WFD in coastal waters those assessments undertaken for WFD do not need to be repeated under MSFD. However there are a number of biological components where the MSFD requires assessment and WFD does not, such as cetaceans, fish and birds as well specifically mentioning inputs of energy. Specific standards or methods are not yet determined but are likely to be less detailed than those created for the WFD.

c) National Legislation

i. The Conservation of Habitats and Species Regulations 2010

19.2.21 These Regulations succeed the original Conservation (Natural Habitats, &c) Regulations 1994 and consolidate all the various amendments made to the 1994 Regulations in respect of England and Wales (herein referred to as the Habitats Regulations).

19.2.22 The Regulations implement the Habitats and Birds Directives (described earlier). The Regulations make provision for the protection and management of sites, including the control of potentially damaging operations that may affect designated sites.

ii. The Wildlife and Countryside Act 1981

19.2.23 The Wildlife and Countryside Act (WCA) (as amended by the Countryside and Rights of Way Act 2000 (CRoW)) consolidates and amends existing legislation to implement the Bern Convention and the Birds Directive. The WCA strengthens provisions under the National Parks and Access to the Countryside Act 1949 to establish NNRs in England and Wales. The legislation provides for the designation, protection and management of NNRs which can be established on land and land covered by water, so it can therefore extend into the intertidal zone, but not below low water (e.g. the Bridgwater Bay NNR). These areas can be designated for their flora, fauna or geological interests. The WCA provides for the designation of SSSIs, and Marine Nature Reserves.

19.2.24 Bridgwater Bay is a designated SSSI and comprises a wide range of habitats ranging from extensive intertidal mudflats and saltmarsh to shingle beach and grazing marsh intersected by freshwater and brackish ditches. It is important both nationally and internationally for the overwintering and passage of large numbers of migrant waders and waterfowl. Bridgwater Bay was designated a wetland of international importance under the Ramsar Convention and a NNR under Section 23 of the National Parks and Access to the Countryside Act 1949.

iii. Countryside and Rights of Way Act 2000

19.2.25 The Countryside Rights of Way (CRoW) Act provides for public access on foot to certain types of land, amends the law for public rights of way, increases protection for SSSIs and strengthens wildlife enforcement legislation and provides for better management of Areas of Outstanding Natural Beauty (AONB).

iv. The Water Environment (Water Framework Directive) (England and Wales) Regulations 2010 SI 3242

19.2.26 The Regulations provide the mechanism to implement river basin districts within England and Wales in accordance with the WFD. The Regulations require a new strategic planning process to be established for the purpose of managing, protecting and improving the quality of water resources.

v. Water Resources Act 1991

19.2.27 The Water Resources Act (WRA) came into effect in 1991 and replaced corresponding sections of the Water Act 1989. The WRA sets out the responsibilities of the Environment Agency in relation to water pollution, resource management, flood defence, fisheries, and in some areas, navigation. The WRA regulates discharges to controlled waters, namely rivers, estuaries, coastal waters, lakes and groundwaters. This is distinct from the drainage of water or trade effluent from trade premises into a sewer. Discharge to controlled waters is only permitted with the consent of the Environment Agency. An aim of the Act is to ensure that the polluter pays the cost of the consequences of their discharges.

vi. Planning Policy Statement 9 (PPS9) Biodiversity and Geological Conservation

19.2.28 Planning Policy Statement 9 (PPS9) sets out the Government's national planning policies on the protection of biodiversity and geological conservation through the planning system. Government objectives in relation to biodiversity and geological conservation aim to conserve, enhance and restore biodiversity, and promote sustainability. The aims and objectives of PPS9 are delivered via Regional Spatial Strategies and Local Development Frameworks implemented by the regional and local planning bodies.

19.2.29 PPS9 establishes a series of key principles that regional planning bodies and local planning authorities should adhere to in order to ensure that the potential impacts of planning decisions on biodiversity and geological conservation are fully considered. This is accompanied by Office of the Deputy Prime Minister (ODPM) Circular 06/2005 which provides administrative guidance on the application of the law relating to planning and nature conservation. There is the need to determine environmental effects under other EC Directives, such as the Habitats Directive (92/43/EEC), the Wild Birds Directive (79/409/EEC), the Integrated Pollution Prevention and Control Directive (96/61/EC) or the Control of Major Accident Hazards Directive (96/82/EC). There are links between all of these even though their requirements and those of the EIA Directive are independent of each other. Advice on the links between these, as enabled by the Habitats Regulations, is in PPG 9 on Nature Conservation (or, in Wales, Planning Guidance (Wales) Planning Policy First Revision), and on the links between the Town and Country Planning system and the IPPC authorisation system in PPG 23 on Planning and Pollution Control (or, in Wales, Planning Guidance (Wales) Planning Policy First Revision and Planning Guidance (Wales) Technical Advice Note (Wales) 5 'Nature Conservation and Planning') (Ref. 19.160).

19.2.30 This guidance advises that planning policies and decisions should aim to maintain and enhance, restore or add to biodiversity and geological conservation interests. A strategic approach to the conservation, enhancement and restoration of biodiversity and geology should be taken, recognising the contribution that sites, areas and features (both individually and in combination) make to conserving these resources. Development should contribute to rural renewal and urban renaissance by enhancing biodiversity in green spaces and among developments so that they are used by wildlife and valued by people.

19.2.31 Networks of natural habitats are considered within PPS9 to represent a valuable resource. To reflect their importance, emphasis is placed upon Local Planning Authorities to maintain networks by: “avoiding or repairing the fragmentation and isolation of natural habitats through policies in plans”.

vii. The Marine and Coastal Access Act 2009

19.2.32 The Marine and Coastal Access Act 2009 aims to enable better protection of marine ecosystems and prevent a decline in marine biodiversity. The Act sets out provisions for more coherent planning in the marine environment in terms of issuing consents and permits for activities in the marine and coastal environment. The Act also contains provisions to allow for the designation of Marine Conservation Zones (MCZs) and the creation of a network or Marine Protected Areas (MPAs).

viii. UK Biodiversity Action Plan

19.2.33 The UK BAP is the UK response to the Convention on Biological Diversity 1992. The Plan describes the UK’s biological resources and commits a detailed plan for the protection of these resources. Within the plan, a list of priority species and habitats is developed, for which specific action should be taken to conserve these species and habitats. The implementation of the BAP is the responsibility of various statutory and non-statutory organisations. This is a requirement of the CRoW (2000).

ix. Salmon and Freshwater Fisheries Act 1975

19.2.34 The Salmon and Freshwater Fisheries Act 1975 (SAFFA), as modified by the Marine and Coastal Access Act 2009, applies to salmon, trout (including sea trout) and freshwater fish. The 1975 Act contains rules governing the: Prohibition of Certain Modes of Taking or Destroying Fish, Obstructions to Passage of Fish, Times of Fishing and Selling and Exporting Fish, Fishing Licences, Authorisations, Administration and Enforcement.

x. Eel Management Plans

19.2.35 In accordance with Article 4 of Council Regulation (EC) No 1100/2007 of 18 September 2007, which established measures for the recovery of the stock of European eel, the UK submitted 15 Eel Management Plans for approval by the Commission in December 2008. These plans are set at the River Basin District level, as defined under the Water Framework Directive 2000/60/EC, covering England and Wales, Scotland and Northern Ireland.

19.2.36 Eel Management Plans have been implemented for the Severn Catchment which aim to provide an escapement of silver eel biomass that is at least equal to 40% of the potential escapement to be expected in the absence of anthropogenic influence. In addition, the European Eel Regulation requires that a system is in place to ensure that by 2013, 60% of eel less than 12 cm long which are caught commercially each year are used for restocking in suitable habitat.

19.2.37 To meet the European Eel Regulation cited above, the Eels (England and Wales) Regulations 2009 (Statutory Instrument No. 3344) came into force on 15 January 2010. These Regulations establish measures for the recovery of the stock of European eel for England and Wales. These domestic regulations will enable the protection and sustainable management of the populations of European eel by addressing the passage of eels. Part 4 of the Regulations provides the Environment Agency with powers to serve notice on an owner, occupier or responsible person to: 'make provisions for the passage of eels through dams and other obstructions, and require the placement of screens that will protect eels over some intakes and outlets (i.e. in a diversion structure)'.

d) Regional Planning Policy

i. Somerset and Exmoor Joint Structure Plan 1996-2016

19.2.38 The Joint Structure Plan (JSP) provides the strategic base for all land use planning in the combined area covered by Somerset and the Exmoor National Park for the period up to 2016. The Plan has been prepared as a JSP between Somerset County Council and the Exmoor National Park Authority. The JSP policies relevant to marine ecology in the vicinity of the proposed development include Policy 1: Nature Conservation and Policy 15: Coastal Development. These are described as:

- Policy 1 - Nature Conservation, states that the biodiversity of Somerset (and the Exmoor National Park) will be protected, conserved, restored, enhanced, and managed in accordance with the UK and relevant regional and local BAPs. Spatial target habitats are provided for coastal sand dune, coastal vegetated shingle, and *Sabellaria alveolata* reef. Maintenance target areas are set for coastal sand dune and coastal vegetated sand dune, however, the full extent of *S. alveolata* reef is not known. A target has been set to mitigate the natural loss of coastal sand dune, although establishment and restoration targets are ongoing for coastal vegetated shingle and *S. alveolata* reef.
- Policy 15 - Coastal Development, predominantly considers development on the coast and emphasises the importance of protecting and enhancing natural marine resources including those afforded international protection.

19.2.39 Of the habitats listed above, all have a maintenance target area and all, but *Sabellaria* reefs and seagrass beds, have targets for the years 2010 and 2020. The aforementioned habitats are described as having non-quantifiable future target areas. In addition, quantifiable maintenance and target areas are not provided for littoral sand and gravel habitats. It is stated, however, that for these habitats, the retention of the existing extent and realisation of opportunities for their expansion, is very important.

e) Local Planning Policy

i. West Somerset Council Local Development Framework

19.2.40 West Somerset Council is currently undertaking public consultation on the Local Development Framework Core Strategy.

ii. West Somerset Council Local Plan (2006)

19.2.41 The West Somerset Local Plan covers the administrative area of West Somerset, excluding Exmoor National Park which has a separate Local Plan.

iii. Local Biodiversity Action Plan LBAP (Sedgemoor and West Somerset)

19.2.42 The Local Biodiversity Action Plan for the Sedgemoor District is currently being prepared. Under the West Somerset BAP, coastal vegetated shingle and *Sabellaria alveolata* reefs are identified as priority habitats.

19.3 Methodology

a) Introduction

19.3.1 The methodology adopted for assessing the potential environmental impacts on the marine environment from the HPC development is set out in **Volume 1, Chapter 7** and this is outlined, together with areas where the marine environment impact assessment is unique, in the following sections.

19.3.2 There is currently no statutory defined methodology for carrying out Environmental Impact Assessment (EIA) in the UK, although there is Government guidance. Accordingly, the approach adopted herein is based on best practice methodology from a number of key UK guidance documents on EIA including, but not limited to, the Department for Communities and Local Government (2000) (Ref. 19.256), Institute of Environmental Management and Assessment, IEMA (2004) (Ref.19.257), Environment Agency (2002) (Ref.19.258) and Institute of Ecology and Environmental Management, IEEM (2006) (Ref. 19.259).

19.3.3 Numerous studies have been conducted examining the biological assemblages of the Severn Estuary and Bristol Channel (e.g. Refs. 19.1, 19.2 and 19.3). In addition, some studies have specifically focussed on the ecology of the area surrounding Hinkley Point (e.g. Refs. 19.4 to 9.14). An important long-term data set, the ‘Severn Estuary Data Set’ (SEDS) is also available from the monthly sampling of the intake screens at HPB, instigated in January 1981 and continuing to this day. The collection of this data set was begun by the Central Electricity Generating Board

(CEGB) and provides relative abundance data for fish (>80 species), macroinvertebrates (>20 species) and planktonic organisms (>40 species).

b) Marine Studies Specific to Hinkley Point C

i. Introduction

19.3.4 A series of field investigations has been undertaken to provide additional baseline data and appropriate numerical modelling tools have been developed in order to inform both environmental assessment procedures and support considerations of appropriate engineering design. Experience of construction and operational impacts of other UK power stations indicate that the likely impacts of HPC will be evident at different spatial scales. For example, construction of the cooling water intake and outfall structures will be likely to result in localised impacts, whereas the effects of a thermal plume created by cooling water discharged from the outfall could potentially extend over many kilometres. The overall aim of the field survey effort was to establish a contemporary baseline for the intertidal and subtidal species and habitats found on and around Hinkley Point, with respect to both potential localised impacts and potential wider scale impacts such as the cooling water discharges.

19.3.5 A key component of the marine studies has been the British EDF (previously British Energy) Estuarine and Marine Studies (BEEMS) programme. As this programme was acquired by EDF together with British Energy early in 2009, by which time both parties had established marine surveys in the vicinity of Hinkley Point, the programme of survey efforts utilised in this Environmental Statement (ES) reflects the process of rationalisation and integration that subsequently followed.

19.3.6 Where available, methods used for the surveys were based on best practice recommendations including those outlined in the Marine Monitoring Handbook (Ref. 19.15). Aspects of the UK National Marine Monitoring Programme Green Book (Ref. 19.16) were also considered. These documents provide detailed standard methodologies for intertidal and subtidal sampling.

19.3.7 Additional methodologies have been developed or adapted as appropriate from past examples of best practice by BEEMS utilising, when appropriate, expert advice from an Expert Panel established within that framework. These needs have occurred where standard methodologies have been lacking in definition (e.g. for cooling water entrainment, impingement and thermal plume assessment, including numerical modelling approach), in order to inform WFD metrics, or where there has been advantage in asking such a group to consider the site specific context (i.e. key features). The relevant Scientific Advisory Reports issued by the BEEMS Expert Panel are listed in **Table 19.3**.

Table 19.3: BEEMS Scientific Advisory Reports bearing on Methodology and Approach

BEEMS SAR Number	Title	Date	Source
SAR 001 (Ref. 19.17)	Key features of the marine ecosystem off Hinkley Point in relation to new nuclear build	September 2010	Expert Panel
SAR 005 (Ref. 19.18)	Methodology for the measurement of entrainment	March 2011	Expert Panel
SAR 006 (Ref. 19.19)	Methodology for the measurement of impingement	March 2011	Expert Panel
SAR 007 (Ref. 19.20)	Methodology for the measurement of plumes	May 2011	Expert Panel
SAR 008 (Ref. 19.21)	Thermal standards for cooling water from new build nuclear power stations	March 2011	Expert Panel
SAR 009 (Ref. 19.199)	Chlorination by-products in power station cooling waters.	2011	Expert Panel

19.3.8 As described above, the approach and the initial extent of the survey programme was discussed in detail and agreed with stakeholders, including Natural England (NE), the Environment Agency and the Countryside Council for Wales (CCW). Subsequent developments in that programme, further to EDF Energy's acquisition of British Energy, have been discussed both with these bodies separately and in a common forum within the HPC Marine Authorities Liaison Group (MALG), as appropriate.

19.3.9 Relevant reports arising from the BEEMS effort are listed in **Table 19.4** below.

Table 19.4: Feeder Reports Utilised in Preparing the Hinkley Point Marine Ecology Synthesis

(NB this does not include all BEEMS reports relevant to Hinkley Point: others are referenced separately in **Volume 2**, **Chapters 17 and 18**)

BEEMS Report Number	Title	Date	Source
TR016 (Ref. 19.22)	BEEMS Hinkley Point intertidal review of biological and physical habitat information. R.1428	April 2008	ABP mer Ltd.
TR029 (Ref. 19.23)	Ecological characterisation of the intertidal region of Hinkley Point, Severn Estuary: results from 2008 field survey and assessment of risk. Vers. 2	March 2009	Cefas
TR031 (Ref. 19.24)	Nearshore habitat survey	March 2009	Titan
TR039 (Edition 4) (Ref. 19.25)	Seabed habitat mapping: Interpretation of swath bathymetry, side-scan sonar and ground-truthing results	January 2011	Cefas

BEEMS Report Number	Title	Date	Source
TR060 (Ref. 19.26)	Hinkley Point physical sciences report. Hydrodynamics, climatology, sedimentology and coastal geomorphology – an initial assessment of coastal hazards related to potential new nuclear build	December 2009	Cefas
TR065 (Ref. 19.27)	Predictions of impingement and entrainment by a new nuclear power station at Hinkley Point. Edition 2.	September 2010	Cefas
TR067 (Edition 2) (Ref. 19.28)	Hinkley Point nearshore communities: Results of the day grab surveys 2008 – 2010	October 2010	Cefas
TR068 (Edition 2) (Ref. 19.29)	The effects of the new nuclear build on the marine ecology of Hinkley Point and Bridgwater Bay	May 2011	Cefas
TR068b (Ref. 19.30)	Distribution of Coralline turfs at Hinkley Point with respect to nuclear new build	November 2010	Cefas
TR070 (Ref. 19.31)	An initial assessment of the effects of new nuclear build on water quality at Hinkley Point. Edition 3.	February 2011	Cefas
TR071 (Edition 4) (Ref. 19.32)	Review of commercial fisheries activity in the vicinity of Hinkley Point Power Station	February, 2011	Cefas
TR083 (Edition 3) (Ref. 19.33)	Hinkley Point nearshore communities: Results of the 2m beam trawl and plankton surveys 2008 - 2010	November 2010	Cefas
TR083a (Ref. 19.34)	Hinkley Point nearshore Communities: Plankton surveys 2010	November 2010	Cefas
TR104 (Ref. 19.35)	Hinkley Point *Sabellaria* assessment: Analysis of survey data for 2009	January 2010	MES Ltd.
TR129 (Ref. 19.36)	HP Comprehensive Impingement Monitoring Programme 2009-2010	February 2011	Pisces
TR134 (Ref. 19.37)	*Macoma balthica* temperature sensitivity review	January 2011	Cefas
TR135 (Ref.19.38)	HP thermal plume modelling: stage 3 review – detailed evaluation of the validation of the two Stage 3 models	January 2011	Cefas
TR136 (Ref.19.39)	Benthic biological resource characterisation	May 2011	MES Ltd.
TR136A (Ref. 19.40)	Comparison of macrobenthic fauna and sediment characteristics from Hamon and Day grab samples	May 2011	Cefas
TR138 (Ref. 19.41)	BEEMS nearshore habitat survey: Hinkley Point – Bridgwater Bay final report	January 2011	TES Ltd.
TR141 (Ref. 19.42)	Hinkley Point *Sabellaria* assessment: Analysis of survey data 2010	August 2010	MES Ltd.

BEEMS Report Number	Title	Date	Source
TR148 Ed 2 (Ref. 19.43)	A synthesis of impingement and entrainment predictions for NNB at Hinkley Point	March 2011	Cefas
TR153 (Ref.19.44)	Tolerance of *Sabellaria spinulosa* to aqueous chlorine; Final Report	March 2011	SAMS
TR154 (Ref. 19.45)	Hinkley spring intertidal survey and analysis report	November 2010	IECS
TR155 (Ref. 19.46)	Hinkley summer intertidal survey and analysis report	November 2010	IECS
TR156 (Ref. 19.47)	Hinkley autumn intertidal survey and analysis report	March 2011	IECS
TR157 (Ref. 19.48)	Hinkley winter intertidal survey and analysis report	March 2011	IECS
TR158 (Ref. 19.49)	Methods for monitoring the thermal environment of Bridgwater Bay intertidal habitats	April 2011	Cefas
TR160 (Ref. 19.50)	Variability in population structure and condition of *Macoma balthica* along its geographical range	May 2011	Cefas
TR161 (Ref. 19.51)	Initial investigations of the links between intertidal macrofauna and their avian predators in Bridgwater Bay with an Individual-Based Model	May 2011	Cefas
TR162 (Ref. 19.52)	Hinkley Point chlorination responses of key intertidal species – literature review	November 2010	Cefas
TR163 (Ref. 19.53)	Acute and behavioural effects of chlorinated seawater on intertidal mudflat species	April 2011	Cefas
TR164 (Ref. 19.54)	Molecular analyses of faecal material for diet analysis of protected intertidal birds	May 2011	Cefas
TR167 (Ref. 19.55)	Biotope mapping survey of Hinkley Point – Watchet intertidal area (Region 1)	March 2011	IECS
TR169 (Ref. 19.56)	Pile driving and marine life – potential implications for Nuclear New Build at Hinkley Point	January 2011	Cefas
TR170a (Ref. 19.57)	Cetacean Monitoring: 1st report	June 2010	SMRU Ltd.
TR177 (Ref. 19.59)	Hinkley Point thermal plume modelling. GETM Stage 3a results with the final cooling water configuration	February 2011	Cefas
TR178 (Ref. 19.60)	Hinkley Point Modelling: Chemical Plume Modelling (TRO, Hydrazine, DO, Ammonia)	May 2011	Cefas
TR180 (Ref. 19.61)	Hinkley Point intertidal fish and mobile epifauna survey: December 2010	March 2011	APEM
TR183 (Ref. 19.62)	Inter-annual variability in the intertidal mudflat communities of Bridgwater Bay	March 2011	Cefas

BEEMS Report Number	Title	Date	Source
TR184 (Ref. 19.14)	Hinkley Point marine ecology synthesis report	May 2011	Cefas
TR186 (Ref. 19.63)	Predicted effects of new nuclear build on water quality at Hinkley Point	February 2011	Cefas
TR182 (Ref. 19.65)	Delft3D Hinkley Point thermal plume modelling.	February 2011	Cefas
TR187 (Ref. 19.67)	HP thermal plume modelling: selection of meteorological and geomorphological scenarios.	February 2011	Cefas
TR159 (Ref. 19.177)	Intertidal fish survey	August 2010	Apem
TR027 (Ref. 19.222)	Entrainment monitoring feasibility study	January 2009	Jacobs
TR081 (Ref. 19.225)	Laboratory and power plant based entrainment studies: a literature review	October 2008	Jacobs
TR117 Ed.2 (Ref. 19.231)	Assessment of effects of cooling water intake velocity on fish entrapment risk at Hinkley Point	2010	Cefas
TR197 (Ref. 19.236)	Modelling of the optimal position of a FRR system for Hinkley Point C	June 2011	Cefas
TR194 (Ref. 19.239)	Modelling fish deterrents at Hinkley Point C	June 2011	FGS Ltd.
SPP 061 (Ref. 19.248)	Cod in the Celtic and Irish Seas	September 2011	Cefas
SPP 062 (Ref. 19.249)	*Macoma balthica* population structure at Hinkley Point and elsewhere in the Severn Estuary	September 2011	Cefas
SPP 063 (Ref. 19.250)	Entrainment impact on organisms at Hinkley Point C – supplementary note.	September 2011	Cefas
SPP 065 (Ref. 260)	Reassessment of juvenile cod impingement predictions at HPC	September 2011	Cefas

ii. Description of Surveys

19.3.10 Following the initial review of the tidal regime of the area and likely extent of any cooling water plume related issue, a series of high resolution bathymetric surveys using sidescan and swathe sonar of a wide area of the subtidal off Hinkley Point were completed (Ref. 19.25). In combination with high resolution LIDAR (Light Detection and Ranging) survey data obtained from the Environment Agency, the results were analysed to produce detailed maps of bed morphology (**Figure 19.2**) and surface sediment habitat type (**Figure 19.4**), leading in turn to habitat and biotope mapping (**Figure 19.18**).

19.3.11 An initial set of offshore biological surveys was instigated in February 2008 and covered a broad area of the Severn Estuary up to 15km from the proposed position of HPC (the estimated extent of any thermal influence of cooling water discharges) (**Figure 19.5**). The programme then extended to include further off-shore surveys in June, August and November of 2008 and May 2009 for:

- subtidal benthic infauna, sampled with a 0.1m^2 Day grab;
- subtidal benthic epifauna, sampled with a 2m beam trawl;
- benthic fish, sampled with a beam trawl;
- fish egg and larval abundance, as sampled by Gulf VII high speed plankton net; and
- zooplankton and phytoplankton using standard plankton nets.

19.3.12 Intertidal habitats were surveyed in July 2008. In order to ensure comprehensive spatial coverage of the various biotopes involved, this intertidal sampling was directed by the use of existing biotope maps, where available, arising from earlier studies carried out for Natural England. The area surveyed covered both soft and hard sediments ranging from the intertidal mud and sandflats up to approximately 8km north of the River Parrett Estuary, to the shoreline approximately 15km west of Hinkley Point (**Figure 19.3**). In total 55 sample sites were selected, which consisted of 40 soft sediment locations, 12 rocky shore sites and three sites located on saltmarsh. Sample sites were chosen to cover as wide a range of biotopes as possible within the intertidal zone in the main study area.

19.3.13 A more detailed description of the survey programme is available in Ref. 19.23, 19.27, 19.28 and 19.33.

19.3.14 Findings from the benthic and intertidal studies were subsequently utilised to validate a series of biotope maps that were initially developed on the basis of habitat mapping derived from remote sensing.

iii. Surveys for Intertidal Fish and Mobile Epifauna

19.3.15 Following a review of the existing biological datasets it was recognised that there was a lack of data relating to the utilisation of the intertidal zone by fish and mobile invertebrates. The location of HPC borders a large expanse of intertidal sediments: initial work had identified that this area could fall within the footprint of the thermal plume from the cooling water discharge. A study was initiated in August 2009 with an aim of increasing the knowledge base regarding the numbers and types of species utilising these habitats on both a temporal and spatial basis. To date, six surveys have been conducted over August, October and December 2009 and February, April and June 2010.

19.3.16 To gain a comprehensive understanding of the species utilising these habitats, the survey was designed to incorporate a range of techniques. Although primarily designed to target fish, mobile epifauna caught as bycatch were also recorded. The sampling strategy for fish was designed to follow the best practice WFD ‘multi-method’ approach, utilising a combination of static fyke nets and marginally deployed seine nets. Three sites were selected which were considered to provide a range of habitats and flows typical of the wider area of Bridgwater Bay, which are shown in **Figure 19.5**.

iv. Fish on Screen Surveys

19.3.17 As a check on the long-term fish on screens monitoring at HPB, an additional programme of such monitoring was established utilising a more comprehensive methodology designed to obtain a quantitative, rather than semi-quantitative assessment of the station catch over the course of a year. The methodology used was directly comparable (e.g. Ref. 19.207) to that used for scaling mitigation benefits associated with cooling water intake design improvements at previous nuclear power station developments in the UK.

c) Ecological Impact Assessment Methodology

19.3.18 Specific elements relating to marine ecology have been incorporated into the methodology where appropriate, as set out in the following tables.

i. Value and Sensitivity of the Receptor

19.3.19 The value of a receptor is determined based on geographical context (e.g. international, national, regional, see below) and conservation designations. Where appropriate, the criteria assigned for determining the sensitivity of receptors has been based on information derived from the Marine Life Network (MarLIN). The criteria utilised are summarised in **Table 19.5**.

Table 19.5: Criteria used to Determine Sensitivity and Value for Marine Ecology

Definition	Value and Sensitivity Guidelines
High	**Value** Feature/receptor possesses key characteristics which contribute considerably to the distinctiveness, rarity and character of the site/receptor e.g. Designated features of International/National designation/importance e.g. SAC, SSSI, Ramsar, SPA, BAP. Feature/receptor possess important biodiversity, social/community value and/or economic value. Feature/receptor is rarely sighted. **Sensitivity** Receptor populations are identified as having very low capacity to adapt to, or recover from, proposed form of change i.e. population is highly sensitive to change.
Medium	**Value** Feature/receptor possesses key characteristics which contribute considerably to the distinctiveness, rarity and character of the site/receptor e.g. designated features of Regional/County designation/importance e.g. BAP, Nature Reserves. Feature/receptor possess moderate biodiversity, social/community value and/or economic value. Feature/receptor is occasionally sighted. **Sensitivity** Receptor is identified as having low capacity to accommodate proposed form of change i.e. is moderately sensitive.

Definition	Value and Sensitivity Guidelines
Low	**Value** Feature/receptor only possesses characteristics which are of District or Local importance. Feature/receptor not designated or only designated at the district or local level e.g. LNR. Feature/receptor possesses some biodiversity, social/community value and/or economic value. Feature/receptor is relatively common. **Sensitivity** Feature/receptor is identified as having tolerance to changes within the range of natural variation i.e. is only slightly sensitive.
Very Low	**Value** Feature/receptor characteristics do not make a contribution to the character or distinctiveness locally. Feature/receptor not designated. Feature/receptor possesses low biodiversity, social/community value and/or economic value. Feature/receptor is abundant. **Sensitivity** Feature/receptor identified as being generally tolerant of the proposed change i.e. of low sensitivity.

ii. Magnitude of Impact

19.3.20 The criteria used to assign magnitude to an effect, with specific regard to marine ecological interests, are set out in **Table 19.6**.

Table 19.6: Criteria for Determining Magnitude for Effects on Marine Ecology

Magnitude of impact	Criteria
High	The quality and availability of habitats and species are degraded to the extent that locally rare populations and habitats are destroyed and protected species and habitats experience widespread change, such that the integrity of the ecosystem and the conservation status of a designation may be compromised. Activities predicted to occur and affect receptors continuously over the long-term, and during sensitive life stages. Recovery, if it occurs, would be expected to be long-term i.e. ten years following the cessation of activity. Impacts not limited to areas within and adjacent to the development.
Medium	The quality and availability of habitats and species are degraded to the extent that the population or habitat experiences reduction in number or range. Activities predicted to occur and affect receptors regularly and intermittently, over the medium to short-term and during sensitive life stages. Recovery expected to be medium term timescales i.e. five years following cessation of activity. Impacts largely limited to the areas within and adjacent to the development.
Low	The quality and availability of habitats and species experience some limited degradation. Disturbance to population size and occupied area within the range of natural variability. Activities predicted to occur intermittently and irregularly over the medium to short-term. Recovery expected to be short-term i.e. one year following cessation of activity. Impacts limited to the area within the development.

Magnitude of impact	Criteria
Very Low	Although there may be some impacts on individuals it is considered that the quality and availability of habitats and species would experience little or no degradation. Any disturbance would be in the range of natural variability. Activities predicted to occur occasionally and for a short period. Recovery expected to be relatively rapid i.e. less than approximately six months following cessation of activity. Impacts limited to the area within the development.

iii. Significance

19.3.21 The significance of the impact is judged on the relationship between the magnitude of effect and the assessed value and sensitivity of the receptor. The methodology used to assess the predicted significance of impacts, without mitigation, is outlined in **Volume 1, Chapter 7**.

19.3.22 For the purpose of this impact assessment, statutory designations and any potential breaches of environmental legislation take precedence in determining significance, because the protection afforded to a particular receptor or resource has already been established as a matter of law. Thus, using the defined criteria and IAM, features to which designations apply have automatically been determined to be of high value (or of a higher value than non-designated features), and as a result any impact tends to be of a greater significance than an impact on features to which no designation applies. Hence, for designated features, the use of the value criteria leads to an initial presumption that impacts will be of a high significance. Information on sensitivity can then be used to modify or maintain this initial assessment as appropriate.

d) Definition of Area of Effect

i. Introduction

19.3.23 The layout of the existing HPA and HPB cooling water (CW) intake and outfalls, together with the analogous HPC intakes and outfalls, is shown in **Figure 19.6**.

19.3.24 Thermal plume modelling was undertaken using both the General Estuarine Transport Model (GETM) and Delft 3D models (see Refs. 19.59, 19.65, 19.38, 19.67) to determine the area of effect of HPC on the marine environment. These models have been employed as a complementary 'ensemble' following Environment Agency guidance (see Ref. 19.68 and **Appendix 18A** to **Volume 2 Chapter 18**), and utilise the same physical data inputs but different algorithms for the solution of a range of variables in order to gain greater confidence over the degree of predictive uncertainty involved.

19.3.25 Both models were subject to the same degree of independent peer review, and identical requirements for calibration and validation against independent data sets. This ensemble was used to support both engineering design considerations and environmental considerations.

19.3.26 Model outputs used to inform this particular appraisal have been obtained primarily from the GETM model which, from experience in its use together with other models in similar circumstances, is known to predict slightly higher seawater temperatures in the mid to far field area of the thermal plume. The GETM outputs thus provide an indication of the upper bound of the temperature range likely to be experienced, whilst the Delft 3D outputs can be considered to reflect a lower boundary. Differences between such models, even when utilising the same input values and subject to audit against a standard set of criteria, are to be expected.

19.3.27 The outputs described here are provided in order to illustrate the extent of the thermal plume across the whole tidal cycle for neap and spring tides and thereby the area of effect of HPC.

19.3.28 The sea temperature of Bridgwater Bay and the River Parrett Estuary has been known to range naturally from 2 - 23ºC (Ref. 19.3). Key modelling outputs required to inform the assessment, indicating modelled increases above ambient temperature due to the thermal plumes of both HPC and HPB, are provided in **Volume 2**, **Chapter 18** of this ES, 'Marine Water and Sediment Quality' and are briefly summarised below.

19.3.29 As the key environmental sensitivity associated with the behaviour of the thermal plume is the impact on habitats, primarily the marine ecology in intertidal areas of Bridgwater Bay, the extent of plume intrusion into these areas has been taken to be the key indicator of environmental impact when evaluating possible intake and outfall locations. The modelling outputs have been employed in support of an assessment of the functional ecological implications of plume behaviour, described later within this chapter and within the HRA.

ii. Baseline and other Scenarios Tested

19.3.30 Three scenarios for HPC intake and outfall configurations were tested to simulate the range of potential locations and their effects on the environment. The range of intake and outfall positions tested is illustrated by **Figure 19.7**.

Table 19.7: Total Estimated Areas (in km^2) of Mean Annual Temperature Uplift due to Thermal Plumes from Different Power Station Intake/Outfall Configurations and Operational Regimes (from Ref. 19.59)

Configuration under Test		Thermal Uplift					
Hinkley Point C Load	Hinkley Point B Load	>1 °C Area (km^2)	>2 °C Area (km^2)	>3 °C Area (km^2)	>4 °C Area (km^2)	>5 °C Area (km^2)	>6 °C Area (km^2)
Tests for initial selection of Hinkley Point C discharge location – with simulated cooling water volumes of $120m^3/sec^{-1}$ at an average temp. of 12.2°C							
Cross shore discharge; 100% - Configuration 2	0%	22.6	6.22	1.502	0.377	0.166	0.053
Intermediate discharge; 100% - Configuration 3	0%	27.2	4.10	0	0	0	0
Offshore discharge; 100% - Configuration 1	0%	25.2	0.43	0	0	0	0

Configuration under Test		Thermal Uplift					
Hinkley Point C Load	Hinkley Point B Load	>1 °C Area (km^2)	>2 °C Area (km^2)	>3 °C Area (km^2)	>4 °C Area (km^2)	>5 °C Area (km^2)	>6 °C Area (km^2)
Tests using refined engineering information on selected offshore discharge location (configuration 5a) – with simulated cooling water volumes of 125m³/sec at an average temp. of 11.6°C and, for Hinkley Point B station (100% load) 53m³./sec⁻¹ at an average temp. of 10°C							
0%	100%	6.9	1.35	0.036	0	0	0
0%	70%	4.0	0.05	0	0	0	0
100%	70%	40.3	11.42	0.471	0.007	0	0
100%	0%	29.6	2.86	0.003	0	0	0

19.3.31 Allowing the cooling water of HPC to discharge directly onto the intertidal area west of Hinkley Point (termed 'Configuration 2') was found to result in a transport of heated water to the east, close to shore, resulting in an area of 1.4km^2 of intertidal habitat being exposed to an annual increase in water temperature of >2°C. Moving the outfall a moderate distance offshore ('Configuration 3') reduced this impact to 0.4km^2 and moving it a long distance offshore reduced the area of intertidal habitat subject to >2°C increase to zero ('Configuration 1').

19.3.32 'Configuration 1' thus produced the least thermal effect on the intertidal habitat and so became subject to engineering refinement in order to capture a realistic flow regime, a refined inlet design and modified intake/outfall locations informed by subsea geology, resulting in test 'Configuration 5a'. On testing, this configuration maintained the area of habitat subject to >2°C annual temperature uplift at essentially zero.

19.3.33 Further modelling was then undertaken to predict the combined effect of the proposed HPC station using 'Configuration 5a', with HPB at its current loading of approximately 70%. This in-combination configuration (termed 'Configuration 6a') showed a large intersection between thermal plume and intertidal habitat (see **Table 19.8**). This simulation estimated that an area of 2.55km^2 (2550ha) of Stolford Bay and Stert Flats would be exposed to temperature increases of >2°C. This comprises 2.31km^2 of low Total Prey Availability (TPA) and 0.24km^2 of medium TPA habitat (see Ref. 19.14), based on a formal classification of the invertebrate populations involved, and their availability as prey to higher trophic levels (this measure describes the availability of the overall macro-infauna food resource, using the summed biomass of all species present at a particular location; in this respect, it takes no account of individual preferences for particular prey species, summarising the total potential food available to birds across the site). Such an in-combination impact would only occur over a period in which both HPB and HPC were operational.

19.3.34 HPB is currently scheduled to cease operation in 2016. If it does so then there will be no overlap between the operation of HPB and HPC and, therefore, no in-combination impact involving the thermal plumes would arise. However, EDF Energy has stated that it will seek life extensions across its Advanced Gas-cooled Reactor (AGR) fleet (which includes HPB) of an average of 5 years, and longer if safe and economic to do so. There is thus a possibility that the operation of HPB may be extended beyond 2016. As a result there is a need to assess the impact of the continued generation of the two power stations both alone (HPB for baseline purposes) and in combination with respect to the influence of the thermal plume on marine ecology. For further discussion of the baseline assumptions incorporated in this assessment, see **Section 19.5** on **Scope of Assessment** below.

19.3.35 Should HPB operate at 100% load, the estimates provided in **Table 19.7** and **Table 19.8** suggest that the operation of HPC alone, using the distribution of the >2°C uplift, would effectively have no impact over potentially sensitive areas.

Table 19.8: Estimated Areas (in km^2) of Intertidal Habitat Impacted by Mean Annual Temperature Uplift Due to Thermal Plumes from Different Power Station Operational Regimes, Utilising Offshore Hinkley Point C Discharge Location (from Ref. 19.59)

Operational Regime		TPA Class	Thermal Uplift		
Hinkley Point C	Hinkley Point B		>1 °C) Area (km^2)	>2 °C) Area (km^2)	>3 °C) Area (km^2)
0%	100%	Low	1.67	0.61	0
		Medium	0.45	0	0
		High	0.57	0	0
		Very high	0.29	0	0
0%	70%	Low	1.30	0	0
		Medium	0.18	0	0
		High	0.15	0	0
		Very high	0.09	0	0
100%	70%	Low	4.59	2.31	0.10
		Medium	2.78	0.24	0
		High	0.68	0	0
		Very high	0.29	0	0
100%	0%	Low	3.74	0.03	0
		Medium	1.20	0	0
		High	0.10	0	0
		Very high	0	0	0

iii. General Understanding of the Ecological Effects of a Thermal Plume

19.3.36 A review of available literature and research findings has been undertaken to ascertain the potential effects that the change in the thermal regime associated with the HPC cooling water discharge may have on the marine environment. The material reviewed relates to a range of situations in which thermal impacts have been investigated in a range of geographical locations. Sources include the body of information generated during the BEEMS programme of studies.

19.3.37 A number of studies have been undertaken over the past 30-40 years to investigate the impacts of thermal effluent discharges on aquatic ecosystems around the world. These studies have indicated that the long-term discharge of thermal effluents into the coastal environment can result in significant community changes (Ref. 19.69) and have the potential to affect all components of estuarine ecosystems. These studies also indicate that these effects are commonly limited to a restricted area within a few hundred metres of the vicinity of the discharge point, depending on local tidal conditions (Ref. 19.70).

19.3.38 Ref. 19.21 lists some other studies on the response of marine communities to power station discharges outside the UK.

19.3.39 The water column of an estuary is generally well-mixed in terms of temperature and the temperature-stratification of a plume is predicted to vary depending on environmental factors such as temperature of the surrounding water and meteorological conditions. Turbulent conditions (e.g. from storms) will increase heat-loss by mixing with the receiving waters, while high winds will increase heat-loss by radiation to the air. Generally, the heated plume will be less dense and thus more buoyant than the receiving water, and so will rise to the surface and restrict direct impingement of the discharge water on the seabed. However, the plume may be the only layer of water in direct contact with shallow littoral habitats (see **Volume 2**, **Chapters 17** and **18**, and Ref. 19.20).

19.3.40 The potential impacts of a thermal discharge can be classed as direct or indirect impacts. The direct potential temperature impacts of thermal plume discharge fall into four categories (Ref. 19.71):

- the mean temperature in relation to normal temperature (the water is warmer);
- the absolute temperature (as it may approach lethal levels);
- short-term fluctuations in temperature (particularly tidally-driven); and
- barriers to fish migration.

19.3.41 Responses of marine organisms to the conditions allied with a thermal discharge can range from physiological effects, extended growing and reproductive seasons, increased metabolism, and behavioural changes associated with perceived stress (e.g. emigration) or use of defence mechanisms such as shell closure in bivalves, to debilitation (possibly increasing susceptibility to predation) or mortality. Other than the last two, such responses may be positive or negative. Generally, warmer-water species (those distributed further south in the northern hemisphere) are more tolerant of higher temperatures than are colder-water species. Species whose distribution includes the littoral zone are more tolerant than those from the sublittoral, and, within species, different populations are adapted to different thermal tolerances as a result of selection to their ambient habitat (Ref. 19.21).

19.4 Baseline Environment

a) Influence of the Physical Environment

19.4.1 The Severn Estuary has one of the largest tidal ranges in the world, reaching in excess of 13m at Avonmouth, a regime classified as 'hypertidal'. The extreme tidal and turbidity regimes of the Severn Estuary make it unique amongst British estuaries, with the physical environment strongly influencing the distribution and productivity of the biological assemblages present.

19.4.2 A consideration of these physical key features (see Ref. 19.17) is provided in **Volume 2**, **Chapter 17**, Coastal Hydrodynamics and Geomorphology, of this ES. Where particularly relevant to discussion within this chapter, certain key physical features are repeated here. **Table 19.9** below summarises the key ecological features that, in large part, arise from these dynamic conditions.

Table 19.9: Key Features of the Severn Estuary and Bristol Channel Relevant to the Marine Ecology of Hinkley Point (after Ref. 19.17)

Key Features: Physical	Comment
Large funnel shaped estuary facing the Atlantic	Influences fish species (particularly migratory) and other physical features, particularly tidal regime.
Large branching estuary	Sub-estuaries absorb energy at tidal frequencies, but input energy at longer frequencies because of river flow variation. The Parrett, Usk and others are not insignificant regarding freshwater influx into the system.
High salinity variation	Seasonal and tidal variation – River Parrett significantly adds to this in the Hinkley Point area.
Hypertidal	Rare at global scale – includes Bay of Fundy (Canada), the Seine and the Somme (France).
Periodic energy inputs	Spring to neap changes are major in magnitude, resulting in a system with a major component of fortnightly change (as well as other tidal periods). Long periods of low winds reduce the suspended solids concentrations, at least in surface waters. The sedimentary system is therefore periodic, which directly affects the light regime (hence production), the benthic habitats and thus the benthos.
Waves dominant in shallow water	In shallow areas, waves are dominant over the effects of tidal currents. Most important in the Hinkley Point area are the intertidal and shallow 'flats' where it is waves that are mostly responsible in terms of mobilising and/or changing the physical environment and thus affecting the biota.
Surprisingly sediment starved	The vast majority of the seabed in the Bristol Channel and Severn Estuary system is rock or coarse gravel; there is relatively little sand, and most (though not all) of the mud is in suspension or is intermittently mobilised.
Physics makes change in subtidal habitats the norm not the exception	Changes to the sediment transport system have the potential to induce major changes in habitat. Changes in sediment distribution (natural and man made) are likely and these will affect habitats – by definition.
Highly turbid – unique in UK	High concentrations of sediment are present within the water column (in both permanent and temporary suspension and is intermittently deposited) but there is relatively little contribution from the rivers or from the Outer Bristol Channel.
Entrance to Parrett – mobile banks	The mouth of the Parrett has a variety of intertidal and subtidal banks, which consist of layered sediments and are extremely mobile. They thus tend to have low density biota.
Existing Parrett plume impact on intertidal area	Freshwater runoff peaks are significant in that they affect the extent of the existing HPB thermal plume across Bridgwater Bay.
Periodic major changes in bed elevation	Erosion/deposition cycles occur naturally and periodically, especially in outer Bridgwater Bay.

Key Features: Physical	Comment
Coastline and seabed near Parrett susceptible to change	The Stert Flats peninsula is susceptible to breaching in the longer term (century scale), and breaching would significantly affect cooling water flows across the (greatly changed) intertidal habitats.
Residual circulation	Tidal averaging of flows shows strong outward residual flow from Flat Holm to the south side of channel off Kilve. Recirculation cells occur to north and south. This could both trap persistent contaminants or effluent, and provide routes for fish migration. Crudely summarised as: 'fish in north, out south'. This feature persists to the Holm Islands. Given the small magnitude of any residual circulation compared to the regular tidal flows, the significance of this feature is uncertain.
Benthic production dominated by intertidal compared to subtidal	Due to a combination of the distribution of tidally driven bed shear forces and the extreme levels of turbidity present in the water column, there is an apparent discontinuity in ecological production with little subtidally and that, over the soft intertidal areas, driven largely by microphytobenthos. The balance of primary production is thus skewed towards the intertidal zone.
Contains sub-systems which are relatively simple	The Bridgwater Bay ecosystem is relatively simple with few species dominant. Mysids, crabs and brown shrimp (*Crangon*) are important links in the food chain.
Migratory fish corridor	Important for a number of species of conservation interest (shad, salmonids, eel, lampreys).
Impoverished subtidal benthos	Extremely poor compared to other estuaries, because of periodic highly mobile seabed.
Highly productive intertidal soft shore benthos	Stable highly productive mud flats. The mudflats are of two general types: (1) eroding Holocene muds and clays, which are relatively resistant to erosion and able to form a habitat for infauna, and (2) periodically layered mobile sands and muds.

19.4.3 Recent hydrographic studies show that at offshore sites (1km to approximately 5km from the coast) tidal currents may reach a maximum velocity of $1.7 m.s^{-1}$ on spring tides and $1.4 m.s^{-1}$ on neap tides. Velocities were slightly lower at the nearshore site approximately 500m from the coast (peak of $1.5 m.s^{-1}$ on springs and $1.0 m.s^{-1}$ on neaps). Ebb currents were found to be stronger than on the flood tide at all locations.

19.4.4 An estimated 10 million tons of sediment is carried in suspension within the estuary on spring tides (Refs. 19.74 and 19.75). The consequent extreme turbidity levels within the estuary reduce the depth of the photic zone and limits growth of phytoplankton. Turbidity data for sites located off Hinkley Point (>1.5km from the coast) indicate that suspended solids can reach concentrations of $1 g.l^{-1}$ on both the ebb and flood of spring tides. At some locations, advective processes may be more important than local re-suspension processes in terms of determining suspended solid loads.

19.4.5 Literature relating to the invertebrate fauna of the Severn Estuary and the Bristol Channel describe the benthic macrofauna of the region as impoverished when compared with other estuaries, both in terms of the number of species and their abundance (Refs. 19.92, 19.93, 19.94 and 19.242). This finding is supported by the recent BEEMS studies (e.g. Refs. 19.28 and 19.40) around Hinkley Point. The large tidal movements and associated turbidity regime result in an extremely stressful physical environment in which benthic assemblages are primarily influenced by powerful tidal shear forces and the regular deposition, re-suspension and mobilisation of bottom sediments. These stressors restrict the number of species able to tolerate conditions within the estuary. In addition, no macroalgae occur subtidally as a result of a predominance of muddy sediments and the high turbidity of the water. Extreme storm events can also raise turbidity levels within the estuary and result in further temporary changes to estuarine assemblages in the vicinity of Hinkley Point.

19.4.6 The major drivers influencing the macrofaunal populations and species diversity and abundance are thus the high tidal shear forces and chronic sediment surface instability combined with the high turbidity, limiting subtidal primary production. In contrast, the shallower intertidal areas where tidal shear becomes progressively less significant are relatively stable, providing opportunity for the algal growth that is effectively restricted within the water column itself.

b) Phytoplankton and Other Sources of Primary Production

19.4.7 Due to the high suspended sediment concentrations, the photic depth in the estuary is confined to the immediate surface waters, which greatly limits the primary production of phytoplankton (Refs. 19.76-79). Although some phytoplankton are present in the highly turbid sections of the Bristol Channel, primary production rates are far greater in the less turbid areas. Intertidal sediments in the Severn Estuary are known to support microphytobenthic populations, which are frequently dominated by diatoms (Ref. 19.80). The re-suspension of these algae (and the substrates they inhabit) has been demonstrated in the Ems Estuary in The Netherlands, a large, physically dynamic estuary similar to the Severn (e.g. see Ref. 19.81). This strongly suggests that it is largely re-suspended microphytobenthos that contributes to the phytoplankton recorded in local open waters.

19.4.8 There is limited published information available regarding phytoplankton populations in the Bristol Channel and Severn Estuary. Refs 19.82 and 19.83 provide some data on phytoplankton species recorded in the Inner Bristol Channel. Of the diatom species indicated in these records some species are primarily benthic (e.g. *Actinoptychus* spp., *Bacillaria paxillifer, Gyrosigma* spp., *Melosira arctica* and all the *Nitzschia* species), while planktonic species include *Asterionella* spp., *Chaetoceros* spp, *Ditylum brightwellii*, *Odontella* spp. and *Helicotheca tamesis*. This suggests that at least some of phytoplankton component has a microphytobenthic origin.

19.4.9 In total 21 species were recorded off Hinkley Point from the phytoplankton surveys carried out between November 2008 and October 2009. The most frequently recorded species between November 2008 and July 2009 was the diatom *Odontella regia* which was present at all, or nearly all, of the sites on each occasion. This species also had the greatest density with the highest values recorded in July 2009 (reaching up to 1006 individuals per m^{-3}). However, this species was not recorded in the August and October 2009 samples, with *Paralina sulcata* being present at all sites in August and *Odontella sinensis* present at nearly all sites during October. The densities of phytoplankton varied among sampling periods with the highest phytoplankton densities recorded in July 2009, at a mean density of 278 individuals per m^{-3} (which was mainly due to high numbers of *O. regia*). However, when compared with other British coastal waters, phytoplankton densities were relatively low (Ref. 19.84).

19.4.10 The most frequently recorded species, *Odontella regia*, is regarded as a planktonic form. This species was found to occur in a 'low light' group of algae at Helgoland, in the North Sea around Germany (Ref. 19.85) suggesting it may be capable of growth within the extreme conditions of the Severn Estuary. In contrast, *G. delicatula* and *S. unipunctata* are more typical of coastal waters, suggesting they may have been transported into the estuary.

19.4.11 Ref. 19.253 summarises the carbon production budgets for the Bristol Channel. This analysis found annual primary production to be 165g $C.m^{-2}.y^{-1}$ in the Outer Bristol Channel but only 6.8g $C.m^{-2}.y^{-1}$ in the Inner Bristol Channel (excluding a contribution from the *Phaeocystis pouchetti* bloom which occurred in most years in the Central Channel in June). Peak production in the Outer Channel occurred in May/June and June/July in the Inner Channel. Both sub regions had a similar standing crop of phytoplankton, but the annual primary production in the Inner Channel was only 4% of that in the Outer Channel due to rapid light attenuation and the rate of vertical mixing in the turbid waters of the Inner Channel. A further study concluded that advection and dispersion by currents determined the phytoplankton concentration in the Inner Channel rather than local production. Ref. 19.254 suggests that production of microphytobenthos (MPB) on the exposed inter-tidal flats is a major source of primary production in the Inner Channel that may exceed phytoplankton production and that resuspended MPB could be a significant contributor to measured chlorophyll a values. This same study calculated that MPB primary production on the intertidal flats was approximately 33g $C.m^{-2}.y^{-1}$.

19.4.12 The relative importance of different production sources can best be appreciated by considering measurements of Total Particulate Carbon (TPC) in the Inner Channel in July of 2,800mg $C.m^{-3}$, of which 107mg $C.m^{-3}$ was 'phytoplankton' (calculated from chlorophyll a measurements) and 2.8mg $C.m^{-3}$ was zooplankton (Ref. 19.253). At its July peak the zooplankton stock was 50mg $C.m^{-2}$ (2.8 $C.m^{-3}$ x mean depth of 18m) compared with typical values from a thermally stratified Celtic sea site of 1000 to 3000mg $C.m^{-2}$ and 700mg $C.m^{-2}$ in the Outer Channel. Ref. 19.253 concluded that the majority of the TPC and chlorophyll a was allochthonous in origin, i.e. detritus mostly of a terrestrial origin, and that the low values of phytoplankton and zooplankton demonstrated the minor role that the plankton plays in this sub region.

c) Zooplankton

19.4.13 The limitation of primary production due to elevated turbidity levels within the Bridgwater Bay area has the potential to reduce production of any zooplankton which feed on these microscopic plants (Refs. 19.86-88). Estuarine zooplankton, however, are primarily detritivores and it is considered that the main factor limiting zooplankton growth within this system is the need to process high levels of solids for relatively little gain.

19.4.14 Surveys of zooplankton were carried out by the Institute for Marine Environmental Research (IMER) between 1971 and 1981 (Refs. 19.89, 19.90 and 19.253). Ref. 19.89 describes the species assemblages, biomass and seasonal cycles of zooplankton in the Bristol Channel and Severn Estuary. These assemblages were typical of estuaries in northern latitudes, both in terms of their abundance and species composition. Species diversity of the zooplankton in the Bristol Channel, and in the Severn Estuary in particular, has been reported as being relatively low when compared to other coastal shelf areas around the UK (Ref. 19.90) but such limited diversity is typical of the estuaries themselves, where only relatively few species occur although sometimes in very high numbers.

19.4.15 The holoplankton of the Inner Bristol Channel and Bridgwater Bay is dominated by calanoid copepods, primarily those of the genera *Acartia* and *Eurytemora* (Ref. 19.89). The dominant species are the estuarine resident species *Eurytemora affinis* together with the seasonal estuarine resident *Acartia bifilosa*, although *Centropages hamatus* may also occur in moderate densities as well as, less frequently, *Pseudocalanus*. These copepods have been recorded in maximum densities in July following increases in abundance in March, April and May (Refs. 19.89 and 19.90). These same references record the fact that mysids (particularly *Schistomysis spiritus*) also constitute a large part of the total zooplankton biomass in summer (approximately 80%). Meroplankton are generally only present in low numbers in the Bridgwater Bay area (Ref. 19.89).

19.4.16 Salinity and temperature are understood to be important environmental variables affecting zooplankton distribution; the powerful tidal movements also have a considerable influence (Ref. 19.90). When considering the biomass of zooplankton in the Bristol Channel and Severn Estuary, Williams, 1984 (Ref. 19.89) identified a gradient from higher biomass at the seaward extent to lower values further upstream. This gradient was more pronounced in spring for the omnivores and in summer for the carnivores (reflecting the pattern of food availability). Peaks in biomass in the omnivorous zooplankton occurred throughout the year. Carnivorous species such as *Sagitta* and *Pleurobrachia* tended to be more abundant in the latter half of the year.

19.4.17 Qualitative entrainment sampling for zooplankton from HPB has been undertaken monthly for the last 35 years (Ref. 19.91). Ref. 19.259 provides details of the community structure from samples collected between August 1994 and July 1995. Numerically the most abundant zooplankton in the HPB samples were copepods dominated by *Acartia* spp (>50% by number), followed by mysids dominated by *Schistomysis spiritus.*

19.4.18 A total of 43 taxa were recorded during the period between April 2007 and June 2009. The most abundant group of macrozooplankton collected over this sampling period was mysid shrimps, which form a significant component of the diet of pelagic and demersal fish in this area. The mysids showed a strong seasonal pattern in abundance and species-complement in relation to the salinity-cycle, with lowest numbers occurring in January and February. A notable feature of this long-term dataset has been the significant increase in mysid abundance over the last 30 years: peak mysid abundance is now almost six times the level observed in the 1980s and 1990s (peak of approximately 3000 individuals in 2008 HPB samples in comparison with maximum of 500 individuals per sample in the 1980s and 1990s). Since the commencement of sampling, the mysid assemblage has been dominated by three species, *Schistomysis spiritus, Mesopodopsis slabberi* and to a lesser extent *Gastrosaccus spinifer*.

d) Ichythyoplankton

19.4.19 Zooplankton surveys conducted as part of the BEEMS programme were dedicated towards gaining an understanding of ichthyoplankton (fish larvae and egg) abundance and distribution. Overall, fish eggs from nine taxa were recorded (anchovy *(Engraulis encrasicolus)*, rocklings (Lotidae), gurnard (Triglidae), European sea bass *(Dicentrarchus labrax)*, Dover sole *(Solea solea)*, solonette *(Buglossidium luteum)*, mackerel *(Scomber scombrus)*, pilchard *(Sardina pilchardus)*, scaldfish *(Arnoglossus laterna)*) and some unidentified eggs were also collected in June 2008 and May 2009. Larvae of herring (Clupeidae), sprat *(Sprattus sprattus)*, sandeel (Ammodytidae), dragonet (Callionymidae), gobies (Gobiidae), Dover sole, European sea bass and solenette were also recorded (Ref. 19.33). The majority of ichthyoplankton were caught during the May 2009 surveys.

19.4.20 The most frequently recorded component of the ichthyoplankton was anchovy eggs which were collected at over 30% of the stations, with a maximum abundance of 6.51 eggs per m^2 (where abundance is standardised to the number of units under $1m^2$ of sea surface). Historically, anchovy have been rarely reported in the area and its presence here (in particular, the presence of eggs, indicating local spawning) might indicate an increased northward distribution of the species from southern waters. The second most abundant ichthyoplankton group was goby larvae; goby eggs were also collected at 35% of the stations, with a maximum abundance of 2.46 eggs per m^2 (Ref. 19.33). High densities of sea bass larvae were recorded during the May 2009 surveys whereas previously these had not been recorded. With the possible exception of anchovy, the ichthyoplankton species identified during these surveys are not uncommon in coastal or inshore waters and did not have distributions which could be construed as unusual.

e) Subtidal Benthic Infauna

19.4.21 The benthic fauna of the Inner Bristol Channel and Severn Estuary is generally regarded as being an impoverished assemblage dominated by opportunistic species, as a result of the high instability of the sediments (Refs 19.92 and 19.93). The authors of Ref. 19.94 surveyed the bottom fauna at 155 stations in the Bristol Channel from Lundy Island to just above the Holm Islands, and found the area around Hinkley Point to have a reduced hard-bottom community owing to the effects of strong tidal scour. A more recent survey of the fauna of the deep-water channel and marginal areas of the Severn Estuary between Flatholm Island and King Pool, upstream of Hinkley Point, found the benthic fauna of *Sabellaria*-dominated seabed was impoverished when compared to similar habitats in the Bristol Channel and elsewhere in the British Isles (Ref. 19.95).

19.4.22 The recent BEEMS surveys, which sampled the benthos during five quarterly surveys in 2008 and 2009 (Refs. 19.28, 19.39, 19.40; sampling site locations are shown in **Figure 19.5**), found a total of 47 macroinfaunal taxa including *Sabellaria* spp., together with three hyperbenthic taxa (*Crangon crangon* and mysids) and sessile epifauna (bryozoans, hydroids, barnacles). Overall species richness and individual abundance were both very low, and in each of the quarterly surveys, several stations had no macrofauna in any of the samples taken (27% of some 300 grab samples taken across the study period contained no fauna at all). Where fauna were present, on average only 3 individuals were found per $0.1m^2$ sample – and the average number of taxa per $0.1m^2$ sample was <2.

19.4.23 The total numbers of taxa recorded across a single survey were higher in February, June and August of 2008 (23 to 26 taxa) than in the 2008-2009 winter (11 to 15 taxa), while densities of individuals were typically lowest in both winter periods.

19.4.24 Only nine species contributed significantly to this sparse assemblage across the whole study period. The bivalve molluscs *Macoma balthica* (mean abundance 22 individuals per m^2) and *Nucula nucleus* (32 individuals per m^2) dominated in terms of abundance and biomass and, together with the cumacean *Diastylis rathkei* (5.8 individuals per m^2), in terms of occurrence. *Macoma* was found primarily at only two sampling locations directly in front of HPA and HPB, with one observed density of 420 individuals per m^2, but elsewhere was rare. Three species of polychaete characteristic of muddy sands, *Nephtys hombergii* (mean 5.9 individuals per m^2), *Scoloplos armiger* (4.4 individuals per m^2) and *Aphelochaeta marioni* (1.6 individuals per m^2), were the only other taxa recorded in all quarters. The oligochaete *Tubificoides amplivasatus* was recorded in most quarters, while the gastropod *Hydrobia ulvae*, the amphipod *Harpinia pectinata* and the polychaete *Sabellaria alveolata* were the only other taxa to occur at an average density of one individual per m^2 or more, and in the case of the last three in only one quarter (survey).

19.4.25 In general, both macrofaunal species number and densities were found to be highest in nearshore locations and were lower at the sampling sites further offshore, but the data were too sparse to demonstrate any relationship between the “community” and the substratum type.

19.4.26 These low densities represent a high degree of impoverishment and reflect the dynamic conditions of the estuary. Surveys undertaken in autumn 2008 and spring 2009, using 0.5mm mesh sieving rather than the more usual 1.0mm mesh, identified a further component of the fauna. These surveys found that the oligochaete *Tubificoides amplivasatus* (potentially a significant food resource for fish and invertebrates) was the numerically dominant species, with average densities ranging between 200 individuals per m^2 (offshore, April 2009) to 2000 individuals per m^2 (nearshore, May 2009). Otherwise, the results confirmed that the benthic assemblages across the survey area were characterised by the same few dominant species, all at relatively low densities compared with populations elsewhere in the UK, but without any particular distinction in densities between nearshore and offshore stations.

19.4.27 Owing to the impoverished assemblages that make up the Hinkley subtidal benthos, attempts at multivariate analyses in order to explore pattern and its potential drivers tend to provide unsatisfactory results. Equally, it is difficult to attempt to correlate the assemblages that have been observed with the UK biotope classification (Ref. 19.96), although the assemblage present is closest to SS.SMu.SMuVS.NhomTubi *Nephtys hombergii* and *Tubificoides* spp. in variable salinity infralittoral soft mud.

f) Sabellaria

19.4.28 There are two species of the polychaete genus *Sabellaria* ('honeycomb-reef worms') found in the UK. *Sabellaria alveolata* is a Lusitanian species, commonly occurring in the low littoral but also extending into the sublittoral to depths of 20m or more; *Sabellaria spinulosa* is a colder water species, predominantly infralittoral/sublittoral, and mainly distributed off northern and eastern shores of the UK. Both species build sandy tubes; in the case of *S. alveolata* these tubes are normally colonial, and aggregate to form what can be substantial reef structures; *S. spinulosa* tubes are normally built horizontally on hard substrata, but may also aggregate to form reef-like structures (e.g. off the Wash, Eastern England).

19.4.29 Although these species have no statutory protection, their larger aggregations of tubes are considered to be biogenic reefs, consistent with the priority habitat 'reefs' in the sense of Annex 1 of the Habitats and Species Directive and as such *Sabellaria* is a qualifying feature of the Severn Estuary SAC. Biogenic reefs have a number of ecosystem functions: they may stabilise a sedimentary environment, provide hard substratum to which other sessile organisms may attach, can provide additional crevicial habitat, and can alter local hydrodynamics, leading to deposition or erosion of fine sediment particles and their associated organic matter (Ref. 19.97). These structures are therefore considered of some conservation importance under the UK Biodiversity Action Plan (Ref. 19.244).

19.4.30 A *Sabellaria* reef has been defined arbitrarily as a dense aggregation of worms (over 1000 per m^2), generally forming a thick (2cm or more) crust of tubes, covering an area generally exceeding $25m^2$, although patchily (Ref. 19.98). In practice, even the largest *S. alveolata* reefs are more patchy than extensive.

19.4.31 *S. alveolata* predominates on hard substrata both littorally and sublittorally in the Severn Estuary and Bristol Channel. The recent offshore surveys recorded *S. alveolata* (and possibly, but rarely, *S. spinulosa*) but only sparsely and on few occasions. Despite the recorded occurrence of sublittoral *S. alveolata* reefs in this vicinity (e.g. Refs. 19.2, 19.94 and 19.99), no aggregations of reef size were found in the recent Hinkley Point offshore surveys, although remote sensing surveys gave some signals which might suggest some *Sabellaria* reefs in the area.

19.4.32 *S. alveolata* reefs are common on the lower shore along the rock platform fronting HPA, up to 2m above Mean Low Water Spring (MLWS), and within the midfield dispersion pattern of HPB thermal plume. Surveys carried out locally on the intertidal area at Hinkley (Refs. 19.8, 19.11, and 19.12) found that the reefs growing within the flow of the cooling water discharge from the power station were substantially larger, commonly greater than 15cm in height and over 1m across, than those recorded elsewhere along this shore. These larger reef-units also supported a denser and more diverse associated fauna. Tube-building in *S. alveolata* has been shown to be greatest above 15ºC, lower at 10ºC and absent at 5ºC (Yves Gruet, pers. comm.). The greater size of the outfall reefs at Hinkley is attributed to continued growth of the worm (and thus its tubes) during winter periods, while reefs elsewhere were suppressed or even killed by winter frosts.

19.4.33 Recent surveys (Ref. 19.55) have confirmed the persistence of the *Sabellaria* reefs within the lower intertidal areas off Hinkley Point. Based on the classifications summarized in Ref. 19.96 these reef areas are considered to be generally of 'reduced quality', with some areas of 'moderate quality'.

g) Subtidal Epibenthos and Hyperbenthos

19.4.34 The epifauna is made up of species living on (above) the surface of the substratum, or living on other species which are themselves living on or protruding through that surface. The hyperbenthos includes those species living just above the sediment surface. This group includes the mobile epifauna, such as bottom-living shrimps, and prawns. *S. alveolata* is a member of the epifauna, and offers substratum to other sessile epifaunal species including bryozoans and hydroids; this species has largely been dealt with above.

19.4.35 Results from epifaunal surveys (Ref. 19.33) show the area in the vicinity of Hinkley Point to be supporting only a limited diversity of larger, mobile benthic invertebrates, with just 77 benthic invertebrate taxa identified over the three years of survey work. The Crustacea were the most diverse phyla found during the survey programme, accounting for 32-42% of all species recorded. Mollusca and Cnidaria (primarily colonial hydroids) were also key components of the community. The bivalve *Nucula nucleus* was the most abundant species observed, accounting for >38% of all individuals observed. Other key species observed were the cumacean *Diastylis rathkei* and the bivalve *Macoma balthica*.

19.4.36 The epibenthic invertebrate community varied spatially across the sampling area with significant differences in assemblage patterns apparent between nearshore and offshore communities. Assemblage patterns were also closely correlated to substratum, with diversity and abundance of species higher in the soft sedimentary environments in the centre of the survey area and the east of Hinkley Point, compared with communities on the coarse and mixed substrata to the west, which were typically less diverse and abundant. No clear temporal trends could be identified from the survey data.

19.4.37 The dominant species was the common shrimp, *Crangon crangon*, the most important prey species in this region for demersal and benthic fish (and various bird species); *C. crangon* was taken in every survey, and at more stations than any other species. *Crangon* is of some local commercial importance owing to the artisanal fishery on Stert Flats: studies in the 1980s (Ref. 19.100) showed that the Bristol Channel and Severn Estuary population size was of the order of 10^7 to 10^9 individuals, depending upon season.

19.4.38 The other dominant species were also decapod crustaceans, the swimming crab *(Liocarcinus holsatus)* and the pink shrimp *(Pandalus montagui)* being most common. Hermit crabs *(Pagurus bernhardus)* and edible whelks *(Buccinum undatum)* were occasionally present, and most other species incidental.

19.4.39 Impingement and entrainment studies carried out at HPB over the last 35 years have provided extensive information on the local mobile epifauna. The common shrimp *C. crangon* has been the most commonly caught species and has had the greatest abundances (Ref. 19.101). The *Crangon* population is known to remain relatively stable (although there was a year of exceptional recruitment in 2002), although it also exhibits trends both in relation to average water temperature from January to August, and with the Winter North Atlantic Oscillation Index (Ref. 19.102). The abundance of this species has shown seasonality in relation both to recruitment and to the seasonal salinity regime at Hinkley (Ref. 19.103).

19.4.40 Other common species caught at HPB intake screens included the common prawn *(Palaemon serratus)*, and the pink shrimp, which have both shown a clear gradual trend of increasing abundance locally (Ref. 19.102) as well as similar patterns of seasonality in relation to salinity (Ref. 19.103).

h) Intertidal Flora and Fauna

19.4.41 Hinkley Point is fronted by an area of cross-shore rock platforms. That area is flanked by further expanses of intertidal rock, with occasional pockets of sediment, extend to the west. To the east lie the intertidal mudflats of Bridgwater Bay and the saltmarsh areas lining the estuary of the River Parrett.

19.4.42 Given the extreme turbidity regime, the soft-shore microphytobenthos, the macroflora of the intertidal rocky areas and the saltmarshes provide the dominant contribution to primary production within the system (Ref. 19.104). In addition, subtidal benthic assemblages in the Severn Estuary and Inner Bristol Channel generally show low density and diversity (Refs. 19.1 and 19.28). Ecological activity in the Severn Estuary is thus disproportionately concentrated in the intertidal zone.

19.4.43 A number of surveys of the intertidal area at Hinkley Point were undertaken between 1982 and 2001, including environmental impact assessment (EIA) surveys for the proposed CEGB nuclear power station project (Ref. 19.10 and 19.105), and surveys investigating the presence of the mussel *(Mytilus edulis)* (Refs. 19.4, 19.11, 19.13 and 19.106). The results of these surveys indicated a stable community with low faunal and floral diversity.

19.4.44 Habitat and biotope mapping has been completed for this intertidal area (Ref. 19.55) and the mapping of the area fronting the HPC site is shown in **Figures 19.8** to **10**.

19.4.45 The rock platform at Hinkley Point is made up of relatively thin strata of mudstone and limestone which dip some 5° seaward. Erosion of the softer mudstone and progressive fragmentation of the harder limestone has resulted in a series of seaward-inclined limestone pavement platform ledges, running approximately parallel to the shoreline. The upper boundaries of these ledges form small “cliffs” or steps, up to 1m high, behind which water-filled gullies are retained over most or all of the tidal cycle. The angle of strike of the beds fronting the HPC Development Site is such that there is a clear trend in longshore drainage across these platforms whilst the tide is out, from east to west.

19.4.46 The limestone platforms support dense beds of fucoid algae, with a typical zonation from *Pelvetia canaliculata* at the upper-shore, through *Fucus spiralis* and *F. vesiculosus* to *F. serratus* and *Ascophylum niodosum* in the mid- to lower-shore. Hybrids of the *Fucus* species are present, and *Vertebrata lanosa* is common on the *Ascophyllum*. Macroalgae are absent below MLWS, owing to the lack of light in the highly-turbid waters, a condition which extends along this coastline from Kilve to

Sharpness (Refs. 19.3 and 19.107). The top of the shore supports green algae, notably *Ulva intestinalis*, *Ulva prolifera*, *Blidingia minima*, and *Blidingia marginata*.

19.4.47 The area supports a particularly impoverished red-algal flora (Ref. 19.3). There are, however, locally important red-algal communities and one such provides a distinctive feature on the Hinkley frontage: a series of *Corallina* 'run-offs' or 'swards' (Ref. 19.7 and 19.9). These coralline turf habitats have developed on the cross-shore rock platforms, where breaches in the upslope limestone scarps allow water to flow from these longshore drainage lines down across the relatively flat limestone pavement itself, locally maintaining a constant shallowly wetted area whilst the tide is out. A turf of *Corallina* forms dense carpets constrained entirely within the boundaries of these flows (see **Figure 19.11**). The position of these turf run-offs in the intertidal areas local to Hinkley Point has remained stable with time, as they are defined by the shore topography. The annual green algae *Ulva lactuca* can also be found around the margins of these coralline turf areas, as is *Fucus serratus* (Ref. 19.3 and 19.13).

19.4.48 Particularly extensive swards of *Corallina* are to be found adjacent to Hinkley Point and at a locale 3km east of Watchet; the *Corallina* swards found along this rocky intertidal area are thus locally unusual features. These swards provide a refuge habitat that harbours greater diversity than the surrounding rock, in much the same way as *Sabellaria* reefs. As such, these habitats are functionally important and considered worthy of special consideration in the assessment process. The *Corallina* run-offs at Hinkley were found to provide habitat for 38 species, including several which have not been recorded elsewhere in the locality, such as the isopod *Jaera praehirsuta*, the pycnogonid *Anoplodactylus pygmaeus*, and the polychaete *Platynereis dumerilii* (Refs. 19.7 and 19.9). In conservation terms, these mats and their associated communities can be considered as one of the more important intertidal habitats within the region (Ref. 19.3). It has been suggested that these features form part of the 'red algal turf' biotope and are recognized as nationally scarce, and have been designated as a notable community of the hard substrate habitat sub-feature of the SAC (Ref. 19.30).

19.4.49 The other distinctive and important habitat within the intertidal zone at Hinkley Point is that provided by the consolidated agglomerations of *Sabellaria alveolata* tubes, in some areas forming low or moderate grade reefs (as described earlier within this Chapter) – see **Figure 19.11**. Other species that have been found to be significant locally include barnacles, limpets, periwinkles, top shells, dog whelks and anemones, whilst the authors of Ref. 19.13 also noted the presence of rock-boring piddocks *(Pholas dactylus)*.

19.4.50 The area has a very low mussel population (maximum of ten individuals recorded in any one survey) with no naturally occurring, breeding populations of *Mytilus edulis* in the area (Ref. 19.6). When mussels have been found, they have always been in poor condition with low growth rates, and this has been attributed to the high turbidity providing a very low scope for growth for such filter feeding species.

19.4.51 Wide rock pool areas are present on the shore and between the limestone scarp ledges, but, owing to the high turbidity of the water, and the tidally driven cycles of deposition and re-suspension of muds within them, are either poorly colonized or un-colonized. Under-boulder communities are similarly sparse or absent, although shore crabs *(Carcinus maenas)* are present, particularly amongst the low-shore

Sabellaria reefs, where they are a major predator of *S. alveolata* (fragmenting and destroying the reef-units).

19.4.52 Areas of intertidal soft sediment are found predominantly to the east of the Point. The author of Ref. 19.5 surveyed the littoral fine-mud substratum immediately to the east of Hinkley Point (the "Submarine Forest"). The dominant macrofaunal species in that area were the bivalve *Macoma balthica* and the polychaete worm *Nepthys hombergii*. Juvenile gastropods and small spionid polychaetes were also frequent. Perhaps owing to the intense predation pressure on these species, from birds during low tide and from aquatic predators such as fish and decapod crustaceans (particularly *C. crangon*) when covered by the tide, individuals of these species are commonly small and fast maturing, as their survival to reproduction is highly constrained.

19.4.53 Recent surveys (Ref. 19.23) examined 40 soft-sediment sampling stations across the intertidal zone between Brean Down and Hinkley Point (see **Figure 19.5**). A total of 40 macrofaunal taxa were recorded, with a mean of only 6.6 taxa per station. The areas with the highest macrofaunal densities were generally found along the higher-shore regions of Berrow Flats and near the mouth of the River Parrett. Similarly, areas with the greatest macrofaunal biomass were along the upper shore region of Brean Down and Berrow Flats and towards the west of Stert Flats. Neither elevation nor median sediment grain size correlated with macrofaunal biomass or numbers of individuals. Biomass was dominated by three taxa: the Baltic tellin (*Macoma balthica* – 63%), ragworm (*Hediste diversicolor* – 15%) and the laver spire-shell (*Hydrobia ulvae* – 8%). The most widely distributed taxa were *H. ulvae* and *M. balthica* (each observed at 36 stations), with *M. balthica* more dominant on the mid to lower-shore, and ragworm more dominant on the upper shore. Average numbers of *Macoma balthica* over the surveys were 492 individuals per m^2. These species, particularly the tellin, represent the main food-resource for shore-birds and demersal fish and decapods.

19.4.54 The only other macrofaunal species of notable occurrence were the spionid polychaete *Pygospio elegans*, the amphipod *Corophium volutator*, and, at two sites on the south side of the River Parrett, the cleaner-sand-associated amphipod *Bathyporeia pelagica*.

19.4.55 The presence of mobile invertebrate species and the level of fish usage over the soft intertidal areas to the east of Hinkley Point intertidal surveys of the Hinkley Point frontage have been assessed using seine and fyke nets (Ref. 19.61). The commonest invertebrate species recorded were the shrimp *C. crangon*, the prawns *Palaemon elegans*, *Palaemon longirostris* and *Palaemonetes varians* and the mysids *Mesopodopsis slabberi*, *Neomysis integer* and *Schistomysis spiritus*. All of these are important prey species for the fish populations within the estuary.

19.4.56 Unicellular algae are the dominant source of primary production locally. Ref. 19.80 describes the 'intertidal epipelic (sediment surface) floral assemblages' (otherwise known as 'microphytobenthos') from samples collected between 1990 and 1991. Diatoms comprised over 95% of the living cells in most of these samples and occasionally the non-flagellated euglenoid *Euglena deses* was also abundant. Over 60 diatom taxa were identified with 15 to 20 of these recorded regularly throughout the survey period.

19.4.57 There are large fringes of saltmarsh in the estuary. *Spartina* spp. are particularly common and are abundant in Bridgwater Bay NNR (especially around the mouth of the River Parrett); *Spartina anglica* was planted in that area in 1929 as a flood defence measure. In Bridgwater Bay, this particular species now covers an area 3km long and 0.3 to 0.45km wide with an area of approximately 120ha (Ref. 19.108). The total area of saltmarsh habitat in the Severn Estuary as a whole is reported as 1521ha, the majority of which (75%) occurs on the English side (Ref. 19.3). The saltmarshes are regarded as significant nature conservation features and contribute to the SPA, Ramsar and SAC designations.

i) Coastal Squeeze

19.4.58 Loss and gain of intertidal area due to relative sea level rise, coastal squeeze and the possible responses within this particular area are discussed in several documents (see **Volume 2**, **Chapter 17**), although the quantitative estimates of the amounts involved are either missing, poorly explained or poorly defined. Several sources suggest that this will happen locally, without providing estimates. The description of Cell 11 within the current Shoreline Management Plan 2, which includes the Hinkley Point site, suggests that in the short-term (up to 2028) it will experience marginal erosion of 10-30% saltmarsh, although this depends on the evolution of the River Parrett (Ref. 19.109); the uncertainties in this estimate increase from 2058-2108.

19.4.59 Ref. 19.110 indicates an overall habitat loss of 1200ha from Land's End to St David's Head and a gain of >200ha but these values have not been broken down further for Severn Estuary. Lyn Jenkins (Environment Agency, unpubl.) gives a prediction for the Severn estuary of 700ha lost by 2026, 1300ha by 2056 and 2600ha by 2106 for sea level rise.

19.4.60 Ref. 19.111 emphasises that significant effects of sea level rise are likely on the European sites Severn Estuary SAC, SPA and Ramsar sites and that, as recognised by the Shoreline Management Plan 2, there will be the need for new seawalls thus exacerbating coastal squeeze, habitat loss and habitat fragmentation. That report suggests the general changes that are expected: saltmarshes and mud/sandflats will be reduced in the next two decades with a 7% decrease predicted for the whole Severn Estuary. With Bridgwater Bay potentially accreting, thus leading to a local extension of intertidal habitats, the wider intertidal loss may be minimal over the next two decades, but will then be followed by a 5-10% decrease over the next 50 years and 10-20% over the next century (Refs. 19.109, 19.110 and 19.111).

19.4.61 **Volume 2**, **Chapter 17** considers the likely change in the cross-shore profile fronting HPC, driven by relative sea level rise and down-cutting associated with both continuing erosion and dissolution of the limestone platforms. As distribution of both *Corallina* swards and *Sabellaria* reef are interlinked to the geomorphology of the area, then any long-term evolution in cross-shore profiles relative to tidal range will also lead to an alteration in the distribution of these species.

j) Predation by Waterfowl

19.4.62 A local 'assemblage of waterfowl species' is protected under the Severn Estuary SAC designation (Ref. 19.114), as a notable species sub-feature of the estuary feature. This assemblage is also included in the Severn Estuary SPA and Ramsar site designations (again see Ref. 19.114). The following key species are identified in the SPA and Ramsar designations:

- Bewick's swan *(Cygnus columbianus bewickii).*
- European white-fronted goose *(Anser albifrons albifrons).*
- Dunlin *(Calidris alpina alpina).*
- Redshank *(Tringa totanus).*
- Shelduck *(Tadorna tadorna).*
- Gadwall *(Anas strepera)*.

19.4.63 Curlew *(Numenius arquata)*, pintail *(Anas acuta)*, ringed plover *(Charadrius hiaticula)*, grey plover *(Pluvialis squatarola)*, Eurasian teal *(Anas crecca)*, lesser black-backed gull *(Larus fuscus)*, wigeon *(Anas penelope)*, pochard *(Aythya ferrina)*, spotted redshank *(Trynga erythropus)* and tufted duck *(Aythya fuligula)* are also included as components of the overall assemblage (Ref. 19.114).

19.4.64 It is beyond the remit of this chapter to provide an in-depth analysis of spatial and temporal patterns in the bird populations utilising the site; these issues are dealt with in **Volume 2**, **Chapter 20** Terrestrial Ecology and Ornithology. What is of interest here is the degree of dependency these species have on intertidal prey. Tidal flats are known elsewhere to be an important food resource for aquatic birds, which in temperate regions may remove 10-30% of macrofaunal biomass per year (Refs. 19.112 and 19.113).

19.4.65 Understanding the trophic relationships between components of an ecological system is important when attempting to predict the effects of marine operations, as changes in food sources may impact on consumers such as birds if they have particular food requirements. Thus, with an understanding that the thermal plume associated with HPC will extend across a part of the intertidal area of Bridgwater Bay, a functional investigation of the links between the Bridgwater Bay waterfowl assemblage and their potential intertidal food resource became necessary. A full description of the various allied studies that make up this functional assessment may be found in Ref. 19.14.

19.4.66 Information on the bird species frequenting Bridgwater Bay was extracted from local ornithology surveys and identification of the main intertidal-feeding species achieved by examination of their feeding preferences.

19.4.67 Bird count summaries were based on the 2002 to 2007 Wetland Bird Survey (WeBS) high tide Bridgwater Bay and October 2008 to March 2009 low tide western Bridgwater Bay core count data. The low water surveys recorded all wetland birds feeding or resting within the area of coastline or mudflats being surveyed, within two hours either side of the low tide. The mudflats to the east of Hinkley Point were surveyed from two fixed points, at Stert Flats and from Stolford. To the west of Hinkley Point, the coastline was walked from the bay near Lilstock to the west, to the boundary of Hinkley Point power station.

19.4.68 The existing dataset did not however provide all of the necessary information, as it lacked observations for September 2008; these were necessary to fully characterise the over wintering bird populations that feed on the mudflats outside of the breeding period. Thus, an additional September bird count dataset from surveys during 2010 was utilised to understand site usage in the month of September. Surveys were carried out from four observation points on Stert Flats, recording bird counts and behaviour. Surveys were conducted over six hours, allowing a description of changes or pattern in bird distribution across the tidal cycle.

19.4.69 Forty species were recorded as present in Bridgwater Bay during surveys undertaken in 2008, 2009 and September 2010; where 18 species accounted for 99% of all records. Four of the six SPA species were regularly recorded in the bay during 2008 and September 2010. European white-fronted geese and gadwall were not present over that period (although three or four gadwall have since been seen in the area; see **Volume 2**, **Chapter 20**). Three of the SPA species were commonly recorded (dunlin, redshank and shelduck), while a small number (no more than ten) of Bewick's swans were recorded in Stert Flats on two occasions in 2008. The swans were not observed feeding on the intertidal flats (**Table 19.10**).

Table 19.10: Commonly Encountered Bird Species Recorded as Feeding in Bridgwater Bay, ordered by dominance (from Ref. 19.51)

Common Name	Count	% of Total Count	Cumulative %
Dunlin	3602	45.8	45.8
Herring gull	677	8.6	54.3
Knot	602	7.6	62.0
Eurasian curlew	520	6.6	68.6
Common shelduck	509	6.5	75.1
Black-headed gull	435	5.5	80.6
Black-tailed godwit	375	4.8	85.3
Eurasian wigeon	316	4.0	89.3
Eurasian oystercatcher	188	2.4	91.7
Grey plover	116	1.5	93.2
Mallard	108	1.4	94.6
Northern lapwing	90	1.1	95.7
Northern pintail	77	1.0	96.7
Common redshank	65	0.8	97.5
Ruddy turnstone	38	0.5	98.0
Dark-bellied Brent goose	25	0.3	98.3
Ringed plover	18	0.2	98.6
Little egret	13	0.2	98.7
Meadow pipit	12	0.1	98.9

Note: Count represents the sum of bird counts per month, based on data from October 2008 to April 2009. SPA designation species are highlighted.

19.4.70 Information on the Stert Flats birds' feeding preferences comes mainly from the literature (see **Table 19.11**). Observations on feeding behaviour in other locations are not necessarily applicable to Bridgwater Bay, as species may have site-specific preferences. However, they can give a good general overview of the prey species likely to be consumed by the birds, especially if supported by site-specific information.

Table 19.11: Potential Prey of Regularly Occurring Bird Species in the Bridgwater Bay Intertidal Area (table adapted from Ref. 19.114)

Species	Common Name	Potential Prey	Notes	Important Intertidal Feeder?
SPA Species				
Calidris alpina	Dunlin	Small *Scrobicularia plana*, small *Macoma balthica*, *Hydrobia ulvae*, *Corophium volutator*, *Hediste diversicolor*, *Talitrus* spp, *Carcinus* spp		Yes
Tadorna tadorna	Shelduck	***Hydrobia ulvae***, ***Corophium volutator***, young ***Macoma balthica***, young *Mytilus edulis,* young *Cerastoderma edule, Hediste diversicolor,* Nematoda, Polychaeta, Nereididae, Copepoda, Ostracoda, Amphipoda, Mollusca, Tellinacea, Platyhelminthes, Coleoptera, Tipulidae	Feeds on small poly- and oligochaetes when *H.ulvae* in short supply	Yes
Tringa totanus	Redshank	*Mya* spp, *Scrobicularia plana*, *Macoma balthica*, *Hydrobia ulvae*, *Corophium volutator*, *Hediste diversicolor*, *Nephtys* spp,small *Carcinus maenas*, *Crangon crangon, Talitrus* spp		Yes
Cygnus columbianus bewickii	Bewick's swan (Tundra swan)	Seeds, fruits, leaves, roots, rhizomes and stems of aquatic plants grasses sedges, reeds	Intertidal resources are not the main food	
Anas strepera	Gadwall	Seeds, leaves, roots and stems of aquatic plants grasses and stoneworts	Intertidal resources are not the main food	

Species	Common Name	Potential Prey	Notes	Important Intertidal Feeder?
Common Species				
Larus argentatus	Herring gull	Fish, earthworms, crabs, molluscs, echinoderms or marine worms, adult birds, bird eggs and young, rodents, insects berries and tubers	Highly opportunistic diet, exploit almost any superabundant source of food, scavenger	?
Calidris canuta	Knot	*Mytilus edulis*, *Mya* spp, *Scrobicularia plana*, *Macoma balthica*, *Hydrobia ulvae*, *Hediste diversicolor*	Low knot populations have been attributed to low *Macoma* populations	Yes
Numenius arquata	Curlew	*Mya* spp, *Cerastoderma edule, Scrobicularia plana, Macoma balthica, Hediste diversicolor, Arenicola marina, Carcinus maenas,* *Skenea* spp, *Corophium volutator*, Nematoda, *Hydrobia ulvae*		Yes
Larus ridibundus	Black-headed gull	Aquatic and terrestrial insects, earthworms, molluscs, crustaceans, marine worms, fish, rodents agricultural grain	Highly omnivorous, shows scavenging behaviour	?
Limosa limosa	Black-tailed godwit	*Scrobicularia plana*, *Macoma balthica*, *Hediste diversicolor* Possibly also *Skenea* spp, *Corophium* spp, Nematoda, *Hydrobia ulvae*	Bridgwater Bay represents one of the most important sites in the country for this species	Yes
Anas penelope	Eurasian wigeon	Leaves, seeds, stems and root bulbs of pond weeds, fine grasses, horsetails and eelgrass, as well as algae	Herbivorous bird; animal material can however be taken incidentally	
Haematopus ostralegus	Oystercatcher	*Mytilus edulis*, *Mya* spp, *Cerastoderma edule, Scrobicularia plana, Macoma balthica, Hediste diversicolor, Arenicola marina, Carcinus maenas*		Yes
Pluviatilis squatarola	Grey plover	*Scrobicularia* spp, *Macoma balthica*, *Hydrobia ulvae*, *Hediste diversicolor, Arenicola marina*		Yes

Species	Common Name	Potential Prey	Notes	Important Intertidal Feeder?
Anas platyrhynchos	Mallard	Seeds and the vegetative parts of aquatic and terrestrial plants, terrestrial and aquatic invertebrates (insects, molluscs, crustaceans, worms) and occasionally amphibians and fish	Omnivorous and opportunistic species, it shows preference for freshwater and brackish habitat	Unknown
Vatellus vatellus	Northern lapwing	Adult and larval insects, spiders, snails, earthworms	Intertidal resources are not the main food	
Anas acuta	Northern pintail	Algae, seeds, tubers, vegetative parts of aquatic plants, sedges, grasses, aquatic invertebrates (insects, molluscs and crustaceans), amphibians, small fish	Omnivorous and opportunistic	Unknown
Arenaria interpres	Turnstone	*Mytilus edulis*, *Mya* spp, *Scrobicularia* spp, *Macoma balthica*, *Hydrobia ulvae*, *Corophium volutator, Hediste diversicolor*		Yes
Branta bernicla	Dark-bellied Brent goose	Algae, seaweeds, other aquatic plants (e.g. *Zostera* spp, *Ruppia maritima*, *Spartina alterniflora*, *Salicornia* spp)	Mainly herbivorous but it may occasionally take animal matter	Unknown
Charadrius hiaticula	Ringed plover	*Hydrobia ulvae, Corophium volutator, Hediste diversicolor*		Yes
Egretta garzetta	Little egret	Mainly small fish, aquatic and terrestrial insects (e.g. beetles, dragonfly larvae, mole crickets and crickets), crustaceans (e.g. *Palaemonetes* spp., amphipods), amphibians, molluscs (e.g. snails and bivalves), spiders, worms, reptiles and small birds	Highly opportunistic feeder	Unknown
Anthus pratensis	Meadow Pipit	Insects (e.g. flies, beetles and moths) and spiders	Lives on open grassland, tundra, dunes	

Note: *Prey sources identified as being consumed by birds utilising Stert Flats, confirmed by microscopic or molecular faecal analysis (Ref. 19.54), are <u>underlined</u> and those confirmed by both the literature and faecal analyses are shown* ***in bold****. Information on non-mudflat feeding SPA species occurring in Bridgwater Bay is included for reference. Birds are listed in order of dominance at the site.*

19.4.71 Faecal analyses of birds utilising Stert Flats were conducted under the BEEMS programme during 2010 and early 2011 (see **Table 19.12**). Droppings were collected from the vicinity of bird flocks observed on Stert Flats in April, July, September and November 2010 and January 2011. Shelduck was mainly targeted (as it was both common and important in a conservation context) although other droppings were collected, where possible. The faeces were subject to microscopic and molecular analysis, to provide a qualitative estimate of the birds' diets. Microscopic analysis aimed to qualify all identifiable food sources, while molecular analyses aimed at *Hydrobia ulvae*, *Macoma balthica*, *Hediste diversicolor* and nematodes. Full details of the analyses are given in Ref. 19.45-48 and 19.54.

Table 19.12: Dietary Constituents of Birds Utilising Stert Flats during 2010 and early 2011, as Identified from Microscopic and Molecular Analyses of Bird Faeces (Ref. 19.54)

	April 2010		**July 2010**		**November 2010**[a]		**January 2011**	
	N = 4 Shelduck n = 2 Unknown species n = 2		N = 5 Shelduck n = 3 Godwit/curlew n = 2		N = 34 Shelduck n = 27 Knot/dunlin n = 3 (no microscopy) Unknown species n = 4 (no microscopy)		N = 20 Shelduck n = 20	
	Mic	Mol	Mic	Mol	Mic	Mol	Mic	Mol
Nematoda	[b]	(1)	[e]	(1)		(15)		(19)
Polychaeta								
Nereididae								
Hediste diversicolor		(2)		(1)		(5)		
Copepoda	[c]							
Ostracoda								
Amphipoda								
Corophium sp.			[e]					
Mollusca								
Tellinacea[f]								
Macoma balthica		(3)		(1)		(6)		(8)
Hydrobia ulvae	[b]	(2)	[e]	(2)		(10)		
Skenea sp			[d]					
Platyhelminthes	[b]							
Coleoptera	[c]							
Tipulidae								

Note: Surveys focussed on shelduck, although droppings from other species were collected, where possible. Table entries refer to shelduck droppings, unless otherwise stated.

Mic = microscopic analysis; Mol = molecular analysis; (#) Numbers in parentheses indicate the number of droppings in which the prey taxon was identified. Molecular analyses aimed only at *Macoma balthica, Hediste diversicolor, Hydrobia ulvae* and nematode.s and data are presented for the species overall.

[a] All samples subject to molecular analysis; only the first 20 were microscopically analysed.

[b] Only recorded in droppings from unknown species.

[c] Recorded in shelduck and unknown species droppings.

[d] Only recorded in godwit/curlew droppings.

[e] Recorded in shelduck and godwit/curlew droppings.

[f] Likely to be *Macoma balthica*, as no other Tellinacean recorded at Stert Flats during the BEEMS surveys.

19.4.72 Taken together, the analyses suggest that shelduck foraging on the flats have relatively diverse diets (Ref. 19.14). Molecular analysis (Ref. 19.54) confirms that local shelduck consume *Hydrobia ulvae*, *Macoma balthica*, *Hediste diversicolor* and nematodes. The molecular tools suggest uptake of additional prey species (the large number of bands detected on the analysis gels indicates the presence of other species) and microscopic examination of the droppings confirms polychaetes, platyhelminths, insects and a range of crustacea are consumed, as well as, potentially, microphytobenthos or macroalgae (some droppings were tinted green, though the source of this colouration is yet to be identified). Godwits/curlew (the droppings were recovered from a mixed godwit/curlew flock and could not be differentiated) on Stert Flats consume nematodes, *Corophium* species, *Hydrobia ulvae* and *Skenea*, another gastropod genus.

19.4.73 The qualitative nature of the analytical methods employed negates the possibility of ascertaining the precise extent to which the birds consume the various prey sources, and these analyses relate mainly to shelduck. However, the fact that the results support the food sources identified in the scientific literature increases confidence that the food preference is generally-sourced.

k) Distribution of Bird Prey Resources

19.4.74 Initial investigations of bird-invertebrate food web links focussed on the overall prey resource. This is a useful initial approach, when a variety of bird species are of interest and/or where specific feeding preferences are not known. In order to do this, a measure of food availability, 'Total Prey Availability' (TPA) (Ref. 19.29), was used. This measure describes the availability of the overall macro-infauna food resource, using the summed biomass of all species present at a particular location. In this respect, it takes no account of individual preferences for particular prey species, summarising the total potential food available to birds across the site.

19.4.75 TPA is calculated as: $TPA_z = E \int B_i$ where E = emersion time at station Z, and Bi = total biomass of all individual prey species > 1mm at station Z. Biomass was utilised, rather than the number of individual prey items, as this is more closely related to the energetic requirements of foraging birds (Re.19.116). Details of the calculations are given in Ref. 19.14 and the process is shown in **Figure 19.12**.

19.4.76 The total biomass of all potential prey items varied across the site. A trend of increasing biomass with increasing station elevation was visible for transects to the north of the Parrett estuary mouth, but this pattern was less clear to the south (**Figure 19.12 A**). After weighting biomass by emersion time, the importance of high shore sites was further increased (**Figure 19.12 B**) so that the final map of Stert Flats featured two potential feeding hotspots (**Figure 19.12 C, D**). One was located along the northern edge of the Flats close to the Parrett; the other along the southern shoreline of Stert Flats. Stolford Bay, to the east of Hinkley Point, may be a low-quality habitat for foraging birds, due to its combination of low macrofaunal biomass and shorter emersion time. Seasonal or inter-annual patterns of TPA have yet to be assessed for Bridgwater Bay. However, there was some degree of seasonal variability in the infaunal assemblages overall (although little evidence of significant short-term inter-annual variability).

19.4.77 While this approach gives a good overview of the potential food available to birds feeding on the mudflats, it does not differentiate between species likely to be consumed and those not favourable to the birds. Once further information on bird species utilising the site and understanding of their feeding preferences had been gathered, further investigations focussed on specific bird and prey species.

19.4.78 Inspection of the overall feeding preferences and infauna survey information suggests the main infauna species on Stert Flats known or likely to be consumed by the local birds are the Baltic tellin *(Macoma balthica)*, ragworm *(Hediste diversicolor)* and laver spire shell *(Hydrobia ulvae)* (see Refs. 19.23 and 19.62). They are all patchily distributed across the Bridgwater Bay intertidal flats, with *H. diversicolor* seeming to be more common in the upper shore and *M. balthica* in the lower – see **Figure 19.13**. Information on seasonal variability in these food sources was not available at the time of writing, although the mudflat fauna are known to be relatively stable between years. The predator and prey links are described in Section 19.6 ii).

l) Fish Assemblages

i. Introduction

19.4.79 This section provides information on the fish assemblages and associated resource (from a commercial perspective) of the Severn Estuary. The information covers all fish species which may potentially be impacted at some stage of their lifecycle by the marine works associated with HPC and thus includes the populations of fish which utilise the Severn Estuary as a migratory conduit between the sea and rivers flowing into the Severn Estuary, together with purely marine species which may utilise the estuary for the whole, or only part of their lifecycle.

19.4.80 When considering estuarine fish species, especially in connection with WFD requirements, it is important to understand the Ecological Use Functional Guild (EUFG) and to which guild each species belongs. The main ecological guilds for estuarine fish have recently been refined (Refs. 19.117, 19.118 and 19.119). The categories with their abbreviations are summarised below based on Ref. 19.120:

- *Estuarine Species* (ES): Can be resident (i.e. entire life cycle estuarine) or migrant (i.e. adults spawn in estuaries, marine larval phase, with juveniles returning to an estuary). Species with discrete populations in both estuarine and fully marine environments are included.
- *Marine Migrants* (MM): Adults live and spawn in marine environments, with juveniles frequently found in estuaries in large numbers. Juveniles can be opportunistic (i.e. can find suitable conditions within or outside estuaries), or dependant (i.e. require estuarine types of habitat).
- *Marine Stragglers* (MS): Live and breed in the marine environment. No estuarine habitat requirements but can enter lower reaches of estuaries. These stenohaline species generally avoid areas with salinities of less than 35‰, which can restrict up-estuary movement.
- *Anadromous* (A): Most growth occurs at sea, adults migrate from coastal marine areas to freshwaters to spawn (e.g. Atlantic salmon).

- *Catadromous* (C): Adults migrate from freshwaters to marine areas to spawn, but most growth occurs within freshwaters (e.g. European eel). Anadromous and catadromous species can be grouped together as diadromous species, i.e. migrating between marine and freshwater environments.
- *Freshwater Species* (FS): Those freshwater species found frequently, but in moderate numbers in estuaries and whose distribution only occasionally extends beyond areas of low salinity.

ii. Published Information

19.4.81 Numerous studies have been conducted examining fish assemblages within the Severn Estuary and the Bristol Channel (e.g. Ref. 19.121). As a result, information is available regarding species richness, assemblage composition and population dynamics of the Estuary and Channel (e.g. Refs. 19.122, 19.123 and 19.124), and a number of studies have been conducted to investigate the life history and migratory movement of specific species (e.g. Refs. 19.125-129).

19.4.82 No systematic targeted surveying or sampling of diadromous species is undertaken in the Estuary. Indeed, the paucity of diadromous species in long-term HPB intake records indicates that these species are highly dispersed across the Inner Bristol Channel in the Estuary, and can only be sampled in meaningful numbers when aggregated for reproduction in rivers.

19.4.83 Various data sources exist for diadromous species. Due to the high recreational, commercial and conservation value of salmon, a systematic monitoring framework exists for determining the status of various salmon fisheries. Data from rod catches and in some instances fish counters are used to estimate total run size, annually, on a river-by-river basis. The population size is then expressed in terms of the percentage of a conservation limit. The conservation limit is the number of salmon required to fully populate the river with juvenile salmon and is established for each river based largely on the area of suitable juvenile habitat present.

19.4.84 The recent SAC designation of the Wye, Usk and Tywi for shad and the Wye and Usk for sea and river lamprey under Annex I and Annex II of the Habitats Directive has created an impetus for monitoring these populations. Recent reports on lamprey (Ref. 19.130) and shad (Ref. 19.131) provide a basis for the assessment of these species. Both reports also discuss the results of surveys for these river populations in terms of the Severn Estuary. River specific datasets have been used to assess the status of riverine populations of species directly; the status of these species in the Estuary has been inferred largely from this data.

iii. The Hinkley Point B Severn Estuary Dataset (SEDS)

19.4.85 A comprehensive source of information regarding the abundance and species richness of fish in the Inner Bristol Channel is provided by the entrainment and impingement data collected at HPB since 1981. These long-term studies were instigated by the CEGB and since then monthly samples have systematically been taken and recorded. A long-term dataset of this nature is both uncommon and helpful. This dataset, currently maintained by Pisces Conservation with the sampling supported by the HPB operator and known of as the 'Severn Estuary Dataset'

(SEDS), is primarily of use in assessing the status of purely marine species, but is also relevant to some diadaromous species, most notably the eel *(Anguilla anguilla)*.

19.4.86 A total of 83 estuarine and marine fish species have been recorded since these surveys began. Between April 2006 and March 2007, 29 fish species were recorded and 42 species were recorded between January and December 2008 (P. Henderson *pers. comm.*). Prior to the relatively low species richness of the 2007 catch, the number of species caught each year ranged from a low of 33 in 1982 to a high of 46 species in 1998 (Ref. 19.124).

19.4.87 The ten most abundant species recorded within SEDS are sprat *(Sprattus sprattus)*, whiting *(Merlangius merlangus)*, sand goby *(Pomatoschistus minutus)*, poor cod *(Trisopterus minutus)*, Dover sole *(Solea solea)*, pout *(Trisopterus luscus)*, common sea snail *(Liparis liparis)*, sea, bass *(Dicentrarchus labrax)*, flounder *(Platichthys flesus)* and dab *(Limanda limanda)*. Eight of these species are marine migrants with one marine straggler (dab), and one estuarine species (sand goby). In terms of abundance and diversity, marine migrants provided the greatest contribution to the fish assemblage in the Bristol Channel around Hinkley Point, and while marine straggler species richness is relatively high, they are frequently represented by a small number of individuals.

19.4.88 The routine monitoring undertaken at HPB indicates a gradual increase in the number of fish caught, related to increasing sea temperature and decreased salinity. Increasing abundance has been observed for species which are relatively close to their northern limits in the Bristol Channel such as sole and sea bass. Conversely, species relatively close to their southern limit in the Bristol Channel (i.e. relatively cold-water preferring species) e.g. dab and sea snail, have experienced a decline in abundance. An observed step change in the set of occasional visitor species (i.e. those species with a northern distribution limit at the Bristol Channel, or just south) has also been related to increased sea temperatures.

m) Fish and Fauna

19.4.89 The high tidal flows and turbidity observed locally create harsh environmental conditions for fauna, with the subtidal seabed areas being largely depauperate in terms of invertebrates. It is often claimed that this results in a unique fish community. However, SEDS shows that the fish community is broadly similar in structure to that of other estuaries in the south of England (Ref. 19.132).

19.4.90 The impoverished benthic fauna means that the fish productivity of the Bridgwater Bay area is primarily dependant upon mysids, amphipods, and euphausids, in addition to the brown shrimp, *C. crangon* (Ref. 19.133). Few fish complete their entire life cycle in the area. Rather, most marine species exploit the productivity of the intertidal areas as juveniles, moving in and out of the Severn Estuary and Inner Bristol Channel seasonally in response to limitations of low temperature and salinity in the latter part of winter. *C. crangon* is thought to be limited by low temperature and salinity. This winter period also coincides with periods of lower prey availability, as observed in mysids and carideans (Ref. 19.134) and *C. crangon,* which are also thought to be limited by low temperature and salinity. The variable chemical and physical conditions prevalent locally, combined with low levels of small zooplankton required by larval fish, render the area unsuitable for reproduction. Adult fish thus migrate offshore to waters with more stable physio-chemical conditions and abundance of planktonic prey. On maturation, many fish move offshore. Eggs and larvae then colonise local estuarine areas via tidal movements in the summer and autumn, although some post-larval fish such as sprat and transparent goby may enter in early spring.

19.4.91 Although not unique in terms of community structure, the authors of Ref. 19.128 conclude that the extent of sheltered estuarine habitats present in the Bristol Channel means that it should be considered amongst the most important nursery areas in Britain.

i. Marine Species

19.4.92 The broader fish population of the Severn Estuary and Bristol Channel is of a similar species composition to that of other estuaries and coastal regions in south-west England (Ref. 19.132), comprising approximately 80 species. The most common species are sprat and whiting, which are present at an order of magnitude higher by number than the next most abundant species, namely poor cod, sand goby, sea snail, pout and sole. For marine species, the estuary is primarily used as a nursery ground – the extensive areas of shallow marginal mudflat provide extensive juvenile feeding opportunities, but none of the species present completes its entire life cycle within the estuary. Studies indicate that the estuary holds a single, mobile fish community and relative abundances observed at HPB are representative of the estuary between Berkeley and Minehead.

19.4.93 Recent years have seen a marked increase in the abundance and species richness of fish in the Estuary (Refs. 19.123, 19.128), which may be as much as threefold the abundance observed in the early 1980s. Although this is partially attributable to improved water quality, as proposed by Ref. 19.123, increased temperature and decreased salinity appear to be the predominant environmental factors causing this increase. To some extent this may also reflect the large natural interannual variations commonly observed in some species, notably the pelagics.

ii. Seasonality of Fish Presence, Abundance and Migration

19.4.94 Numbers of individual fish present in the Estuary, indicated by captures at HPB, show a clear seasonal pattern with lowest numbers present in April and May rising steadily through the summer and autumn to a peak in December, where numbers decline in January, February and March. Species abundance follows a similar, albeit less pronounced, seasonality. Lowest annual monthly average species counts occur in May, June and July, peaks in abundance occur in October and November and then abundance declines throughout the remaining winter months and spring.

19.4.95 The HPB SEDS data reveals patterns in abundance. Peak abundances for the 13 most common species (which comprise 95.6% of the total number of individuals) are illustrated in **Figure 19.14**. This shows that most species exhibit a peak from September to January with all species being present for all or almost all of the year. However, it is also apparent that the area is used to an appreciable extent at all times of the year, with no clear period when all fish species are in low abundance.

19.4.96 The majority of fish species which occur in the area around Hinkley Point can be regarded as opportunists, which spawn elsewhere. The tolerance of lower salinities of many of these opportunists enables them to exploit the higher productivity and/or lower predation risk present locally.

19.4.97 Larvae of these species are tidally transported from offshore areas into the Inner Bristol Channel in the late summer and autumn. Upon metamorphosis these then colonise progressively upstream areas for a number of months utilising selective tidal stream transport. Broadly speaking, young of the year migrate seaward again in winter months, in response to reducing salinity (Ref. 19.122) and/or temperature. In the case of a number of fish species, in particular gadoids, the seaward migration is closely correlated with and in response to abundance of *C. crangon* (Ref. 19.122). This pattern of progressive colonisation in late summer and autumn, peak abundance in September and October, followed by reduced abundance due to seaward migration, can be seen for sand goby, sole, dab, pout and sea bass **Figure 19.14** with similar but delayed patterns occurring for poor cod whiting and grey mullet. Such species will undertake several years migrating between estuarine regions and the sea before maturing, when they adopt a purely offshore existence.

19.4.98 As discussed above, the benthic fauna of the local sea area is generally impoverished, with the shallower margins having a relatively high benthic productivity compared to the relatively barren, deeper areas (Ref. 19.36). The shallow margins are also the preferred habitat of crustacean prey, most notably the brown shrimp *(C. crangon)*.

19.4.99 Given the benthic conditions and the associated impoverishment, the very much more productive intertidal mudflats are of primary importance to fish. Of the four most abundant flatfish in the Severn, plaice and flounder utilise tidal transport to migrate shorewards with rising tides, feeding only on intertidal areas at high tide. Dab and sole, however, also utilise subtidal habitats for feeding (Ref. 19.135) although in the case of sole, 'this year' juvenile fish (0+) were found to prefer shallower regions (Ref. 19.136). This dependence on, and preference for, intertidal areas is related to prey abundance, notably *C. crangon* which is a key prey source (Ref. 19.133). The preference for sheltered shallow areas is also noted for gadoids (Ref. 19.122) and sea bass (Ref. 19.137). Ref. 19.243 confirms that the high intertidal offers optimal habitat for the early life stages of species such as sea bass.

19.4.100 Ten marine species found within the area are UK BAP species: cod *(Gadus morhua)*, herring *(Clupea harengus)*, plaice *(Pleuronectes platessa)*, sole *(S. solea)*, whiting *(Merlangius merlangus)*, blue whiting *(Micromesistius poutassou)*, hake *(Merluccius merluccius)*, horse mackerel *(Trachurus trachurus)*, ling *(Molva molva)* and saithe (*Pollachius virens*, coalfish). The entire estuarine fish community fulfils the Ramsar Criterion 8, which considers a wetland to be internationally important if it is an important source of prey for fishes, or is a spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend. These are inherent characteristics of estuaries and their associated fish communities (Ref. 19.135 and 19.138). Similarly, the area fulfils Criterion 7 in which a wetland is internationally important when supporting '"*a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity*". In having a total of just over 80 species, the estuary has a species complement comparable to other similar estuaries in Europe (Ref. 19.120 and 19.138).

19.4.101 Cod and the thornback ray are listed on the OSPAR List of Threatened and/or Declining Species and Habitats, however, thornback ray is only listed as under threat and/or in decline in the Greater North Sea and not in the Bristol Channel area. Cod is rated as vulnerable on the IUCN Red List of Threatened Species (Ref. 19.140).

iii. Diadromous Fish Species

19.4.102 Diadromous fish primarily utilise the Estuary for migration between their natal rivers - most notably the rivers Wye, Usk and Severn, and marine feeding grounds. Seasonal migratory utilisation of the Severn Estuary is described in **Table 19.13.** They may also use the estuary for feeding, e.g. in the case of juvenile shad, and river lamprey. The following paragraphs describe the migratory species associated with the Severn Estuary and associated rivers.

19.4.103 Seven diadromous fish species are known to migrate through the Severn Estuary; Atlantic salmon *(Salmo salar)*, twaite shad *(A. fallax)*, allis shad *(Alosa alosa)*, river lamprey *(L. fluviatilis)*, sea lamprey *(P. marinus)*, sea trout *(Salmo trutta)* and European eel *(Anguilla anguilla)*. Each of the species is anadromous with the exception of the catadromous eel. All of these species, apart from sea trout and eel, are listed as Annex II species under the EC Habitats Directive (92/43/EEC). In addition, Atlantic salmon and river lamprey are listed under Annex V of the Directive. All of these diadromous species are afforded protection as UK BAP priority species. Sea lamprey and salmon are also on the OSPAR List of Threatened and/or Declining Species and Habitats and both sea and river lamprey are on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species (Ref. 19.140). Twaite shad is also on the IUCN Red List of Threatened Species and is listed under the Wildlife and Countryside Act 1983. All of the above mentioned species, except shad and Sea trout are protected under the Salmon and Freshwater Fisheries Act 1975 as amended by the Marine and Coastal Access Act, 2009.

19.4.104 All seven migratory species found within the estuary together form a qualifying feature of the Severn Estuary Ramsar site. Although each of these species is present, only twaite shad, river and sea lamprey are qualifying features of the SAC designation of the Severn Estuary.

19.4.105 At least two individuals of five of the seven migratory species have been recorded at the intake screens of HPB (the exceptions being allis shad and sea trout). In particular, relatively high numbers of juvenile twaite shad have been entrained at Hinkley Point with annual catches ranging from fewer than ten individuals in 1981, 1982, 1987, 1988, 1991 and 1993 to over 100 in 1989 (Ref. 19.141). Numbers of twaite shad impinged at Hinkley Point tend to peak in July and August.

iv. Estuarine Populations of Diadromous Species

19.4.106 In the context of estuarine fish species as a whole, other than eels, anadromous species of populations belonging to the adjacent rivers are rare, and infrequently recorded. For these migratory fish, the long-term data from HPB is of more limited value. Other data are required to assess these populations which, although rare, form the basis of the statutory nature conservation designations of the Estuary and the adjacent rivers. Given that anadromous fish populations are more amenable to survey when aggregated in rivers of origin, river specific data is more meaningful due to each river representing a discrete management, (and for some species, biological) unit. Riverine survey data have been relied upon and the available data, as presented for individual species below, have been interpreted in the context of the Estuary.

19.4.107 Lamprey and shad surveys carried out on the rivers Wye and Usk provide an indication of the conservation conditions for these rivers (Ref. 19.130 and 19.131). In the absence of direct data, the Severn Estuary populations for these species can be inferred. Ref. 19.130 discusses the validity of inferring the health of estuary populations from the adjacent rivers, specifically in the context of the Severn Estuary. The main uncertainty lies in the extent to which other rivers (most notably the Severn) contribute to the estuarine population, and the health of these populations. If, as has been suggested, lamprey populations are less faithful to their river of birth and the Severn population is therefore a more homogenous population, then the status of the species in any one river (e.g. the Wye or the Usk) can be considered to be representative of the estuarine population as a whole. If this is not the case, the Usk and Wye together are likely to comprise a sufficiently large proportion of the Severn Estuary population to make the assumption nonetheless correct, as only a very small percentage of lamprey in the estuary will be derived from other rivers and retain some heterogeneity.

Table 19.13: Migratory Movements of Diadromous Species found within the Severn Estuary, showing Important Months and Directions of Movement

Species	↑/↓	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Salmon	↑			■	■	■	■	■	■	■			
Smolt	↓				■	■	■						
Sea trout	↑						■	■	■	■			
Shad	↑				■	■	■						
Shad (Juv.)	↓				■	■		■	■	■			
Sea Lamprey	↑	■				■	■	■					
S. Lamprey (Juv.)	↓										■	■	■
River Lamprey	↑	■		■	■				■	■	■	■	
R.Lamprey (Juv.)	↓	■	■	■	■	■					■	■	■
Eel	↓									■	■	■	
Elvers	↑				■	■	■	■	■	■			

v. Salmon

19.4.108 Adult salmon migrate upstream primarily from July to September, with fish migrating during this time being primarily one-sea-winter salmon. Adult salmon also migrate in earlier months of the year, and although inferior in number, these comprise higher numbers of multi-sea-winter salmon. Multi-sea-winter salmon, and those which migrate upstream in earlier months (traits partially genetically determined and co-related) are of higher conservation importance than salmon generally and have undergone disproportionately large declines. This is more pronounced in the River Wye stock than perhaps any other UK river. This is reflected in their being afforded a range of specific conservation measures of both a non-statutory and statutory nature (e.g. national spring-run salmon conservation byelaws).

19.4.109 Salmon smolts migrate downstream through the estuary towards marine feeding grounds between April and June. Available evidence suggests that salmon smolt migration is characterised by selective tidal stream transport on the ebb tide, near the water surface in the areas of strongest flow, and takes place during the night (Ref. 19.142). Ref. 19.142 suggests that smolts pass rapidly through the estuary and do not require a significant period of acclimation to saline conditions.

19.4.110 Adult salmon migration within estuaries is characterised by utilisation of tidal flows, and, prior to entry to freshwater, salmon may reside in estuaries for varying periods. Ref. 19.143 found this to vary between nine hours and 190 days in the Fowey Estuary. During this time, salmon move up and down estuaries, and progress upstream by making effective use of the flood tide and seeking refuge from outflowing tidal currents (ebb tides) by utilising more marginal, lower velocity parts of the Estuary (Ref. 19.141).

19.4.111 Residence time in estuaries is largely dependant on riverine flow and temperature, with high riverine flows and low temperatures resulting in relatively quick river entry, and low flows with delayed entry whereby salmon reside in the estuary, or return to sea. An important feature of delayed entry is that this results in lower likelihood of salmon entering the river (Ref. 19.144).

19.4.112 Atlantic salmon are considered to be in unfavourable condition within both the River Wye and Usk SACs. They are currently failing to meet their Conservation Limits (CLs) set by Salmon Action Plans on the Rivers Wye and Taff/Ely. Although there is some uncertainty, the Rivers Usk and Severn appear to be complying with their CL targets. Overall, it is likely that the estuary population is below the population sought by managers to maintain its conservation and fisheries objectives.

vi. Lampreys

19.4.113 Adult river lamprey are known to enter UK rivers generally in the late autumn, although, unlike sea lampreys which undertake more extensive marine migrations, river lamprey make more use of estuarine habitats throughout their marine phase (Ref. 19.145). Sea lamprey migrate through the estuary and enter rivers to spawn in the early spring.

19.4.114 Ref. 19.122 recorded peaks in abundance of downstream migrating juvenile river lamprey in the Severn Estuary between October and January.

19.4.115 The most recent condition assessment round in 2007 classified all UK SACs with the exception of the River Usk as unfavourable for river lamprey and all but the River Wye as unfavourable for sea lamprey. In the absence of a comprehensive understanding of the amount of available lamprey habitat within each of the rivers, the current conservation status assessment procedure does not enable an assessment of standing stock to be made, therefore precluding the derivation of a species population estimate. No estimates have been made of the number of returning adults or outmigrating transformers of river or sea lamprey within the tributary rivers of the Severn Estuary.

vii.Shads – Allis Shad and Twaite Shad

19.4.116 Adult shads enter the Severn Estuary between April and June on their way to spawn in the rivers Severn, Wye and Usk, with peak immigration occurring in May.

19.4.117 Young of the year shad colonise the estuary from rivers from July, until migrating seaward in autumn. Ref. 19.122 recorded maximum numbers of juvenile twaite shad in the Severn in August and September. Juveniles may also return to the estuary the following April to May before returning seaward again in the late summer. This indicates that the estuary is more than merely a migration route for shad, and that it is of importance as a feeding ground for juveniles.

19.4.118 Inferring status of twaite shad populations in the Estuary from the adjacent riverine populations leads to an uncertain conclusion. Although data comparable to that of Ref. 19.131 does not exist for the Severn, its status is thought to be improving. However, both twaite and allis shad are currently classified as being in unfavourable status for all of their designated rivers (Usk, Wye and Tywi). Few estimates of the stock sizes of twaite or allis shad within the Bristol Channel or the Severn Estuary's tributary rivers have been made and the current conservation status sampling protocol does not enable quantitative assessments of standing stock to be made. During the derivation of the UK BAP priority species list Miran Aprahamian (pers. comm.) estimated that the twaite shad populations in the UK totalled approximately 100,000 returning adults split between the Rivers Severn, Wye, Usk and Tywi as 20,000, 50,000, 20,000 and 10,000 individuals respectively.

viii. Eel

19.4.119 Eels are catadromous, reproducing in the sea, and migrating to freshwaters to undertake most of their feeding and growth. The Severn Estuary and its rivers constitute the largest eel fishery in the UK; constituting 95% of all glass eels (juveniles migrating towards freshwater) caught in England and Wales. The majority of upstream migration of elvers (juveniles) takes place between April and September inclusive although closer to tidal limits this may be concentrated within the months of April to July (Ref. 19.146). The same authors suggest that peak downstream runs of adult eels take place between September and November.

19.4.120 European eel is categorised as Critically Endangered on the IUCN Red List of Threatened Species. Eel are considered to be under threat and have seen a significant decline in stocks. The International Council for the Exploration of the Sea (ICES) state that the European eel stock is outside safe biological limits. In 2007, the European Community entered into force a Europe-wide recovery plan (Ref. 19.147) with implementation measures which began in 2009. In March 2009, eel was also added to the Convention on International Trade in Endangered Species (CITES) Appendix II list, which details species in which trade must be controlled. In January 2010, the Eels (England and Wales) Regulations 2009 (Statutory Instrument No. 3344) came into force to meet the European measure. The new Regulations provide for consideration of passage and screening for eels.

19.4.121 Eel Management Plans have been implemented for the Severn Catchment which aim to provide an escapement of silver eel biomass that is at least equal to 40% of the potential escapement to be expected in the absence of anthropogenic influence. It is currently estimated that an escapement rate of approximately 34% is being achieved (Ref. 19.148).

19.4.122 In addition, Council Regulation (EC) No 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European Eel (the European Eel Regulation) requires that a system is in place to ensure that, by 2013, 60% of eels less than 12cm long, which are caught commercially each year, are used for restocking in suitable habitat. On the basis of an estimate that the glass eel/elver fishery on the River Severn takes 10% of the stock it has been estimated that the glass eel population was within the region of 3 million individuals in 2008.

19.4.123 Data from long-term monitoring at HPB indicates a long- term exponential decline in catches from the commencement of records in 1980. This trend is also evident in the recruitment of glass eels to Europe which has declined since the late 1970s by as much as 99%.

ix. Sea Trout

19.4.124 Sea trout share much of the of the Atlantic salmon's biology as well as having a similar life history. Key differences include a higher degree of repeat iteroparity in sea trout (i.e. individuals have a greater propensity to survive to undertake repeated spawnings), and sea trout undertake their marine phase in coastal waters rather than undertaking the more extensive marine migrations of salmon.

19.4.125 Adult sea trout generally enter rivers in South Wales and the south-west of England from June to September, with smaller numbers entering at other times of the year.

19.4.126 Studies have indicated that sea trout smolt migratory behaviour is similar to that of salmon, taking place between April and June, utilising selective transport by ebb tides primarily at night, near the water surface in the fastest moving part of the water column (Ref. 19.142).

19.4.127 Data from rod, putcher and net fisheries indicate that sea trout occur at much inferior numbers than salmon. This is in contrast with nearby rivers in South Wales, which have strong sea trout populations (*e.g.* Tywi and Teifi). This suggests that riverine and estuarine conditions within the Severn are inherently unfavourable to sea trout. Given that the marine phase of sea trout is more coastal and estuarine than salmon, it may be that the highly dynamic nature of the Severn does not offer suitable inshore habitat.

n) Offshore Fish Surveys

19.4.128 Recent offshore surveys in support of the environmental assessment process in Bridgwater Bay in the vicinity of Hinkley Point (Ref. 19.33 and **Figure 19.5**) have recorded a total of 15 species of fish (**Table 19.14**). All fish caught were less than 30cm in length. Overall, the species with the highest catch rate were greater sandeel *(Hyperoplus lanceolatus)*, solenette *(Buglossidium luteum)* and whiting. During the four surveys (one scoping and three quarterly surveys) no significant concentrations of finfish species, commercial or otherwise, were identified.

19.4.129 These 2m beam trawl did not catch a single individual of any species of prime conservation or ecological concern, such as eel, salmonids (salmon and sea trout), smelt, and shad. However, Ref. 19.33 notes that the River Parrett, which discharges into Bridgwater Bay east of the HPC Development Site, historically had an eel population that was once heavily fished, with an estimated 10,000 eels per night in the river at peak migration times. Data collected by the Environment Agency for the period 1990 to 2006 indicate a general decline in eel density on the Parrett since the 1990s with little recruitment of small eel into the river. In 1992 maximum densities of up to 100 individuals per $100m^{-2}$ were recorded with this decreasing to below approximately 20 individuals per $100m^{-2}$ in 2006. Current European eel populations are depleted, and the evidence available suggests it is likely that only a small fraction of the historical eel run now takes place.

Table 19.14: Catch of Fish by 2m Beam Trawl (tows standardised to $1000m^2$) (Ref. 19.33)

Species	Q2/08 (Jun)	Q3/08 (Aug)	Q4/08 (Nov)	Q2/09 (May)
Dab	0	2.3	12.7	0
Five bearded rockling	1.8	0	0	0
Four bearded rockling	0.8	0	0	0
Greater sandeel	51.7	23.9	35.4	0
Grey gurnard	1.4	0	0	0
Herring	0	0	6	1.2
Lesser sandeel	0	0	29.4	0
Montague's sea snail	0.9	0	0	0
Poor cod	3.1	0	0	0
Sand goby	0	4.5	6.7	0
Solenette	58.9	8.5	22.3	60.2
Sprat	3.4	0	41.1	2.1
Thornback ray	0	1	0	0
Two spot goby	1.6	0	0	0
Whiting	0	26.6	27.6	1.1

o) Intertidal Fish Surveys

19.4.130 Intertidal fish surveys (Refs. 19.45-48) to a design compatible with Environment Agency WFD transitional waters fish sampling protocols, were instigated over Bridgwater Bay in mid 2009 and continued until early 2011. Over the latter half of 2009, a total of 2,500 fish represented by 20 species were caught. Variations in species richness, relative species composition and total abundance has been observed on both a temporal and spatial basis, with the two sampling methods (fyke and seine nets) also demonstrating selectivity in the species and life stages captured.

19.4.131 Results from these surveys (**Table 19.15**) have indicated that the intertidal zone near Hinkley Point is a foraging and nursery area for a broad range of species, including several species and life stages (such as juvenile sea bass and mullet). In accord with the findings of Ref.19.243, these species and life stages would appear to selectively use the upper intertidal zone in favour of subtidal habitats.

Table 19.15: Species Caught during the Intertidal Fish Survey

Species	Fyke Nets	Seine Nets
Atlantic cod, *Gadus morhua*	✓	
Atlantic herring, *Clupea harengus*		✓
Common goby, *Pomatoschistus microps*	✓	✓
Common sole, *Solea solea*	✓	✓
Conger eel, *Conger conger*	✓	
Couche's goby, *Gobius couchi*		✓
European eel, *Anguilla anguilla*	✓	✓
Flounder, *Platichthys flesus*	✓	✓
Sand goby, *Pomatoschistus minutus*	✓	✓
Sea bass, *Dicentrarchus labrax*	✓	✓
Smooth hound, *Mustelus mustelus*	✓	
Sprat, *Spratus sprattus*	✓	✓
Pollack, *Pollachius virens*		✓
Poor cod, *Trisopterus minutus*	✓	
Thinlip mullet, *Liza ramada*	✓	✓
Transparent goby, *Aphia minuta*		✓
Whiting, *Merlangius merlangus*	✓	✓
5-Bearded rockling, *Ciliata mustela*	✓	✓
3-Spined stickleback, *Gasterosteus aculeatus*		✓
15-Spined stickleback, *Spinachia spinachia*		✓

p) Fish Impingement at Hinkley Point B in 2008 and 2009

19.4.132 Forty-two species of fish were recorded from the monthly impingement samples between January 2008 and June 2009. As is normal for the Bristol Channel, whiting and sprat were the most abundant fish species. A notable feature was the large number of snake pipefish impinged on the screens (this was the first time large numbers of this species have been recorded at HPB over a sampling period extending over the last 30 years). It is likely that many snake pipefish were able to penetrate the 1cm mesh and therefore passed through the cooling water circuit. This suggests that this pelagic pipefish has recently become extremely abundant in the estuary.

19.4.133 A comparison of the relative abundances of fish impinged upon the power station screens and those sampled offshore showed that sprat and whiting dominate the fish fauna at all sampled localities. Furthermore, of the 18 recorded species impinged on the screens in 2008, 13 were also caught in one or more of the offshore samples. A comparison of the fish species and relative abundances recorded offshore and from the power station screens, showed that herring, sprat and whiting dominated the fish fauna at all localities.

19.4.134 Sixteen species of fish were recorded from the monthly impingement samples in May and June 2009. As is normal for this locality at this time of year, the catch was dominated by whiting, with Dover sole and flounder also common (737, 217 and 90 individuals caught respectively). Late spring to early summer is the time of year when fish abundance and species richness is at the minimum for the year. A notable feature of the June 2009 sample was the unusually large number of juvenile 0+ cod impinged, an indication of what has probably been the second highest level of recruitment in that stock of cod in the historical time series. This was the largest number recorded in a six hour sample since sampling at HPB began in 1981. The long term time-series of sampling maintained at HPB has tended, over the years, to mirror the spikes in cod recruitment known from fisheries studies fairly well. Data fhe Comprehensive Impingement (CIMP) survey (Ref. 19.36), operated by BEEMS in parallel to that longer term effort over 2009/10, clearly show those juvenile cod being impinged in large numbers at that time.

19.4.135 Of the 32 species impinged during the survey period (November 2008 to October 2009), 21 were sampled offshore. In addition, four species were sampled offshore which were not recorded at the intake during this period (anchovy, pearlside, sand eel, and solenette).

q) Commercial Fishing

19.4.136 This section provides baseline information on commercial fisheries within the Severn Estuary and Inner Bristol Channel area (i.e. the area around Hinkley). Ref. 19.32 considers the fisheries resources present in the area and those that depend on it in the commercial fishing sector. The catching sector supports a range of associated upstream activities, such as vessel and gear suppliers, and downstream activities such as marketing, processing and distribution. Due to the estuarine nature of the area and importance of commercial fisheries for migratory species such as eels and salmonids, these are also discussed in this section.

19.4.137 Ref. 19.32 reviews a number of data sources including:

- Radiological habits survey (Ref. 19.149).
- Coastal Fisheries of England and Wales (Ref. 19.150).
- Landing statistics from the Marine and Fisheries Agency.
- Communications with Industry Liaison Officers, North Devon Fisherman's Association and South Wales Sea Fisheries Committee.
- Data from the Environment Agency.

i. Overview of Fishing Activity in the Bristol Channel and Severn Estuary

19.4.138 Commercial fishing effort in the Outer Bristol Channel is extensive with vessels from the North Devon, Cornish and South Wales coastlines targeting a variety of species throughout the year. Fisheries include potting for lobsters, crabs and whelks, with netting and trawling targeting the ray and mixed fisheries. Targeted fisheries for squid and sea bass also occur during the summer months with some North Devon boats fishing off the sand banks in the Bristol Channel.

19.4.139 There are also commercial fisheries for migratory species, including salmon, sea trout and eels in the Severn Estuary and surrounding rivers. However, the value of rod fisheries dwarfs those of netting, and is mainly concentrated in the River Wye, targeting salmon. An Environment Agency study (Ref. 19.151) estimated the market value of fishing rights for salmon rod fisheries in England and Wales to be £128 million. This was based on an average rod catch of 15,200 fish and an average value of £8,400 per salmon caught. In contrast, the same study concluded that in 2001 the net economic capital value of salmon net fisheries in England and Wales was around £3 million.

ii. Marine Fisheries

19.4.140 The level of commercial fishing activity in the Severn Estuary and Inner Bristol Channel (Ref. 19.32) is generally much lower than on grounds to the west, principally as a result of the strong tides, together with the low density of fish above the statutory Minimum Landing Size (MLS). The Estuary acts as important nursery grounds for many commercially valuable species, including sole and sea bass and, as a result, the majority of the fish found within the Estuary are juveniles.

19.4.141 During the surveys reported in Ref. 19.149, it was noted that the level of commercial fishing was relatively low, with five full-time commercial fishers active in the area, three at Stert Flats at Stolford using stake-nets and set-nets, two at Blue Anchor also using stakenets and a further two fishers that had commercial licences but were not using them, but based out of Watchet. Commercial fishing for crustaceans was only identified at Stolford. There, two fishers were setnetting over mud mainly for brown shrimps, *C. crangon*. To the east of Hinkley Point, two fishermen maintain ranks of fixed stowe or stake-nets on the Steart Flats, catching shrimps, mullet, rays and sole from July to October (Ref. 19.150), and molluscs are gathered by hand.

19.4.142 Many of the commercial fishing vessels operating out of the north Somerset and South Wales coastal areas are under 10m in length and operate on a part-time basis supplementing income with charter angling trips, especially for cod which have remained relatively abundant in the area. The under 10m fishing fleet is not required to submit logbooks to Defra detailing catch levels. However, under the Commission Regulations (EC) No 1077/2008, an audit trail is now established to track all landings from first point of sale, although no data are as yet available from this process.

19.4.143 There are three <10m vessels working part time from the Usk at Newport, using small beam trawls for flatfish and brown shrimps which are also taken in Cardiff Bay (Ref. 19.150). There are two part-time boats operating out of Minehead, setting pots and taking out angling parties with several part-time boats also setting pots and nets close inshore between Highbridge and Burnham-on-Sea. Two angling charter boats operate from Watchet Harbour, taking regular inshore angling trips along the coast between Blue Anchor and Stert Flats. It would appear from the available data that trawling and drift netting are no longer being practiced by anyone in the waters off Hinkley Point.

19.4.144 Marine Management Organisation (MMO, formerly the Maritime and Fisheries Agency, MFA) landings statistics cover the relevant ICES statistical rectangle (31E6), a summary of which is presented in **Table 19.16** (taken from Ref. 19.27).

19.4.145 **Table 19.16** shows the average landed weight (kg) per year for certain species and their value in pounds sterling. The species with the greatest value per kilogram is sole, followed by sea bass and then cod. When actual catches are looked at, sea bass is most valuable, followed by crab and then plaice. Overall, sea bass is considered the more commercially important species, followed by sole and crab. The catches and price of the other species make them profitable, but not the main area of focus. These data are well reflected in the types of gear used in the area, driftnets and fixed nets to catch sea bass and cod, pots to catch crabs and trawling for sole and plaice.

19.4.146 The data represent the landings for the whole of statistical rectangle 31E6, and they cover a large area, including some commercially active ports such as Swansea and Port Talbot. Therefore, the actual level of commercial fishing around Hinkley Point cannot be calculated accurately.

Table 19.16: Average Annual (between 2004 and 2008) Weights (kg) and Values (£) of Fish Landings by ICES Statistical Rectangle

ICES Rectangle 31E6	Sea Bass	Cod	Conger	Crab	Herring	Plaice	Sole	Sprat	Whiting
Weight (kg)	6,335	1,342	168	4,847		1,450	1,427		153
Value (£)	34,585	2,992	136	6,401		2,692	12,298		111
Value (£/kg)	5.74	1.93	0.75	1.51	0.59	1.38	7.75	0.41	0.60

Note: *Values are either the actual value at the time of sale or, where this was not available, an estimate based on average prices maintained locally by MMO.*

19.4.147 Consultation with the MMO and local fisheries officers has corroborated the view that commercial activity in the Hinkley Point area is very limited. There have been no industry observer trips out of Watchet or Minehead, because there is no large-scale fishing activity there, and the only port nearby with commercial-scale landings is Ilfracombe.

19.4.148 The North Devon Fishermen's Association (NDFA) stated that none of its members operated as far up the Channel as Hinkley Point and they have no large-scale commercial activity east of Lynmouth; there are no trawlers or potters from the NDFA that work that ground. It was also stated that, because of the extremely strong tidal currents around Hinkley Point and further up the Bristol Channel, there would be little if any commercial trawling or drift netting.

19.4.149 The South Wales Sea Fisheries Committee (SWSFC) said that boats do use a lot of the Channel but would not operate as far up as Hinkley Point on any large scale.

iii. Migratory Fisheries

19.4.150 Fisheries for migratory species are of significant economic value, particularly in rural areas. However, overall salmon and sea trout netting is declining, in response to the phasing out of mixed stock fisheries and falling demand for wild salmon. Eel and elver net fishing in recent years has fluctuated in response to market forces.

19.4.151 Migratory species that are targeted commercially in the Severn Estuary and surrounding rivers include salmon, sea trout and eels. Both allis and twaite shad are also present in the Severn Estuary and were formerly fished commercially before numbers declined and the fishery collapsed. In the middle of the 19th century the value of shad rivalled that of salmon and in the River Severn, shad made up about one third of all catches.

19.4.152 Many of the net fishing methods used to target migratory species on the Severn Estuary are unique to the area and have a long history, notably lave netting (using a 'Y' shaped net and 'stalking' or 'cowering' in the shallows to catch the salmon migrating), and putcher nets (rows of baskets which use the ebb tide to trap salmon).

iv. Salmon and Sea Trout

19.4.153 The Estuary fisheries exploit mixed stocks of salmon originating from at least seven rivers entering the Estuary, most notably the Severn, Wye and Usk. Net licences issued for catching salmon also allow the fishermen to take sea trout. Hence, it is impossible to distinguish the allocation of effort between salmon and sea trout fishing. Sea trout are found in 26% of all rivers, and their distribution across England and Wales is very irregular. Wales has the widest distribution, with sea trout present in 49% of rivers. The licensed fishery in the Severn Estuary in 2007 comprised two seine nets, 20 lave nets and four fixed engines (e.g. putchers); see **Table 19.17**.

Table 19.17: Allowable and Utilised Effort for the Principal Salmon Net Fisheries in 2007

River/Fishery	Method	No. of Licences	Allowable Effort Net Days	% days Utilised	Av. Day/lic.
Severn	Putchers	4	304	79	60
Severn	Seine	2	312	0	0
Severn	Lave	20	1,560	15	12
Wye	Lave	7	553	24	19

Note: *adapted from Salmonid Stocks and Fisheries in England and Wales, 2007 (after Ref. 19.154).*

19.4.154 Salmon caught before 1st June must be released, with catches continuing from then until August. In 2000, local interests bought out drift netting in the mouth of the Usk, in Newport Bay and the putcher rank just upstream of Uskmouth which accounts for the lack of reported salmon net catches in the Usk after 1999 (**Table 19.8**). The breakdown of the net catches in the rivers Severn, Wye and Usk by gear type from 1999 to 2006 indicates that fixed engines or putchers account for the highest numbers of salmon taken. There are salmon putchers at the south-west and north-east ends of the Severn Bridge, at Aust and Beachley, and at Alvington below Lydney Lock (Ref. 19.154).

19.4.155 The total provisional figures for net and rod catches taken for the Midlands (River Severn) and Welsh (all rivers) regions in 2007 are described in Ref. 19.152 (see **Table 19.19**). The catches from these regions made up 21% of the total catches for England and Wales in 2007. Catch figures indicate the importance of the recreational rod and line fishery in Welsh rivers (especially the rivers Wye and Usk) with reported catches seven times higher than those of the net fishery. These figures do not take account of catches of salmon which go unreported (including those taken illegally), and it is estimated that there may have been a total of 22,000 additional fish caught in 2007 (Ref. 19.153).

Table 19.18: Summary of Salmon Net Catches Numbers Landed, 1999-2006

River	Method	1999	2000	2001	2002	2003	2004	2005	2006
Severn	Seine nets	35	41	5	20	38	43	25	13
	Lave nets	190	228	186	116	295	380	135	138
	Fixed engines	764	704	836	1054	1207	346	778	713
Wye	Lave nets	3	11	2	6	6	8	7	6
Usk	Drift nets	726	0	0	0	0	0	0	0

Note: *adapted from Salmonid and Freshwater Fisheries Statistics for England and Wales, 2006 (after Ref. 19.154).*

Table 19.19: Provisional Net and Rod Salmon Catches (including released fish) by Region for the 2007 Season

Region	Net Catch		Rod Catch		Total Catch	
	No.	Weight (kg)	No.	Weight (kg)	No.	Weight (kg)
Midlands	676	3,184	261	1,112	937	4,296
Welsh	613	2,022	4,488	16,239	5,101	18,261
Total	1,289	5,206	4,749	17,351	6,038	22,557

Note: *adapted from Salmon Stocks and Fisheries in England and Wales, 2007 (Ref. 19.153).*

v. Eels

19.4.156 Eels are found in all European countries bordering or connected to the North Atlantic. They are caught as elvers (juveniles returning from the sea) or adults in a variety of fisheries each with different levels of exploitation. Over the past two decades, catch data from across Europe show glass eel populations declining rapidly from the high levels of the 1970s, while 2001 produced a record minimum of just one percent of previous peak levels, and most recent data show a continued decrease and no significant recovery from the 2001 all time low.

19.4.157 Only hand-held dip nets are permitted for the capture of glass eels or elvers, and fishing is concentrated where the fish are plentiful and easy to catch, principally in estuaries of the Severn and other rivers draining into the Bristol Channel, such as the Parrett. Catch returns from these fisheries have been compulsory over the past few years and provide a good indication of the trend in eel recruitment. The fishing season is short, coinciding with the elvers entering rivers on spring tides in April and May (Ref. 19.154).

19.4.158 The number of licenses issued to fish for glass eel/elver in the Severn Estuary and Bristol Channel ranged from 487 to 577 between 2002 and 2004. Elvers are known to be targeted during their landward migration between November and March using dipnets within the area just seaward of Bridgwater Bay. The national 2007 catch was 2,051kg of which the Severn Estuary and Bristol Channel are estimated to represent 95% equating to a catch of 1,948kg. Based on an average individual weight per elver of approximately 0.5 g this would equate to 3,896,000 individuals. Only a small proportion of elvers caught are for domestic consumption, the majority are sold for re-seeding eel farms in Asia.

19.4.159 Eels are caught commercially in a number of locations and by a variety of instruments including fyke nets, putcheons and weir traps. The level of eel fishing effort is measured as the number of licensed instruments of all types. Licence sales in England and Wales have fluctuated between 1,500 and 2,700 (per year,) most likely in response to market price fluctuations. Many rivers throughout the Severn Estuary catchment support eel fyke net fisheries between spring and autumn. Fyke nets fished on the Wye take yellow eels in spring and summer and silver eels in autumn.

19.4.160 Between 2002 and 2004 the number of licenses issued for this fishery reduced from 80 to 47 although catches in fact rose over this period from 156kg in 2002 to 980kg in 2003 followed by a slight decline in 2004 to 569kg. The 2007 annual adult eel catch for Wales, South-West England and the Midlands was 2,396kg (data provided by the Environment Agency). The 2004 catch indicates that the Severn Estuary represents approximately 12% of this regional catch. As such, the 2007 adult eel catch for the Severn Estuary is estimated at approximately 288kg. Based on empirical data, there is presumed to be a 20:1 ratio of male to female eel in the Severn Estuary. Male and female eel reach maturity and migrate at different ages and, as such, will vary in weight. Taking an average weight of 90 g however for male silver eel of 90g and 580g for females (based on the most common ages at maturity), the adult eel catch for the Severn Estuary and Bristol Channel would equate to 3,040 males and 24.8 females.

vi. Recreational Fishing

19.4.161 Recreational angling accounts for the highest amount of fishing effort within the Severn Estuary and Inner Bristol Channel. Anglers fish from the shores along much of the Inner Bristol Channel targeting cod in the winter and sea bass in the summer, with other species such as whiting, flounder, eels, rays, sole and conger also caught. Angling is also carried out from charter vessels, and both forms represent an important recreational use of the Estuary, even though the quantities and values of fish taken are small compared to commercial fisheries.

r) Marine Mammals

19.4.162 A desk-based review of available data on marine mammals within the Severn Estuary and Bristol Channel was conducted. Subsequently, following the publication of guidance from by the Joint Nature Conservation Committee (JNCC) (Ref. 19.155), a network of acoustic sensors was deployed off the site.

19.4.163 A study of the Welsh shore of the Bristol Channel (around the Gower Peninsula and Swansea Bay) during the early 2000s documented regular occurrences of the harbour porpoise (*Phocoena phocoena)*, as well as occasional sightings of the common dolphin (*Delphinus delphis)* (Ref. 19.156).

19.4.164 Aside from this study, there is little available information regarding cetacean activity in the areas of the Inner Bristol Channel and Severn Estuary, although common dolphin *(D. delphis)*, bottlenose *(Tursiops truncatus)* and Risso's *(Grampus griseus)* dolphins, as well as grey seals *(Halichoerus grypus)* have been recorded in the wider Bristol Channel area in the past (Ref. 19.157).

19.4.165 The BEEMS programme has initiated an acoustic monitoring programme to assess cetacean site usage in relation to potential HPC construction impacts (Ref. 19.57). Recording devices have been deployed at two locations around the proposed temporary jetty and the cooling water intake and outfall structures, and a further three locations on a depth transect from the front of the station around 25km westwards into the Bristol Channel (**Figure 19.15**). These record cetacean 'clicks', the vocalisations used as a means of navigation and prey location (Ref. 19.156). The devices have been *in situ* for approximately since early 2011.

19.4.166 Harbour porpoise have been recorded at each of the five locations, including the vicinity of the proposed jetty and intake/outfall structures; see **Figure 19.15**. The initial dataset suggests a strong depth-preference, with the number of days on which porpoise were recorded increasing along the gradient from the existing station towards the open waters of the Channel (**Table 19.20**). The data on dolphin clicks have yet to be analysed, so the occurrence of these species in the area remains unclear, but initial inspection of the data suggests they are also found in the area.

Table 19.20: The Number of Days of Porpoise Recordings at the BEEMS Acoustic Recording Stations around Hinkley Point (from Ref. 19.57) during Initial Survey Period of 77 Days

Station	Location	Approximate water depth (m)	No. of days when porpoise clicks were recorded	Percentage of total recording days when porpoise clicks were recorded
1	Vicinity of proposed jetty	3.4	7	9
2	Vicinity of proposed intake/outfall	5	10	13
3	Inner transect, north-west of station	12	30	39
4	Mid-transect	12	20	37
5	Outer transect	20	51	66

19.4.167 Information on site fidelity and temporal patterns in the Channel's cetaceans is scarcer than that on their occurrence. It is unclear if the harbour porpoise recorded in the area are local residents or visitors, though workers involved in the Welsh study suggest they may be resident (Ref. 19.156). There is no clear evidence of significant seasonal patterns in the Welsh porpoises, although there is some indication of seasonal aggregations in the Carmarthen area (during November; see Ref. 19.156).

19.5 Scope of Assessment

a) Existing Baseline Condition

19.5.1 Section 19.4 above describes the existing baseline condition, in terms of the observed character of the local marine ecological interests, against which the assessment developed within this chapter is then undertaken. That baseline incorporates the presence and function of the existing HPB station. Where the impacts of HPB operations are isolated in the assessment below this is solely for the purposes of supporting, as a surrogate, understandings and predictions of the likely impacts of HPC beyond that baseline condition.

19.5.2 In recent years the HPB station has been obliged to maintain a lower operational load, meaning that reduced volumes have been abstracted and a reduced thermal output has been put to sea. These reduced volumes have been taken into account in characterising the impingement rates observed at that station and elaborated upon in predicting catches for HPC. Likewise, the development of numerical hydrodynamic models in support of the HPC development over this period has been calibrated against the reduced plume signature.

19.5.3 For the purposes of this assessment, calculations of the baseline condition have presumed the HPB station to be operating at 100% load, this being what is permitted under that station's consent to operate. So, for example, all plume extents are mapped with HPB operating at full load and the starting point for any comparison with fishing mortality will include, as baseline, the predicted influence of that existing operation, again at full load.

19.5.4 The observed condition of the benthic fauna utilised in this assessment will have been representative of HPB at high load, given that load reductions began just before the surveys commenced.

b) Significant Elements of the HPC development

19.5.5 The elements of the proposed HPC power station development which could lead to potential effects on the marine environment are likely to be the construction and operation of the following:

- the temporary jetty;
- the seawall;
- land-based discharges; and
- the cooling water system.

19.5.6 For each of these a number of potential impacts have been identified. Generally, these impacts can be grouped into several broader categories (e.g. habitat loss and disturbance). The proposed Fish Recovery and Return system is considered in Section 19.8, Mitigation.

c) Temporary Jetty

19.5.7 A temporary jetty would be constructed and operated during the overall construction phase for the HPC project. As a temporary structure, the potential effects of jetty construction, operation and dismantling are considered as a part of the construction stage of the project. These activities have the potential to generate the following changes which could impact on marine habitats and species:

- intertidal and subtidal habitat loss and disturbance due to piling, construction and maintenance activities;
- physical disturbance to habitats due to alterations in longshore current patterns caused by both the jetty structures themselves and dredging (including maintenance dredging) of the berthing pocket;
- alterations in water quality due to run-off from the jetty and its constituent materials during construction and dismantling;
- noise and vibration due to piling and vessel movements; and
- artificial lighting during construction and operation.

d) Construction of the Seawall

19.5.8 A new seawall will be constructed for coastal protection purposes on the line of the existing cliffs fronting the HPC Development Site, at the top of the intertidal shore. These activities have the potential to generate the following changes which could have an impact on marine habitats and species:

- loss of upper shore habitat and modification to slope of intertidal zone;
- physical disturbance to the upper shore during construction (machinery access and trampling by people);
- water quality alterations on the shore via run-off from works and other potential contaminant release;
- noise and vibration caused by operation of machinery and rock removal; and
- artificial lighting during 24 hour construction of the seawall.

e) Land Based Discharges

19.5.9 Construction and operational activities on the main site have the potential to create discharges, which could generate changes in water quality that have an impact on marine habitats and species.

f) Cooling Water System

i. Construction of the Vertical Shafts Offshore

19.5.10 The construction of the cooling water system, involving the construction of vertical shafts approximately 1.8km offshore for the placement of outfall structures and 3.3km offshore for intake structures, has the potential to generate the following changes which could impact on marine habitats and species:

- temporary and permanent loss of seabed habitat;
- physical disturbance to the seabed around each drilling site;
- water quality alterations due to discharges from dewatering activities and from platforms and support vessels, waste materials, chemicals associated with drilling operations;
- water quality alterations due to sediment disturbance and potential contaminant mobilisation;
- noise and vibration associated with both pile driving (for anchorage of platforms) and vessel movements; and
- artificial lighting if offshore construction works continue during the hours of darkness.

ii. Construction of the Horizontal Tunnels

19.5.11 The main cooling water tunnels connecting the power station itself to the cooling water intakes, via the shafts described above, will be drilled beneath the intertidal shore and seabed from land. All waste arisings will thus be managed, at least initially, onshore. These activities have the potential to generate the following changes which could impact on marine habitats and species:

- water quality changes due to discharge of waste water from tunnel drilling. If mud-assisted drilling is used this could contain suspended solids (including bentonite), organic polymer, and waste salts following control of pH; and
- vibration and noise.

iii. Operation of the cooling water systems

19.5.12 The operation of the cooling water systems at HPC will involve the abstraction and subsequent discharge of approximately 125 $m^3.s^{-1}$ on a virtually continuous basis over the full generating lifetime of that station. The principle impacts of abstraction will be: the impingement of fish and other marine life on screens; the entrainment of smaller organisms through these screens, their passage through the plant, subjection to stresses of pressure, increased temperature and potential chlorination and their subsequent return to sea; and any influence caused by the thermal plume arising and any associated residual biocides associated with the discharge.

19.5.13 Although the decision was made from the outset to incorporate relevant best practice mitigation into the design of the HPC cooling water system, no allowance for these features has been made in completing the initial assessments that follow below. Best practice measures include: the offshore location of intakes; use of low velocity side entry (LVSE) intake design; use of a behavioural cue at these intakes to deter fish; and use of a means of fish recovery from the screens in order to return fish and crustacean to sea in good condition.

19.5.14 This approach has permitted a direct translation of observed (and unmitigated) impingement levels at HPB across to predictions at HPC. The benefits of applying best practice in terms of mitigation are then considered in Section 19.8 of this chapter.

g) Accidents and Incidents

19.5.15 There is the risk of impact due to accidents occurring during construction (e.g. water quality changes due to chemical spillages and surface water discharges containing spilled/leaked contaminants) and, to a lesser degree, during operation. It is not possible to assess the potential impact of such incidents/accidents as they could vary significantly in scale, location and type with variable outcomes on potential receptors.

19.5.16 The implementation of best practice management measures during construction and operation will be the mechanism by which the potential risk of accidents occurring is managed and any consequential impacts are either eliminated or minimised.

19.6 Assessment of Impacts

a) Introduction

19.6.1 As a result of the very high suspended sediment concentration of the Inner Bristol Channel, the marine waters and the physical habitats and assemblages associated with them have a particularly low sensitivity to localised disturbances to the sediment regime. Similarly, as described in **Volume 2 Chapter 17**, the extremely dynamic nature of the Inner Bristol Channel (i.e. an extreme hyper-tidal range, associated with high current speeds), its physical scale and the level of temporal and spatial variance that are already the norm, due primarily to the tidal regime, strongly suggest that in order for any significant change to occur a human intervention in the system would, itself, have to be very significant. Within this context, the main marine infrastructure components considered as a part of this development are, in comparison, either of a very small scale (e.g. the intake-outfall structures) or designed so as to offer little hindrance to coastal processes (e.g. the temporary jetty). There are clear exceptions however, most obviously the issue of *Corallina* turf habitat discussed below.

19.6.2 With specific reference to the operational phase, whilst the scale of cooling water abstraction and discharge may appear from an anthropocentric perspective to be large, the physical scale and the level of temporal and spatial variance described above mean that the actual influence of these activities tends to be subtle and, even with considerable effort, difficult to discern. This is certainly the case for the thermal plume that will be associated with HPC. The plume will be characterised by localised increases in sea temperature and residual traces of contaminants, both of which will diminish with time and distance from the outfall and depth through the water column. The dynamic behaviour of this plume will be dictated by a combination of the effluent's low relative density and the ebb and flood tidal currents. The result is a relatively widespread but nonetheless subtle area of influence.

19.6.3 These physical processes not only lend themselves to numerical modelling but also, given the thermal signature of any existing plume's presence and the appropriate level of care, provide a means of calibration and validation of these models which then in turn permits a high level of confidence in their predictions. These predictions can extend to the outer reaches of that plume's influence. An ensemble of such predictive tools have been employed extensively in support of the assessment that follows within this chapter. The development of the models used in support of the HPC assessment is described within **Volume 2 Appendix 18A** of this ES.

19.6.4 Just as these issues of scale and variance are highly significant for any consideration of HPC within the context of the physical environment of the waters off Hinkley Point, any consideration of the ecology of these same waters is subject to the same conditions in terms of the biological response to these same conditions. In the simplest terms, the ecology is driven by and responsive to the scale and variance of the physical environment it inhabits. One of the consequences of that environment around Hinkley is that many of the species involved are highly resilient to variations in salinity, temperature and high levels of suspended solids. Many are also, through either reproductive or dispersal strategies, their migratory behaviours (both seasonal and tidal), and their form and habit, resilient to the degree of physical disturbance and tidal displacement which represent, in this hypertidal environment, the norm.

19.6.5 Whilst these attributes of the local marine and estuarine ecology are significant in considering the effects of construction-related disturbance and the potential impacts of the thermal plume, density dependence can also be significant when considering the potential impacts of impingement and entrainment. The general principle of density dependence is that increasing population size reduces available resources, limiting population growth. So when numbers of young fish are caught by either fishing activities or a power station this same principle suggests that survival and growth amongst the remainder of the population involved will increase. Due to the high level of complexity involved, density dependant factors such as this cannot be taken into account in the assessments completed below but, where this applies, it lends an additional level of precaution to the estimates used.

19.6.6 Having stated that elements of the physical environment are open to high levels of predictability, there are also significant elements of uncertainty fundamental to the assessments that follow. Populations of individual species will rise and fall within years and between years in a complex manner. This is most obviously the case for species that are well studied, such as commercial fishery stocks, but it will also be true for those not subject to this level of scrutiny. The baseline characterisation studies described above, and the population or stock size estimates utilised in the assessment that follows, provide reasonable understandings of the present day condition and are considered to be sufficient to need in this instance, but they are also subject to constant change. In sum, however, the functional components of that ecology will tend to track the physical regime, so although specific components of that ecology (such as an individual species population) will tend to increase and decrease in a complex fashion, the functionality and attributes of the assemblage as a whole will tend to behave more conservatively. This means that assessments made today, on the basis of good knowledge should, with care and maintenance of that assessment, remain relevant over time.

b) High value receptors

19.6.7 A number of receptors considered in this assessment are recognised as being of high value in conservation terms. For the purposes of predictions of impacts, however, the technical assessment has been developed on the basis of their sensitivity to the specific pressure or ‘stressor’ under consideration. Examples of where this approach has been used include the reef-building polychaete worm *Sabellaria alveolata* and the algal turf forming species *Corallina*. Despite this approach, the value of the receptor has nevertheless not been ignored in final determinations.

c) Potential Impacts during Construction

i. Habitat Loss and Change

19.6.8 A number of components of the construction works and activities will lead to small-scale habitat loss and/or change in existing habitat conditions. This section covers those activities that will lead to permanent loss of marine habitat (intertidal and subtidal) and/or permanent change. Temporary disturbance to habitat during construction is covered under the section on physical disturbance.

19.6.9 The location of the proposed temporary jetty in relation to the intertidal area is shown in **Figure 19.16**. The installation of piers to support the jetty would result in direct habitat loss in the intertidal area. Some 52 piers would be installed across the intertidal area and the footprint of these piers would cover an area of approximately 34m^2. These piers across the intertidal area would be installed by using a balance of land-based plant gaining access across the shore, and marine engineering plant, such as a jack-up barge or rig, working from seaward.

IMPACT: Intertidal Habitat Loss as a Result of Construction of the Temporary Jetty

19.6.10 The Hinkley intertidal area supports communities that, in terms of species composition, may be considered typical of such coastlines around much of the UK. The fucoids *Fucus spiralis* and *Fucus vesiculosus* in particular are typical of sheltered to moderately exposed shores and occupy much of the intertidal at Hinkley Point. These species are widespread in their distribution and are not species of conservation concern. With the exception of the *Corallina* habitat, this intertidal area is thus considered to be of medium value.

19.6.11 The *Corallina* swards are of significance as they have been identified as a notable community of the hard substrate habitat which is a sub-feature of the SAC.

19.6.12 There are no areas of intertidal or subtidal *Sabellaria* reef in close proximity to the proposed jetty location; this was confirmed both by an acoustic seabed survey and subsequent ground-truthing carried out to check this understanding locally (Ref. 19.35). The nearest area of *Sabellaria* reef is a small section within the intertidal >500m to the east (in front of HPA) and a wider area some 500m to the west. As no *Sabellaria* reef habitat is located close to the jetty no impact is anticipated for this receptor.

19.6.13 Thus whilst it is clear that some small-scale habitat loss would occur, the footprint of the jetty piles is negligible in relation to the area of the intertidal zone (**Figure 19.16**) and the magnitude of the effect on that intertidal area as a whole is, therefore, considered to be low. In addition the majority of the habitats represented within the intertidal area are common and the species involved are widely dispersed across the Hinkley Point intertidal and throughout the UK, suggesting medium value. Taking these factors into account, the impact of this small-scale loss is considered **minor adverse** with regard to the majority of the intertidal communities present. The presence of *Corallina* turf in the area, however, merits further consideration.

IMPACT: Loss of Corallina as a Result of Construction of the Temporary Jetty

19.6.14 The *Corallina* biotope is considered to be of high value. The locations of channels with *Corallina* and associated run-offs were mapped and are shown in relation to the proposed jetty in **Figure 19.17**. It can be seen that the jetty will be located in the vicinity of the western extent of the channels supporting *Corallina* but has been deliberately positioned between, rather than over, mapped areas of cross-channel features that are heavily colonised by this species (and can be described as maintaining *Corallina* turf).

19.6.15 Given the proposed siting of the temporary jetty, the scale of this habitat loss would be very small and it is likely that *Corallina* would only be present in parts of the habitat lost. In addition, recolonisation will occur after the removal of the jetty. Hence, the magnitude of this effect is predicted to be very low and the significance of the impact is assessed to be **minor adverse**.

IMPACT: Intertidal Habitat Change as a Result of Construction of the Seawall

19.6.16 The upper area of the shore where the seawall would be constructed is effectively unoccupied by marine species and dominated by cobble/shingle material associated with both washout from the cliff and storm-driven longshore transport. The biotope is classified as 'barren littoral shingle', as shown by **Figures 19.8-10**. Within the construction area itself, **no impact** upon marine fauna or flora would thus occur.

IMPACT: Subtidal Habitat Loss as a Result of the Construction of the Vertical Shafts for the Cooling Water System

19.6.17 Habitat loss would occur due to excavation of the seabed for the construction of vertical shafts connecting to the horizontal (intake and outfall) tunnels. Habitat loss/modification would be permanent for the area of the estuary bed required for the vertical shaft openings. It would be temporary at the anchoring locations (wet drill operation) and for the area around the vertical shaft opening.

19.6.18 The benthos of the area surrounding both the intake and outfall structures is typical of the extensive muddy plain that makes up most of the local seabed. Population densities are low due to the extreme tidal conditions. The most prevalent species around the proposed vertical shaft sites are the oligochaete *Tubificoides amplivasatus* and the polychaete *Nephtys*. All species identified are commonly found at a national level. The biotope concerned is '*Nephtys hombergii* and *Macoma balthica* in infralittoral sandy mud', also described as 'Mobile circalittoral sandy mud supporting a sparse faunal compliment', a biotope which covers approximately 76km^2 out of the total of 94km^2 surveyed locally – see **Figure 19.18** (Refs. 19.14 and 19.25). The habitat type which is likely to be lost is thus locally common and widespread as well as being common throughout estuaries in the UK.

19.6.19 The vertical intake shafts in total would represent a loss of subtidal habitat of approximately 58m^2. The area of the opening of the outfall vertical shafts would be approximately 39m^2. This represents significantly less than 0.1% of the area of the '*Nephtys hombergii* and *Macoma balthica* in infralittoral sandy mud' within Bridgwater Bay. In addition, during wet drilling, there would be temporary loss of habitat around the anchor sites, which would again probably be in the region of 0.1% of the area of the dominant biotope in Bridgwater Bay. The percentage of this habitat lost due to construction of the vertical shafts in relation to its local extent is considered to be small and, therefore, the magnitude of this effect is assessed as very low. The sensitivity of the receptor to impact is low and, thus, the significance of the impact is predicted to be **negligible**.

IMPACT: Indirect Impact to Subtidal Fauna as a Result of the Construction of the Vertical Shafts for the Cooling Water System

19.6.20 The predominant epifauna within the area is the brown shrimp *Crangon crangon*. As with other mobile epifaunal species, *C. Crangon* would be able to move away from the area to seek suitable nearby habitat and would be less affected by the habitat loss. In the areas of disturbance around the shafts a typical faunal assemblage would very quickly become re-established due to tidal mobilisation of surface sediments. Even in less dynamic systems the evidence from studies of recovery rates in subtidal benthic communities of the type present within the footprint of the works clearly demonstrates that soft-sediment, bivalve-annelid dominated communities are able to recover from disturbance events within one to two years (Ref. 19.161). As a result, the sensitivity of this habitat is considered to be low.

19.6.21 Overall, given that rapid recovery of affected areas within the construction footprint would be expected, the impact of this activity would be predominantly related to the small-scale habitat loss (as described above). The loss of this area of habitat would have a **negligible** impact upon the extent and functioning of the affected subtidal communities.

19.6.22 The small loss of subtidal habitat that would occur during construction of the shafts would not be expected to have any impact on prey availability for fish.

IMPACT: Sabellaria as a Result of the Construction of the Vertical Shafts for the Cooling Water System

19.6.23 Subtidal *Sabellaria* may be present at the vertical shaft sites, however, given the local habitat type involved, it is not anticipated that any reef formations would be present. Therefore, it is considered that there would be **no impact** on *Sabellaria* reef through construction of the vertical shafts.

IMPACT: Subtidal Habitat Change due to Capital and Maintenance Dredging

19.6.24 As noted in **Volume 2**, **Chapter 17**, the operating face of the jetty head will be aligned with the direction of ebb/flood tidal currents in the vicinity. A berthing pocket immediately associated with that operational area will be dredged in order to allow safe delivery of materials across a range of tidal conditions. This dredged area is estimated to be 160m in length and 27m in width with sediments removed to a uniform depth of around 3.5m below the existing seabed (4.5m below Chart Datum (CD)).

19.6.25 Given the uniform nature of the substrate with depth (Ref. 19.26) and the dominance of the tidal regime and the associated processes of sediment suspension, mobilisation and deposition, any physical habitat loss due to dredging within this chronically disturbed environment is expected to be of short duration, and given the dominant sedient transport regime a typical subtidal assemblage is likely to become re-established quickly thereafter.

19.6.26 Again, the benthos of this area is typical of the extensive muddy plain that makes up most of the local seabed. Population densities are low due to the extreme tidal conditions. All species identified are commonly found at a national level. The biotope concerned is *'Nephtys hombergii* and *Macoma balthica* in infralittoral sandy mud', also described as 'mobile circalittoral sandy mud supporting a sparse faunal compliment', a biotope which covers approximately 76km^2 out of the total of 94km^2 surveyed locally – see **Figure 19.18** (Refs. 19.14 and 19.25). The habitat type which is likely to be affected in this instance is thus locally common and widespread. Hence the magnitude of the effect is predicted to be low.

19.6.27 As with the area around the cooling water headworks, the predominant epifauna within the area is the brown shrimp *C. crangon*. As with other mobile epifaunal species, *C. crangon* would be able to move away from the area to seek suitable nearby habitat if need be. In the areas of disturbance both within the berthing pocket area itself and around its margins, a typical faunal assemblage would very quickly become re-established due to tidal mobilisation of surface sediments. Even in less dynamic systems the evidence from studies of recovery rates in subtidal benthic communities of the type present within the footprint of the works clearly demonstrates that soft-sediment, bivalve-annelid dominated communities are able to recover from disturbance events within one to two years (Ref. 19.161). As a result the sensitivity of this habitat is considered to be low.

19.6.28 On this basis, the significance of the impact has been assessed as **minor adverse**.

ii. Physical Disturbance

IMPACT: Disturbance to Intertidal Habitats during Construction of the Temporary Jetty

19.6.29 Several activities associated with the construction of the jetty may cause disturbance to the intertidal area within and adjacent to its footprint, including piling, dredging and the use of construction plant and materials. The impacts of dredging are discussed in Paragraph 19.6.42 below. Piling works (the drilling/piling and use of jack-up rigs) has the greatest potential to cause disturbance, along with the machinery movements required to emplace the jetty infrastructure. These activities may lead to the generation of debris (e.g. from drilling), channel blocking, smothering and the abrasion of rock surfaces supporting intertidal communities.

19.6.30 Plant and vehicles working on the intertidal shore itself will be deliberately constrained within narrow construction corridors no more than 20m wide to either flank of the jetty structure itself, and a similarly constrained 10m wide route along the top of the intertidal area (above MHWS) in order to provide landward access to the works. A wider corridor (75m to either flank of the line of the jetty) will limit the deployment of marine engineering plant, such as a piling barge.

19.6.31 The volumes of fine sediment generated during drilling and through disturbance by machinery on intertidal sediments are likely to be very low in comparison to the existing high sediment loadings present in the water column. The sensitivity of local habitats is considered to be medium, and the significance of this impact is therefore predicted to be **minor adverse**.

IMPACT: Disturbance to Sabellaria due to Construction of the Temporary Jetty

19.6.32 There is no observed occurrence of intertidal or subtidal habitat supporting *Sabellaria* reef within 500m of the jetty and therefore the likelihood of this receptor being directly impacted by the jetty construction works is considered highly unlikely. Although there is the potential for some sediment disturbed during construction to be transported into intertidal areas supporting *Sabellaria* reef, it is considered that the overall volumes would be negligible in the context of the high volumes of sediment routinely present in the water column. As such, **no impact** on *Sabellaria* reef is predicted in terms of this aspect of the temporary jetty construction works.

IMPACT: Disturbance to Corallina due to Pile Driving and Plant Movements

19.6.33 Disturbance to intertidal habitat in the vicinity of the jetty would be unlikely to affect the continuing presence of many of the intertidal species present (e.g. fucoid dominated communities). Given the species involved, the recolonisation of any disturbed areas would be expected to be relatively rapid (one to two years). No long-term effects would thus be expected.

19.6.34 However, as stated previously, *Corallina* turf is considered to be of importance as it provides a habitat for many other organisms; it is also, for this reason, recognised as a notable community of the hard substrate habitat which is a sub-feature of the SAC. It is, therefore, considered to be of high value. On the basis of the mapping work, the *Corallina* biotope intermittently occurs within an area of some 500m x 50m.

19.6.35 An additional factor is that the longshore drainage channels upon which the *Corallina* run-offs themselves depend tend to flow from east to west across the shore, implying that any disturbance to one of these channels may have an impact on habitat areas to the immediate west of the construction area. The jetty will be located towards the western end of the extent of the known distribution of *Corallina* (see **Figure 19.17**) and the alignment deliberately avoids the mapped *Corallina* spillways. Even if the construction area activities were to extend further than 20m from the actual alignment of the jetty itself, this suggests that in total an area of less than 4% of *Corallina* biotope area (*c*. 118,800m^2 within the vicinity of Hinkley Point) would be present within the footprint of the works, although this area would increase if a longshore drainage channel were to be compromised. This would nonetheless represent a relatively small area and indicates that even if all of the *Corallina* biotope within this wider area were disturbed, which would be highly unlikely, this change would be of very low magnitude, resulting in a **minor adverse** impact.

IMPACT: Intertidal Habitats due to Scour Associated with Jetty Piers

19.6.36 An expert assessment of the level of sediment scour (see **Volume 2, Chapter 17** for further information) that would be associated with the jetty piles due to waves and tidal streams has shown that soft sediments would be scoured to a depth of no more than 1.3m in the immediate vicinity of the piers themselves.

19.6.37 The top width of a scour hole in non-cohesive sediments is a function of the scour depth and the angle of repose of the sediment involved. As a conservative measure, the angle of repose associated with a loose fine sand would be in the order of 26-28°

which translates into an area around each pier foot, in soft sediment, of no more than a couple of metres.

19.6.38 This impact on sediment distribution would be limited to the length of the jetty that extends across the muddy seabed. The extent of this disturbance feature around the piers themselves is predicted to be very low and would be confined to a habitat type (i.e. soft sediment) that is subject to continual remobilisation due to tidal forces, and thus of very low sensitivity. The sediment transport processes associated with scour are normal to this hypertidal (>6m tidal range) habitat and the impact associated with this element of disturbance is, thus, assessed as **negligible**.

19.6.39 The effect described above would not occur in association with the piers introduced across the exposed rocky platform of the intertidal shore or the exposed rock that the line of the jetty will cross in the near subtidal area. Shear forces around the foot of these structures will be increased and could result in a loss of fauna and flora in the immediate area around each. Again, the extent of this disturbance feature around the piles themselves is predicted to be very limited and any loss of associated flora and fauna of very low magnitude. The impact associated with this element of disturbance is thus assessed as **negligible**.

19.6.40 **Volume 2**, **Chapter 17** discusses the potential impact of construction works on the superficial geology of the cross-shore rock platform flanking the jetty, and recognises that a moderate adverse impact may occur due to the high sensitivity of the receptor but relatively low magnitude of the effect involved.

IMPACT: Intertidal Disturbance Associated with Construction of the Seawall

19.6.41 Under the existing coastline configuration, the alignment of the proposed seawall places it above the Mean High Water Mark.

19.6.42 The construction works would require that machinery for the excavation works and actual placement of the seawall have access to the upper intertidal area, either on a permanent or temporary basis depending on whether tidal conditions permit. Given that rock from the upper intertidal area would be removed during excavation (this impact is covered under the section on habitat loss/change, see above), further disturbance would therefore be limited to any additional effect that machinery operating along the upper shore would have on existing intertidal communities.

19.6.43 There is also the potential for some sediment release during the excavation and construction of the seawall. The volume of sediment released is anticipated to be minimal and is unlikely to result in any noticeable increase in sedimentation on the intertidal area either in isolation or in combination with other construction activities.

19.6.44 A 30m wide construction zone will be established fronting the HPC Development Site and all works on the sea wall confined to this zone. **Figure 19.35** shows the extent of that zone in relation to intertidal habitat distribution (Ref. 19.55). The biotopes that would be involved within the footprint of this zone are (areas rounded to nearest 10 m^2 and indications of recoverability from MarLIN database: http://www.marlin.ac.uk/):

- Eunis A1.32; 1,200 m^2; 'Fucoids on variable salinity rock'; high recoverability (full recovery within about 5 years).
- Eunis A1.321; 4,530 m^2; '[*Pelvetia canaliculata*] on sheltered variable salinity littoral fringe rock'; moderate recoverability (full recovery up to 10 years).
- Eunis A1.322: 1,710 m^2; '[*Fucus spiralis*] on sheltered variable salinity upper eulittoral rock'; high recoverability (full recovery within about five years).
- Eunis A1.421: 430 m^2; 'Green seaweeds [*Enteromorpha spp.*] and [*Cladophora spp.*] in shallow upper shore rockpools'; very high recoverability (full recovery within at most 6 months).
- Eunis A2.111: 17,880 m^2; 'Barren littoral shingle'; no intolerance to disturbance.

19.6.45 This 30m zone would not encroach into the area that supports the local *Corallina* turf interest and, at is nearest point, would be some 40m from the habitat supporting that interest.

19.6.46 The works would be temporary and no permanent loss of habitat would occur.

19.6.47 The biotopes directly involved in these temporary works, and listed above, would recover within a reasonable timespan from the disturbance generated by the works. Each is widespread locally and typical of this part of the Bristol Channel.

19.6.48 Whilst the loss of some areas of biotope would occur while this construction zone is in use, given the relatively short duration of the works and the generally high level of recoverability involved, this suggests that sensitivity is low. Given that a frontage of approximately 750m long will be disturbed, the magnitude of the effect is considered to be medium. A **minor adverse** impact is thus predicted.

IMPACT: Disturbance to Corallina due to Construction of the Seawall

19.6.49 The observed distribution of the *Corallina* biotope shows that the nearest occurrence is approximately 75m from the site of the proposed seawall. Given the distance between the seawall and the presence of *Corallina* it is considered unlikely that the seawall works would have the potential to impact upon this interest. As a consequence, **no impact** on *Corallina* as a result of the construction works for the seawall is anticipated.

IMPACT: Intertidal Disturbance Associated with Delivery of Rock Armour for Sea Wall

19.6.50 Two layers of rock armour (total thickness 2.5m, nominal rock diameter 1.35m, median rock mass 6.54t) will be placed at the toe of the sea wall in order to protect that toe from scour and beach lowering. This armour will be placed along a frontage of approximately 760m. Rock armour would be delivered by barge directly to the Hinkley frontage and temporarily placed seaward of the works area to provide protection during sea wall construction.

19.6.51 Vessels grounding on the shore as the tide falls may cause some physical damage to that shore but this will be limited to localised abrasion on initial grounding and the subsequent presence of that passive mass over the surface over the low tidal period. Damage to physical and ecological receptors would generally be minor, with one potential exception: if the activity were to occur over areas of *Sabellaria* colony, loss of localised elements of reef within the berthing footprint involved may occur.

19.6.52 Unloading and transport of materials will involve the movement of vehicles across the shore. If this were to involve the areas of limestone/shale platform, compaction and subsequent erosive loss of the area could be presumed. If this were to involve areas of *Sabellaria* reef, loss of that reef within the affected area could be presumed. Again if this activity were to extend within the limestone shale platform areas, an impact on the *Corallina* interest could be presumed, both through direct loss or compromise to the longshore drainage channels which support that particular interest (for each of these interests, see Ref.19.55 and **Figure 19.36**).

19.6.53 To avoid physical disturbance to sensitive habitats due either to the grounding of barges or the passage of vehicles, a graphical analysis was been completed in order to constrain the berthing activity to a relatively insensitive intertidal area. The need was to avoid interference with both physical features (most obviously the widely distributed cross-shore rock platforms that are typical of the Hinkley Point frontage) and the potentially sensitive biotopes (both the *Corallina* interest associated with these same rock platforms plus *Sabellaria* reef – see Ref. 19.55), whilst also finding an area of the shore whose topography and surface would be suitable for the operation involved.

19.6.54 **Figure 19.36** shows the intertidal area selected. The barge landing area is largely coincident with the historical graving dock associated with the construction of the substantial HPA/B cooling water intake structure currently positioned offshore. It would be limited at its eastern and western boundaries by rock platform habitat, and on its downshore boundary by *Sabellaria* reef. As a precautionary measure, no vessel would be permitted to come to ground outside an inner perimeter set back 50m from each of these boundaries. This would permit flat bottomed barges to be brought close to shore during a high tide, permitting them to ground over the subsequent low water period and be unloaded, without damaging potentially sensitive receptors.

19.6.55 The biotopes associated with this area (inner zone only) are (areas rounded to nearest 10 m^2 and indications provided of recoverability from MarLIN database: http://www.marlin.ac.uk/):

- Eunis A1.32; 1,757 m^2; ‘Fucoids on variable salinity rock’; high recoverability (full recovery within about 5 years).
- Eunis A1.321; 248 m^2; ‘[*Pelvetia canaliculata*] on sheltered variable salinity littoral fringe rock’; moderate recoverability (full recovery up to 10 years).
- Eunis A1.322; 1,368 m^2; ‘[*Fucus spiralis*] on sheltered variable salinity upper eulittoral rock’; high recoverability (full recovery within about five years).

- Eunis A1.323/A1.326; 4,668 m^2; [*Fucus vesiculosus*] on variable salinity mid eulittoral boulders and stable mixed substrata/[*Fucus serratus*] and [large *Mytilus edulis*] on variable salinity lower eulittoral rock; high recoverability (full recovery within about 5 years).
- Eunis A1.46; 415 m^2; 'Barren rock' or 'hydrolittoral soft rock'; no intolerance to disturbance.
- Eunis A2.111; 3,255 m^2; 'Barren littoral shingle'; no intolerance to disturbance.
- Eunis A2.431; 3,097 m^2; Barnacles and [*Littorina spp.*] on unstable eulittoral mixed substrata; high recoverability (full recovery within about five years).

19.6.56 In practice, the actual area of impact will be very much more limited than the areas above suggest, determined by the actual berthing location chosen within this barge landing area on the basis of navigational practicability, and the route taken by vehicles between the sea wall construction zone and the grounded barge. The most likely berthing area within the restricted zone is characterised as Eunis A1.46, described by MarLIN as having no intolerance to disturbance.

19.6.57 Whilst the loss of some areas of biotope will occur while this barge berthing area is in use, the relatively short duration of the works and the generally high level of recoverability involved suggests that sensitivity is low. Given that, as a worst case, a moderate area of the intertidal shore may potentially be disturbed, the magnitude of the effect is considered to be medium. A **minor adverse** impact is thus predicted.

IMPACT: Disturbance to Subtidal Habitats during Construction of Vertical Shafts for the Cooling Water System

19.6.58 Drilling of the shafts would physically disturb sediment on the estuary bed. The method of anchoring during a wet drill approach would result in varying degrees of disturbance; for example, simple anchors would result in a lesser impact than those requiring piling, and the drilling of these would disturb bottom sediments.

19.6.59 The level of seabed sediment scour around the construction-site is likely to be sufficient to remove the 2m of silt overlying the rock surface locally. Given the existing tidal and sediment transport regime this impact, in sediment transport terms, will be of little consequence.

19.6.60 The main impact of this disturbance would be a localised alteration in habitat type away from soft mud to exposed rock. The scale of this disturbance in relation to the widespread nature of the existing muddy plain that extends widely around this location would be inconsequential and, thus, its magnitude would be very low. Given the continual process of tidally driven suspension, deposition and re-suspension normal to the local muddy plain, the sensitivity of the receptor is also very low; resulting in an impact of **negligible** significance.

IMPACT: Disturbance to Subtidal Habitats due to Increased Suspended Sediments Associated with the Construction of the Vertical Shafts

19.6.61 It is considered highly unlikely that the drilling works would produce levels of suspended solids or bedloads that would, beyond a distance at most a few hundred meters downstream of operation, be greater than levels that occur under natural conditions. For both the local infauna and epifauna as well as the estuarine fish populations, already selected by the prevailing conditions of extreme turbidity, this suggests both a low magnitude effect and very low sensitivity. As a consequence a **negligible** impact is predicted.

IMPACT: Subtidal Habitat Disturbance due to Capital and Maintenance Dredging

19.6.62 As noted in **Volume 2**, **Chapter 17**, the operating face of the jetty head will be aligned with the direction of ebb/flood tidal currents in the vicinity. A berthing pocket immediately associated with that operational area will be dredged in order to allow safe delivery of materials across a range of tidal conditions. This dredged area is estimated to be 160m in length and 27m in width with sediments removed to a uniform depth of around 3.5m below the existing seabed (4.5m below CD).

19.6.63 The benthos of this area is typical of the extensive muddy plain that makes up most of the local seabed. Population densities are low due to the extreme tidal conditions. All species identified are commonly found at a national level. The biotope concerned is *'Nephtys hombergii* and *Macoma balthica* in infralittoral sandy mud', also described as 'mobile circalittoral sandy mud supporting a sparse faunal compliment', a biotope which covers approximately 76km^2 out of the total of 94km^2 surveyed locally (**Figure 19.18**, Refs. 19.14 and 19.25). The habitat type which is likely to be affected in this instance is thus locally common and widespread with no protected species; as a result the magnitude of the effect would be low.

19.6.64 Given the existing tidal regime and the associated processes of sediment suspension, mobilisation and deposition, any observable impact due to dredging in this chronically disturbed environment is expected to be of short duration.

19.6.65 As with the area around the cooling water headworks, the predominant epifauna within the area is the brown shrimp *C. crangon*. As with other mobile species, *C. crangon* would be able to move away from the area to seek suitable nearby habitat if need be. In the areas of disturbance both within the berthing pocket area itself and around its margins, a typical faunal assemblage would very quickly become re-established due to tidal mobilisation of surface sediments. Even in less dynamic systems the evidence from studies of recovery rates in subtidal benthic communities of the type present within the footprint of the works clearly demonstrates that soft-sediment, bivalve-annelid dominated communities are able to recover from disturbance events within one to two years (Ref. 19.161). As a result the sensitivity of this habitat to disturbance is considered to be low.

19.6.66 On this basis the significance of the impact is assessed as **minor adverse**.

iii. Changes in Water Quality

IMPACT: Subtidal Habitats due to Spread of Contaminants during Dredging

19.6.67 Capital and, potentially, maintenance dredging, will be required at the seaward end of the jetty to establish and maintain a berthing pocket. Dredging will mobilise sediments and re-suspend particulates in the water column, leading to a temporary and localised increase in suspended solids concentrations and a potential reduction in water quality. Information on existing contaminant loadings within the sediment to be dredged (see **Volume 2**, **Chapter 18**) indicates that there would be a negligible effect on water quality through the mobilisation of this material and thus a **negligible** impact on the local ecology.

IMPACT: Corallina due Changes in Water Quality Associated with Dredging

19.6.68 Although this dredging activity will occur in relatively close proximity to the low water mark and the *Corallina* run-off areas of the lower shore, given the existing tidal regime, any suspended solids in excess of normal levels would largely be advected by the tides and carried elsewhere. A very low magnitude effect would be expected on the *Corallina* run-off feature (i.e. it is expected that the receptor would experience little or no degradation and disturbance is likely to be within the range of natural variability). The sensitivity of the receptor can be regarded as high, on a precautionary basis, given that it is a notable community under the SAC designation. However, given the intermittent presence of the identifiable habitats and their distance from the works, and the fact that *Corallina* is locally selected by the prevailing turbidity regime, in this case its sensitivity is judged to be low. Consequently, the significance of this impact would be **negligible**.

IMPACT: Sabellaria due to Changes in Water Quality Associated with Dredging

19.6.69 Advice provided in Section 5 under Regulation 33(2)(a) of the Habitats Regulations (Ref. 19.114) identifies that *Sabellaria* reef has a moderate level of vulnerability to changes in concentrations of suspended solids. As with *Corallina*, however*, Sabellaria* is locally selected by the prevailing turbidity regime.

19.6.70 The site of the berthing pocket is located greater than 500m away from any areas of intertidal *Sabellaria* reef. Hence, the likelihood of *Sabellaria* being impacted by an increase in suspended solids that would be sufficient to have an adverse effect upon this species is considered very low. The receptor value is nevertheless high as *Sabellaria* reef is an Annex I Habitat, although it's sensitively is considered to be low in this environment. Overall, given the lack of *Sabellaria* in close proximity to the jetty, a **negligible** impact is predicted.

IMPACT: Subtidal Habitats due to Drilling of the Vertical Shafts for the Cooling Water System

19.6.71 During drilling the excavated materials will be mixed with seawater prior to being separated at the water surface. Cuttings with particles larger than 100 microns will be diverted to a barge and sludge re-injected until it reaches a limiting density, at which point this will be diverted to a sludge treatment barge. Filtering would separate solids and seawater, with the seawater being recycled and then released back into the Bristol Channel.

19.6.72 During the drilling works, some sediment from beneath the mobile sediment layer may potentially be disturbed and re-suspended. The volume of sediment likely to be mobilised in this manner is expected to be negligible within the context of existing suspended sediment and bedload concentrations.

19.6.73 The available data show that contaminant levels within the area are relatively evenly spread due to the dynamic tidal flow conditions and regime of continuous re-suspension. This understanding is described in **Volume 2**, **Chapter 18** on Marine Water and Sediment Quality. In this context, and given the low volumes that would be involved, it is anticipated that the impact of any remobilised contaminants on water quality would be negligible. Thus the consequence for the local marine ecology would be a low magnitude effect, set against a very low sensitivity, likewise suggesting an impact of **negligible** significance.

IMPACT: Discharges Associated with the Drilling of the Cooling Water and Fish Recovery Return Tunnels

19.6.74 A variety of discharges will arise from the construction-site, as described below. An offshore discharge location will only become available when the HPC cooling water (CW) system is commissioned; until that time an alternative temporary discharge route has been identified. The impact of commissioning discharges is not described here, but is considered later within this Chapter in the context of the Operational Impacts. The sections below summarise the waste streams involved (greater detail can be found in **Volume 2**, **Chapter 18**) and concludes with an assessment of the consequence of use of the temporary discharge route for marine ecological receptors.

19.6.75 Three main cooling water tunnels will be driven from the land under the seawall, intertidal shore and seabed using dedicated Tunnel Boring Machines. In addition, a further shorter and narrower tunnel will be driven, again from landward, under the seawall and intertidal shore in order to provide a discharge route for the proposed Fish Recovery and Return (FRR) system (described in detail in **Section 19.8** below on mitigation measures).

19.6.76 Some detail of the waste arisings from the cooling water tunnelling operation are described here but quantifications are not yet available for the similar, but very much smaller, FRR operation. For the purpose of this assessment it is taken that the waste arising from that smaller but immediately local operation will be dealt with in precisely the same manner as the cooling water tunnel arisings and will thus not alter the assessment outcome below.

19.6.77 Tunnelling arisings will be recovered to land where they will be treated to separate waste solids from waste water and drilling fluids.

19.6.78 In practice, bentonite-based drilling mud will only be used if geological conditions prove difficult. Consequently a precautionary approach has been taken here which assumes use of the mud-assisted drilling method.

19.6.79 The volume of extracted material in drilling these tunnels would be approximately 577,000m^3 to 650,000m^3 depending on the expansion factor used. While the tunnel machine digs, any bentonite slurry would be sent to the cutting face, become loaded with materials and would then be returned to a separation unit where it would be treated to remove drill cuttings. Dilution water would need to be added to any bentonite and the volume needed for this would be about 60m^3 per hour for the three tunnels, therefore a similar quantity would need to be discharged. This drilling waste could include release of drilling compounds such as bentonite and other chemicals (e.g. organic polymer and residual salt compounds following pH control). Current estimates are that such waste water would contain up to 1,000mg.l^{-1} suspended solids (including 5% bentonite) and 0.7ppm of organic polymers.

19.6.80 These discharges would go to sea via the discharge structure established at the top of the intertidal area. Design studies have considered a number of potential single and multiple outfall configurations and these were tested using a hydraulic model in order to investigate their possible impact on the intertidal shore. The configuration that was selected through that modelling exercise was a single outlet that would result in a relatively confined effluent stream discharge route across the intertidal shore, to the eastern flank of the one-time HPA/B graving dock. This routing will avoid any cross-shore spillage intersecting with sensitive features, such as the longshore drainage routes associated with *Corallina*.

19.6.81 Thus at no point will this discharge route intersect with the *Corallina* interest either directly or via long-shore drainage channels. As noted in Appendix 19A, the influence of suspended solids would have **no impact** on the local *Corallina* and *Sabellaria* interests, and any fresh water input involved would have **no impact** upon the local *Corallina* interest and have **negligible** impact upon *Sabellaria*.

IMPACT: Sewage, Dewatering and Surface Drainage

19.6.82 Sewage and associated wastes associated with the construction workforce will be treated to a tertiary level via package treatment plant prior to discharge, providing a high quality of effluent at point of discharge to the shore. Further details are provided in **Volume 2**, **Chapter 18**.

19.6.83 Surface drainage from the site together with dewatering effluent from the HPC Development Site will also, further to interception, be put to the cross-shore discharge. The base characteristics will be low salinity water plus suspended solids. Again, further details are provided in **Volume 2**, **Chapter 18**.

19.6.84 The discharge of these various waste waters has the potential to impact upon intertidal ecology via their variable salinity, suspended solids composition, and volume.

19.6.85 The high suspended sediment concentration could potentially cause smothering as a result of accretion of fine sediment. Data from existing sources indicate that suspended sediment concentrations in surface waters in the nearshore zone are typically in the order of 250mg/l but can be as high as 1,000mg/l – see **Volume 2**, **Chapter 18**.

19.6.86 As noted above, these discharges would go to sea via the discharge structure established at the top of the intertidal area. Design studies have considered a number of potential single and multiple outfall configurations and these were tested using a hydraulic model in order to investigate their possible impact on the intertidal shore. The configuration that was selected through that modelling exercise was a single outlet that would result in a relatively confined effluent stream discharge route across the intertidal shore, to the eastern flank of the one-time HPA/B graving dock. This routing will avoid any cross-shore spillage intersecting with sensitive features, such as the longshore drainage routes associated with *Corallina*. **Figure 19.19** shows the course of that modelled effluent stream discharge route in relation to biotope mapping, and **Appendix 19A** provides further information on the range of options examined and the allied assessments of impact upon the local marine ecology.

19.6.87 **Figure 19.19** shows both the modelled cross-shore drainage from HPB and a modelled flow pattern associated with the planned discharge structure. At times of low water, the existing discharge, entirely of surface water run-off, crosses a variety of intermediate intertidal biotopes before reaching the lower shore and percolating through an extensive downshore slope of low grade *Sabellaria* reef. The proposed discharge will flow downslope further to the east, firstly across 'barren littoral shingle' biotope then, in turn, '*Pelvetia* on sheltered variable salinity littoral fringe rock', '*Fucus spiralis* on sheltered variable salinity upper eulittoral rock', 'barnacles and *Littorina* spp. on unstable eulittoral mixed substrata', 'hydrolittoral soft rock', and then finally 'a limited downshore extent of '*Sabellaria* reefs on sand-abraded eulittoral rock' – an eastward extension of the same area of low-grade reef currently influenced by the existing surface water drainage.

19.6.88 At no point will this discharge route intersect with the *Corallina* interest either directly or via long-shore drainage channels. As noted in Appendix 19A, the influence of suspended solids would have **no impact** on the local *Corallina* and *Sabellaria* interests, and the fresh water input involved would have **no impact** upon the local *Corallina* interest and have **negligible** impact upon *Sabellaria*.

IMPACT: Corallina due to Discharges Associated with the Drilling of the Cooling Water and Fish Recovery Return Tunnels

19.6.89 Baseline studies have shown that *Corallina* is present within distinctive channels and run-offs along the lower intertidal area, and since any cross-shore discharges could potentially enter these channels and remain there at low tide, a smothering impact is possible. More significantly, a discharge flow might run directly across the *Corallina* run-offs. One of the reasons for the success of the rare *Corallina* run-off biotope on the Hinkley intertidal is the presence of water cover during low tide exposure also allowing high light levels on the alga, a situation not present elsewhere in this region. Excessively high turbidity in discharged water may, if it were to flow towards the *Corallina* run-offs, cause harm. Alterations in salinity, in pH, in turbidity and the presence of organic polymers as well as increased rates of water flow (erosion) are all potentially significant adverse effects on the *Corallina* run-offs. The sensitivity of the algal turf receptor is considered high, but given the mitigation already in place in terms of deliberate placement of the discharge point so as to avoid this particular receptor, the magnitude of any effect is predicted to be very low and the significance of the impact **minor adverse**.

IMPACT: Sabellaria due to Discharges Associated with the Drilling of the Cooling Water and Fish Recovery Return Tunnels

19.6.90 Habitat that supports low grade *Sabellaria* reef of low to medium ‘reefiness’ is present on the lower intertidal area and so there is some potential for discharge from the upper shore to affect this area. **Figure 19.19** shows that the existing surface water drainage discharge already flows into a wider area occupied by that species. On the basis of this observation together with an understanding of estuarine habit and the turbidity regime to which that species is adapted, the sensitivity of this receptor is considered low. The discharged waters would encroach upon lower intertidal habitat only around the time of low tide, reducing the magnitude of the effect to low and leading to an impact of **minor adverse** significance.

IMPACT: Intertidal due to Sedimentation Associated with Discharges

19.6.91 The volumes and suspended solids involved in this discharge may alter the pattern of sedimentation within the modelled area of flow across the intertidal shore. This influence will compete with those of wave and tide, which will in turn rework any materials added or displaced. As the biotope map shows, a significant part of the route of flow will be over rock and shingle and only a limited area involves ‘mixed substrata’ – predominantly limestone cobbles mixed with mud and sandy mud. The impact of variable flow plus suspended solids is thus considered to be of low magnitude and the biotopes involved of low sensitivity; suggesting that a **minor adverse** impact would arise.

IMPACT: Intertidal due to Salinity Associated with Discharges

19.6.92 The discharge will be of variable salinity. Surface water drainage and dewatering water will be of low salinity whilst waste water arising from the tunnelling activities is likely to be variable. As noted above, the existing biotopes which will be crossed by this discharge are frequently described as of ‘variable salinity’ – or are bare rock or barren shingle; the lower shore is occupied by *Sabellaria*, the potential impact on which has already been discussed. On this basis, the sensitivity of the wider intertidal fauna and flora that might be harmed in this instance is considered to be low, and the magnitude of the effect is predicted to be low; hence a **minor adverse** impact is predicted.

IMPACT: Fish due to Increased Suspended Solids Associated with Discharges

19.6.93 Any increase in local suspended solids concentrations associated with these discharges will have the potential to decrease water quality in the vicinity. This could affect fish that may be present in the water column. As discussed previously, the fish assemblage is inevitably well adapted to the existing high turbidity regime and any such alterations to this regime would thus appear to be inconsequential.

19.6.94 While the suspended solids levels associated with the discharge may at times be above background levels, dispersion to background levels would occur over a relatively short distance, suggesting a low magnitude effect. Given that fish are also mobile and would be able to move rapidly out of any waters that are of poor quality, their sensitivity is regarded to be low. Hence the significance of the impact would be **minor adverse**.

IMPACT: Corallina due to Construction of the Seawall

19.6.95 During construction of the seawall there are a number of activities and processes that may lead to a reduction in water quality (as a result of the discharge of potentially contaminated water across the intertidal). The excavation footings for the foundation of the seawall may need to be dewatered and discharge onto the upper intertidal area is likely to be the main route of disposal. This discharge and the excavation works may lead to a localised increase in suspended sediment concentrations.

19.6.96 The location of the seawall works on the uppermost part of the shoreline and largely above MHWS, suggests that the potential for any significant effect on water quality and in turn on the local ecology in the nearshore zone is unlikely. Under high tide conditions, any discharges from the construction area, even if containing relatively high suspended sediment concentrations, would be rapidly dispersed and it is anticipated that background conditions would be achieved close to the points of discharge.

19.6.97 Under low tide conditions, discharges across the upper intertidal area are likely to infiltrate the existing substrates (as they are permeable) and any fine sediment would be anticipated to be washed into the upper beach fabric or deposited in existing areas of mud. Although this depends on the volume of the discharges, it is considered unlikely that they would be of sufficient strength to reach the *Corallina* community present on the lower-mid shore. Even if the discharge were to reach this area and the drainage collected in channels containing *Corallina*, very similar events are understood to occur naturally with rainwater draining off the intertidal area. With the effects of tidal shear these materials would quickly be re-suspended and dispersed. Little impact is thus envisaged on the wider ecology of the shore.

19.6.98 Taking these aspects into consideration, the magnitude of the effect on intertidal communities, and in particular *Corallina*, is thus predicted to be very low. *Corallina* is known (MarLIN) to be moderately well adapted to the periodic natural exposure to extreme salinity variations. It is, however, considered to be of high value in conservation terms. Consequently, the significance of the impact is assessed to be **minor adverse** for this receptor.

IMPACT: Sabellaria due to Construction of the Seawall

19.6.99 Extents of low to medium ‘reefiness’ grade *Sabellaria* reef are present on the lower intertidal several hundreds of metres away from the proposed seawall construction area on the upper shore (**Figures 19.8-10**). It is thus unlikely that any discharge from the seawall construction works would reach the lower intertidal areas supporting *Sabellaria*; even should it do so any such discharge would be diluted or greatly dispersed. **No impact** on this conservation interest feature is thus expected (potential in-combination effects are considered in **Section 19.7** below).

IMPACT: Fish due to Construction of the Seawall

19.6.100 While fish may be present in the vicinity of the discharged waters, it is not anticipated that they would be affected by the discharges as they are fully mobile and able to respond rapidly to an adverse increase in either suspended sediment concentration levels and/or contaminant levels. Given their mobility, **no impact** with respect to fish populations is anticipated.

iv. Noise and Vibration

d) Introduction

19.6.101 A number of construction activities have the potential to generate a significant increase in background noise and vibration levels in marine waters. These aspects of the construction works include: the drilling works for the intake and outfall shafts, construction, operation and dismantling of the temporary jetty and construction of the seawall. No noise and vibration is likely to be caused by land based drainage.

19.6.102 The potential marine receptors are fish and marine mammals, both of which are known to be sensitive to noise disturbance. As a result, both the sensitivity of fish to noise and the scale of noise that might be involved have been reviewed (Ref. 19.56) and as described earlier in this chapter, following recent guidance from JNCC (Ref. 19.155), an array of underwater acoustic sensors has been established both local to the site and on a transect offshore in order to characterise the cetacean interest (Ref. 19.57).

19.6.103 During construction of the shafts for the intake and outfall tunnels the main sources for the generation of noise and vibration will be any piling works and vessel movements around the construction areas themselves. There is no information currently available regarding the types of piling expected to be used (e.g. impact, rotary or vibro piling) so for the purposes of this assessment, as a worst case, it is assumed that percussion piling will be used. Vessel movement noise will be generated regardless of whether piling is used or not.

19.6.104 For the temporary jetty, piling works as well as general construction works would be the main sources of noise and vibration during construction and vessel noise during construction. Details of the construction methodology for the temporary jetty are presented in **Volume 2**, **Chapter 3**.

19.6.105 General activities, including the re-profiling of the cliff face, will generate noise during construction of the seawall. However, given that these works would occur above MHWS the potential for causing an effect to marine species sensitive to acoustic disturbance within the water column is considered negligible. As such the potential impact of noise generated during construction of the seawall is not considered any further in this assessment. The potential effect of noise disturbance on birds that may be utilising the intertidal area during construction of the seawall and the aggregate jetty is covered in **Volume 2**, **Chapter 20** on Terrestrial Ecology and Ornithology'.

Piling Noise – Intake and Outfall Structures and Temporary Jetty

19.6.106 No specific values for the predicted noise levels which could be generated by pile driving during the construction phase for the proposed HPC are yet available as this depends on the technique and equipment to be used. However, a number of previous studies have examined noise levels during construction of coastal developments requiring pile driving. Pile driving has been found to generate sound pressures significantly greater than 192dB re: 1µPa (Ref. 19.162) (Note: the SI unit for the measurement of sound in water is decibels relative (dB re:) to a reference pressure (1µPa)). The level of sound generated can vary in relation to different factors including the size of piles and the scale of the operation (Ref. 19.163).

19.6.107 Studies reported in Ref. 19.164 measuring the sound levels associated with percussive piling found variation in peak to peak pressure changed from 195dB at the pile driver, to approximately 152dB at a distance of about 240m, with a linear decline in sound pressure with distance (measured in metres). 150dB is considered the safe threshold for no physical effects.

19.6.108 The same study (Ref. 19.164) found that at a distance of about 400m from the source of the sound no signal of vibratory piling could be detected, as it was drowned by shipping noise. It also found no evidence that trout reacted to vibro-piling at even a close range of less than 50m. It is probable that the lack of behavioural responses was largely due to the sound energy from the piling being at frequencies at which the fish were relatively insensitive.

Noise Associated with Drilling Works

19.6.109 As described in **Volume 2**, **Chapters 2** and **3** of this ES, a series of three cooling water tunnels will be dry bored from land under the seawall and seabed, in the dry, and two vertical shafts will be wet drilled offshore to meet each of these. In addition a single shorter tunnel to service the FRR discharge will be bored, again from land, to exit in the near subtidal.

19.6.110 No explicit information is available on the level of sound that might be associated with the wet drilling operation, but it is expected that the sound levels involved will be similar to those associated with allied piling activities, and thus have a range of influence of a few hundred meters at most (Ref. 19.56).

19.6.111 The three main cooling water tunnels will be bored by dedicated Tunnel Boring Machines at a depth of between 20 and 40m below the seabed, through a solid rock geology. As a result very little noise is expected to reach the marine environment.

19.6.112 The FRR tunnel will be bored at depth under the seawall and intertidal shore; again, very little if any noise would be expected to reach the marine environment.

Vessel Noise during Construction of the Cooling Water System, Dredging Works for the Temporary Jetty and Operational Traffic using the Temporary Jetty

19.6.113 The construction of the vertical shafts for the intake and outfall structure is likely to require a variety of vessels to move platforms and associated equipment into place, collect discharges, collect and transport drill cuttings and other waste materials, and supply plant and personnel to site.

19.6.114 Capital dredging and possibly maintenance dredging will be required for the berthing pocket at the end of the temporary jetty.

19.6.115 Very large tankers and container ships can generate sound levels in the range 180-190dB re: 1µPa at 1m which is similar to that generated by pile driving (Ref. 19.165) although for smaller vessels the potential impact is greatly reduced. **Table 19.21** shows the sound frequencies and source levels produced by various vessels that may be required during the construction of the proposed development.

Table 19.21: Vessel Sound Frequencies and Source Levels

Vessel	Frequency (Hz)	Source level (dB re 1µPa @ 1m)
Supply vessel	20 – 1,000	110 – 135 (without thrusters) 121 – 146 (with thrusters)
Fishing boat	250 – 1,000	151
Tug (pulling empty barge)	37 – 5,000	145 – 166
Tug (pulling loaded barge)	1,000 – 5,000	161 – 170
Twin diesel work boat	630	159

19.6.116 Ref. 19.165 provides a review of underwater noise in relation to marine dredging and construction activities. Generally, noise generated by dredgers depends on the type of vessel and the activity that is being undertaken. A study by Cefas (Ref. 19.166) of sound levels generated during aggregate dredging found that sound pressure levels were generally found to fall below the ambient noise level (100dB re 1~Pa) within 25km, however some dredging vessel activities were found to emit strong tonal sounds which were detectable at distances greater than 25km. Low frequency sounds were found to be generated by the dredger maintaining its position. Higher frequency sounds (>2kHz) were generated by full dredging activities whilst maintaining position.

19.6.117 Large vessels can cause an aural and potentially a visual disturbance for fish. Generally, vessel noise can elicit avoidance or attraction responses in fish at very low or very high frequencies (Ref. 19.167). Some behavioural changes have been observed in fish in relation to vessel noise such as forming tighter formations, avoiding noise sources and increasing swimming speeds (Ref. 19.168). Experimental studies have shown that avoidance occurs at 118dB within the range of 60 – 3,000 Hz (Ref. 19.169).

19.6.118 There are already large vessels operating within the Severn Estuary/Bristol Channel and fish and marine mammals are likely to have become accustomed to a background level of underwater noise resulting from these activities. In addition, fish and marine mammals have the ability to move away from the sources of vessel noise. As the UK BAP species are all marine migrants moving through the Hinkley Point area from the Bristol Channel, Irish Sea and further afield it would be expected that they would be frequently exposed to vessel noise during their lifetime. Young-of-the-year migratory Annex II species (Atlantic salmon, twaite shad, allis shad, river lamprey, sea lamprey) passing through the estuary, however, would be less acclimatised to vessel noise because of their age.

Effect of Construction Noise on Fish

19.6.119 In order to assess potential impacts of noise on fish an understanding of the hearing abilities of fish is required (see **Table 19.22**). Fish use three organs to detect sound:

the lateral line, the ear and the swim bladder. The presence/absence and characteristics of these organs determine the hearing abilities of fish species which can be considered to be hearing non-specialists, specialists or generalists (Ref. 19.170 and 19.171). Non-specialist fish are those with no swim bladder e.g. lamprey, plaice, dab and sole. Clupeiformes (e.g. sprat, herring and shad) fall within the specialist category and as such can hear sounds over a far greater range than other species (e.g. Ref. 19.172). Species of conservation importance which are considered to be hearing generalists, and are potentially present near the study area, include salmon and eel.

Table 19.22: Hearing Frequency Range for Fish Species of Conservation Importance in the Area around Hinkley Point (Ref. 19.164)

Common Name	Legislative Protection	Hearing Category	Frequency Range (Hz)	Hearing Threshold Range over this Frequency Range (dB re 1µ Pa)
Atlantic salmon, *Salmo salar*	Annex II and V (Habitats Directive) UK BAP	Generalist- swim bladder	30-350	95-130
Shad – Twaite shad, *Alosa fallax*	Annex II (Habitats Directive) UK BAP	Specialist	30,000-60,000	190-198
River lamprey, *Lampetra fluviatilis*	Annex II and V (Habitats Directive) UK BAP	Generalist- no swim bladder	Unavailable	Unavailable
Sea lamprey, *Petromyzon marinus*	Annex II (Habitats Directive) UK BAP	Generalist- no swim bladder	Unavailable	Unavailable
Sea trout, *Salmo trutta morpha trutta*	UK BAP	Generalist-swim bladder	30-350	95-130
Common or Sea Sturgeon, *Acinpenser sturio*	Annex IIa and IVa (Habitats Directive), UK BAP Bern Convention Appendix III, CITIES Appendix I, WCA Sch. 5	Potential specialist	100 – 2000	Unavailable
Eel, *Anguilla anguilla*	UK BAP	Generalist- swim bladder	10-300	Unavailable
Cod, *Gadus morhua*	UK BAP	Generalist- swim bladder	10-500	65-140; /75-110; /95-120
Herring, *Clupea harengus*	UK BAP	Specialist	20-4,000	75-135
Dab,	UK BAP	Generalist- no	30-200	90-105

Common Name	Legislative Protection	Hearing Category	Frequency Range (Hz)	Hearing Threshold Range over this Frequency Range (dB re 1µ Pa)
Limanda limanda		swim bladder		
Sole, *Solea solea*	UK BAP	Generalist- no swim bladder	Unavailable	Unavailable
Plaice, *Pleuronecte s platessa*	UK BAP	Generalist- no swim bladder	Unavailable	Unavailable
Whiting, *Merlangius merlangus*	UK BAP	Generalist – swim bladder	Unavailable	Unavailable

***Note:** Where species data are lacking, data for those of similar physiology are presented where possible.*

19.6.120 In addition to auditory problems, more severe impacts could include the perforation of swim bladders by high-energy underwater noises (Ref. 19.173) which can cause fish to sink, lose the ability to orientate themselves, or lead to internal bleeding and fatality. Noise levels within 5m of pile driving operations can exceed levels that can harm or kill fish, with peak values quoted at around 218dB. The sound pressure levels which may cause harm to fish differs between species and is largely dependent on the presence or absence of a swim bladder. Underwater noise may also create disturbance to local fish populations, although fish will rapidly acclimatise to background noise (Ref. 19.56).

19.6.121 Audiograms (see **Table 19.22**) indicate hearing ranges for some of the species of conservation importance known to be present within the Severn Estuary/Bristol Channel (Ref. 19.164).

19.6.122 Of particular importance in the Severn Estuary are populations of migratory salmon and shad that may be migrating through the estuary during the works. Salmon are only sensitive to low frequency sound and do not react to frequencies above 380 Hz. The lowest response threshold and presumably the frequency of greatest sensitivity are between 100 and 160 Hz. Above this sensitivity rapidly declines. Vibratory piling produces sound within the range of frequencies detectable by salmon.

19.6.123 Shad are clupeids (a family of fish also including herring, sardine and menhaden), and as such it could be considered that they are morphologically very similar to the Atlantic herring (*Clupea harengus*). Studies on American shad *Alosa sapidissima* found shad could detect sound from 200 Hz to over 180,000 Hz, although the two regions of best sensitivity ranged from 200 to 800 Hz and the other from 25 to 150 kHz (Ref.19.174), with the lower bandwidth similar to that reported in herring by Ref. 19.175. It has been suggested that there are subtle differences in the ears of Clupeinae and Alosinae that may provide a mechanical explanation for why only the shads are able to detect ultrasound (Ref. 19.172).

19.6.124 Data on the response of allis shad to sound are limited, however data on the closely related twaite shad indicate noise levels of 158dB and a ramped frequency range of

100 to 500 Hz caused fish to undertake avoidance reactions at 138dB, which was >40dB above ambient noise levels (Ref. 19.176).

19.6.125 Comparing data on vessel noise generation (**Table 19.21**) with the hearing capabilities of the fish species (**Table 19.22**) it can be seen that supply vessels, fishing boats and tugs (pulling empty barges) can generate sound within the hearing frequency range of most species, the only exception being twaite shad. A tug pulling a loaded barge however, can generate sound at much higher frequencies (1,000 to 5,000 Hz) which lies outside the range of the majority of fish species (salmon, twaite shad, sea trout, eel, cod, dab). Similarly the frequency of sound generated by a twin diesel work boat is outside the hearing range of these species.

19.6.126 For fish species to hear the vessels and demonstrate an avoidance reaction, both the frequency and noise level indicated in **Table 19.21** would need to be within the range of a particular species. However, attenuation of sound means that as distance from the vessel increases, noise levels would reach values less than those indicated to be source noise levels in **Table 19.21**.

19.6.127 The impact associated with vessel noise would be expected to be smaller than that associated with pile driving even though vessel noise may be more of a continuous nature. While it might be anticipated that there could be a greater effect due to the combination of vessel plus piling noise, it is considered unlikely that the significance of this cumulative effect would be any greater than for piling alone. This is again due to the fact that any fish within the zone of influence would no longer be present in the affected area or would avoid it while noise levels were raised.

19.6.128 Dredging would only be undertaken for around four weeks during the construction phase and mobile organisms can evade the noise source if required. Consequently, noise impacts associated with dredging are not expected to affect mobile marine ecology receptors.

IMPACT: Generalist (no swim bladder) due to Noise Associated with Piling

19.6.129 Lacking swim bladders, flat fish are deemed to be least likely to be impacted by piling works owing to their weak auditory capacity (restricted to particle motion). Although it is possible that individual fish may be impacted in the immediate vicinity of piling activity, flat fish found around Hinkley Point are widespread and unlikely to be impacted negatively at a population level. The receptor value in this case is considered to be low. The magnitude of the effect is also predicted to be low due to (a) the existing noisy intertidal environment, (b) the fact that at any one time only a very small proportion of the overall population of any one fish species would be likely to be within close proximity to the piling works, (c) the adoption of soft start piling (a gradual increase in noise levels), and (d) the ability of larger fish to swim away from the noise source. The impact significance is therefore predicted to be **negligible**.

IMPACT: Generalist (no swim bladder) due to Noise and Vibration Associated with Dredging

19.6.130 In terms of vessel movements and dredging activities, fish would be present in the vicinity of the dredging for the jetty and therefore, would be directly affected by the noise and vibration associated with the operation of the dredger, which would be temporary. The receptor value is considered to be low, while the magnitude of the effect is predicted to be very low (i.e. it is expected that the receptors would experience little or no degradation as they are generally habituated to vessel noise and disturbance is likely to be within the range of natural variability and limited to areas within and adjacent to the development). The impact of significance is therefore assessed as **negligible**.

IMPACT: Generalist (no swim bladder) due to Noise and Vibration Associated with Construction of Horizontal Tunnels

19.6.131 With regard to drilling noise during the construction of the horizontal tunnels, the depth of the drilling within the bedrock (40-20m depth) suggests that the propagation of sound waves into the water column would be limited. Flatfish, which are sensitive to vibration and low frequency sound, are likely to be able to feel the vibration from the approach of drilling activity through the seabed and would, therefore, have the opportunity to move from the area before noise levels increased. Any avoidance reaction in fish would be likely to be confined to the immediate corridor above the tunnel and it is considered that there would be a very low/negligible sound level within the water column at a distance of >1km from the source.

19.6.132 Thus, for generalist fish species, a low sensitivity combined with low magnitude of effect would have no more than a **minor adverse** impact.

IMPACT: Generalist (swim bladder) due to Noise and Vibration Associated with Piling

19.6.133 There is still considerable uncertainty about the effects of piling noise on migratory fish species, although the available data suggests that levels sufficient to cause serious injury or death are unlikely to occur at distances of greater than 5m from the source, and at greater than 400m it is unlikely that salmon or trout would react at all to vibratory piling. Based on salmonid and clupeid hearing it could be anticipated that migratory fish in the vicinity of piling activities would be expected to show avoidance behaviour to noise levels above 90dB depending on the intensity of background noise.

19.6.134 Anadromous species migrating seaward are unlikely to be prevented from migrating by noise impacts as the size of seaward migrating salmon (smolts), shads and lamprey means that their swimming speeds are typically lower than tidal stream velocities. The movements of juveniles of anadromous species will thus be determined by tidal transport, which means that individuals will tend to pass the area of disturbance fairly rapidly. In the case of salmon smolts, the utilisation of the fastest flowing portion of the estuary would ensure animals are rapidly conveyed past any area subject to disturbance impacts.

19.6.135 The Severn Estuary is a known migratory route and given the designated status and importance of the migratory fish populations the disturbance and potential physical impact of piling could be considered to be of moderate significance. However, given that the Inner Bristol Channel is approximately 20km wide at the point of disturbance and that it is unlikely that elevated noise levels that would lead to avoidance would extend beyond 400m there would be sufficient space for any displaced migratory fish to continue migration. Given the relatively small area of the Inner Bristol Channel that would be impacted during the construction and piling phase it is, therefore, considered that the magnitude of the effect would be low (on a receptor of low sensitivity) and that there would thus be a **minor adverse** impact.

IMPACT: Hearing specialists (swim bladder) due to Noise and Vibration Associated with Piling

19.6.136 The potential impact of noise generated during pile driving would vary depending on the species/assemblage of fish considered. For non-migratory, resident species within the range of the works it is certain that an effect would occur, but that, based on hearing range and sensitivity only species such as herring would be likely to be sensitive to the generated noise levels. For such species, within the immediate vicinity of the piling it would be expected that some disturbance would occur and potentially if fish were within very close proximity to the piling (i.e. within a couple of metres), physical damage could occur. The sensitivity for these species would therefore be high.

19.6.137 It may be presumed that without mitigation individuals would be open to harm if in close proximity to the operations themselves. If percussive piling were to be used without mitigation, the magnitude of the effect would be medium, and the sensitivity of the receptor also medium, with a consequential impact of **moderate adverse** significance.

IMPACT: Effect of Construction Noise on Marine Mammals

19.6.138 As discussed in the baseline section, there is evidence from acoustic monitoring that marine mammals visit the area, however they are not commonly observed and are unlikely to be present on a regular basis in the vicinity of Hinkley Point. For the purpose of this assessment they have been assumed to be intermittently present. The receptor value is considered to be high, as it includes Annex II species of international importance. Impacts are predicted to be direct and temporary, however, due to the limited presence of marine mammals, the adoption of a soft-start approach and their ability to avoid areas of disturbance, the magnitude of the effect is assessed to be very low. Therefore, it is predicted that the impact significance for marine mammals from noise associated with the construction works would be **minor adverse**.

i. Artificial Lighting

19.6.139 The construction works may require that night time working is undertaken, in which case powerful artificial lighting will be needed. This may apply to the drilling works for the intake and outfall shafts, construction and dismantling of the temporary jetty and construction of the seawall. For the purposes of assessment it is presumed that lighting will be required. Lighting will also be required for the temporary jetty during its operation.

19.6.140 The effect of artificial lighting has been considered in relation to two broad habitat types and the species that utilise these habitats – namely intertidal areas and the water column.

IMPACT: Lighting Effects on Intertidal Areas

19.6.141 This effect only applies with regard to the temporary jetty. While it is possible that lighting may be used during construction of the seawall (tidal conditions permitting) there are no intertidal communities of significance (e.g. *Corallina* turfs) within 100m of the location for the seawall.

19.6.142 The invertebrates and plants present on the intertidal are likely to be tolerant to exposure from artificial light as clearly these communities are subject to intense light levels on a daily basis. Artificial lighting would also only have an effect during low tidal conditions, which effectively means that due to attenuation through the water column, communities would not be subject to a 24 hour increase in light levels. Potential impacts on birds are considered in **Volume 2**, **Chapter 20**, Terrestrial Ecology and Ornithology.

19.6.143 Of the *Corallina* dominated biotope present on the Hinkley intertidal only a relatively small area falls within the footprint of the temporary jetty. Within this small area it can also be stated that potential lightfall from artificial lighting would only affect a proportion of the *Corallina* biotope present, as light levels would rapidly drop off away from the source. Although an increase in light levels could potentially promote growth of *Corallina*, it is highly unlikely that the increase that some isolated areas of *Corallina* might be subject to would promote growth such that it was of significance or potentially interfere with other physiological processes. Hence **no impact** is anticipated.

IMPACT: Lighting Effects on the Water Column

19.6.144 In the case of the construction phase, lighting of the works for drilling of the vertical shafts for the intake/outfall structures and for the temporary jetty may influence the water column. Light penetration into the water column will also occur during operation of the temporary jetty.

19.6.145 The key variable to take into account when assessing light attenuation through water is the suspended sediment load of the water. Due to the very high turbidity levels within this area of the Inner Bristol Channel there would be limited penetration of the artificial light into the water column, and it is considered that light levels would be negligible after 1-2m of passage though water. Consequently, only organisms near the water surface may potentially be affected by this night time lighting and benthic organisms on the estuary bed would not be expected to be influenced.

19.6.146 Light is known to have a strong influence on fish behaviour, with photoperiod acting as an environmental cue in relation to reproduction, and also as a factor determining migration. Changes in natural reproductive development rates as a result of artificial light regimes have been demonstrated for a range of fish species. However, this has generally been where the light environment experienced by fish is overwhelmingly determined by that artificial source (e.g. in aquaria, laboratories or fish farm facilities).

19.6.147 Light has also been demonstrated to influence fish migration, with species such as salmon and sea trout migrating predominantly at night rather than day. Similarly, various species have been demonstrated to either be attracted to or repelled by light, with the majority being repelled.

19.6.148 While it is possible that some fish species may be present within the area affected by artificial light, the potential magnitude of change associated with this effect (for the reasons given above) is considered to be very low. Given that it is likely that only a very small percentage of the Inner Bristol Channel would be affected, for both the temporary jetty and the shaft drilling works, and that many species, including migrating fish, would avoid any lit areas and thus be of low sensitivity, the overall effect on fish movement is anticipated to be **negligible** for the construction phase (drilling works and jetty) and operational phase for the temporary jetty.

e) Potential Impacts during Operation

i. Introduction

19.6.149 This section covers the range of impacts that would occur as a result of operational activities. The key aspects and the receptors that these could affect are listed below in **Table 19.23**.

Table 19.23: Key Operational Impacts and Receptors

Receptor	Phytoplankton	Zooplankton	Epifauna	Benthic flora	Subtidal invertebrates	Intertidal habitats (including Sabellaria)	Fish	Marine mammals
Thermal plume impacts			✓	✓	✓	✓	✓	
Chemical plume impacts			✓	✓	✓	✓	✓	
Entrainment and impingement impacts of abstraction on intake screens	✓	✓	✓	✓	✓		✓	

ii. Thermal Discharges

Allied Assessments

19.6.150 The issue of the proposed thermal discharges from HPC is discussed in **Volume 2**, **Chapter 18**. That chapter deals with matters of compliance against specific temperature and allied water quality criteria set down in both regulations and existing guidance. Discussions within this chapter focus solely on the implications of the thermal fields involved on the marine ecology of the system.

Numerical Modelling of Thermal Plumes

19.6.151 The supply of cooling water is fundamental to the operation of any thermal power station and the requirements of a nuclear station are not significantly different from to those using conventional fuels (e.g. coal, oil). HPC is situated on the coast in order to utilise the large volumes of seawater available. In such circumstances the areas potentially most vulnerable to any excess temperature will be the intertidal and shallow water seabed.

19.6.152 The Inner Bristol Channel is subject to both variable freshwater inputs from river estuaries and a variable temperature regime. There may be periods of constant high or low temperature and low salinity during river floods, depending on the season. Therefore, any biological impact will be dependent on a combination of salinity and temperature conditions. More open coastal locations may not be affected by such large salinity and temperature variations, but will be more prone to the effects of weather, wind and waves. For the purposes of both appropriate engineering design and environmental assessment the first step is to secure an understanding of the existing baseline condition over which any proposed discharges will be superimposed.

19.6.153 For HPC, operational requirements determine that at full operating load the cooling water will be discharged at 10 to 12°C above intake, and at full load the cooling water volume involved across both European Pressurised Reactor (EPR) units will be approximately $125m^3.sec^{-1}$.

19.6.154 A continuous supply of cool water is a primary operational requirement. In order to ensure this supply the relative positions of the intakes and outfalls are chosen with considerable care so as to avoid the recirculation of heat during the full range of tidal and meteorological conditions that might be expected. To this extent the needs of the power station operator and the local marine ecology are identical i.e. stable conditions within a limited mixing zone area with efficient loss of excess heat to atmosphere from the sea surface.

19.6.155 To simulate this wide range of hydrodynamic, meteorological and geomorphological conditions the GETM thermal outputs have been used, unless stated otherwise. This model is considered to overestimate water temperature outputs (by approximately 0.5 to 0.75°C); while it is considered that the Delft model was underestimating the extent of the plume. The upper local sea water range temperature of 20.4°C (98 percentile based on 32 years of Cefas data for Hinkley Point) was also used as the basis for a precautionary assessment.

19.6.156 Details of the models employed in support of the HPC development may be found in Refs. 19.59, 19.65, 19.38 and 19.67. A summary of model development is included as **Appendix 18A** to this ES.

19.6.157 Hourly model outputs against a selected set of variables were used to produce time series means and averages. The basic modelling scenarios that were tested, Runs A-E, are described in **Table 19.24**. The runs were used to produce detailed thermal predictions to establish baseline conditions (i.e. HPB operating alone) and to represent a range of potential operating conditions in the future.

19.6.158 In order to establish baseline conditions and validate the model, Runs A and B represent HPB operating at 70% and 100%. The reasons for running variations on the HPB operating scenario relates to a reduction in HPB operating output during the modelling verification and calibration stage. It should be noted that it is not envisaged that operation of HPB at 70% reflects long term operating conditions at HPB. Modelling of HPB between 70% and 100%, however, does provide the ability to assess a range of conditions under which the station could operate both now and in the future (i.e. it reflects a range of current baseline conditions).

19.6.159 Run C calculates the thermal plume conditions in relation to the operation of HPC only (i.e. the effects of HPB are removed). This reflects conditions that would occur in the future when HPB ceases generation.

19.6.160 Run D reflects a time whereby HPC is operating at full capacity and HPB is operating, but potentially below consented maximums (as described above). Run D thus provides the opportunity to assess impacts on the potential lower range of HPB operation.

19.6.161 Run E is considered to represent the upper limit of potential combined operation, i.e. both HPC and HPB are operating at maximum consented levels. For the purposes of the assessment included within this chapter, a five year overlap with HPC is assumed (based on the potential extension of the operational life of HPB).

19.6.162 In summary, Runs A and B are considered to reflect the current baseline conditions experienced at Hinkley Point; while Runs C, D and E reflect potential operating conditions in the future and therefore form the basis of the impact assessment in this chapter, as well as the allied HRA.

Table 19.24: Calculated Thermal Plume Areas at the Bed, for Particular Excess Temperatures

Run	**Total plume area km^2 at the bed at particular mean excess temperatures The 2nd value indicates the equivalent plume area once corrected for the time that cells are dry**					
	≥0.75°C	**≥1.0°C**	**≥1.25°C**	**≥1.5°C**	**≥2°C**	**≥3°C**
Run A Hinkley B (70%)	8.99 4.31	5.88 1.67	4.04 0.56	2.8 0.20	0.71 0.02	0.0 0.0
Run B Hinkley B (100%)	13.58 8.51	9.62 4.71	7.10 2.34	5.18 1.01	3.06 0.20	0.31 0.01
Run C Hinkley C (100%)	51.50 43.7	37.4 27.9	25.77 16.4	18.22 9.54	5.31 2.17	0.0 0.0
Run D Hinkley C (100%)+B (70%)	60.21 54.4	46.26 40.1	35.8 28.7	27.78 19.7	17.95 8.5	3.6 0.20
Run E Hinkley C (100%) + B (100%)	63.83 57.71	49.01 43.38	38.65 32.32	30.50 23.45	19.90 11.17	7.65 0.77

19.6.163 The extent of the thermal mixing zones associated with HPB (which defines the existing baseline) and HPC are illustrated in **Figures 19.20** to **22**.

IMPACT: Thermal Regime Change on Non-migratory Fish

19.6.164 An understanding of the fish assemblages likely to be present in the vicinity of the predicted mixing zone have been obtained from sampling at sea (e.g. Ref. 19.33), from intertidal fish surveys (e.g. Ref. 19.177) and from impingement data collected at HPB (e.g. Ref. 19.36). The dominant species recorded include sprat, whiting, herring, sole and flounder. Both the sampling at sea and the impingement data reveal a wide range of fish species including a number of commercially important species.

19.6.165 Potential impacts on fish assemblages attributable to the discharge of thermal effluent have been comprehensively reviewed by the BEEMS Expert Panel (Ref. 19.21). These may include changes to spawning season, reproductive capacity (Ref. 19.178), feeding behaviour changes and recruitment impacts.

19.6.166 Responses of fish to changes in temperature have been extensively studied in the past, particularly in relation to commercially important species and protected species and in relation to community changes in response to regional climate change (Refs. 19.21 and 19.179). Egg and embryonic life stages may be most at risk from increases in temperature and the significance of this risk will depend in a large part upon their relative abundance within the area and the significance of these larval stages in terms of recruitment, as well as the degree to which they are actually exposed. In practice, recent ichthyoplankton studies carried out off Hinkley Point (Ref. 19.33 and 19.34) suggest that local fish egg and larval abundances are chronically low. Adults would be expected to move away from an area of higher temperature, therefore, reducing the likelihood of exposure.

19.6.167 While fish will undoubtedly be present within the area affected by the thermal plume, the overall effect is difficult to quantify due to the composition of the fish assemblage. Whatever the level of effect on different species it is obvious that fish have the capacity to move in and out of the thermal plume and thus no direct mortality would be expected. It is known that certain species, such as sea bass, congregate near thermal plumes, suggesting that the presence of the thermal plume may be beneficial for this species. Increased temperature may also be beneficial for other Lusitanian (warmer-water) species present in the Inner Bristol Channel, but potentially of some detriment for species nearer the southern extent of their range (Arctic-Boreal or cold-water species) e.g. cod (Ref. 19.21). Given that the predicted warming would cover a relatively small area of the Inner Bristol Channel, the magnitude of the effect is considered to be low. It is apparent that no large-scale changes in the fish assemblage as a result of the predicted temperature change would occur.

19.6.168 There are likely to be small-scale changes in the composition of the epibenthic fish assemblage within the footprint of the thermal plume. But again, as the vast majority of the species present are tolerant to temperature variations within the range predicted for the thermal plume (Ref. 19.14), it is unlikely that any shift in the composition of the assemblage would be significant either within the confines of the affected area itself and certainly not at the Bridgwater Bay-Inner Bristol Channel level. The sensitivity of non-migratory species is therefore low.

19.6.169 Taking the above points into account, whilst it is possible that some small-scale changes to the fish fauna within the footprint of the plume may occur, overall the fish assemblage would retain its existing composition. Only through an Inner Bristol Channel alteration in water temperature would the composition of the fauna be likely to change, as evidenced by the long-term data series collected from the intake screens at HPB (described earlier in this chapter), and such temperature change would not occur as a result of the thermal discharge into a relatively localised area. The conclusion is thus that although temperature sensitivities exist among the fish fauna, the predicted extent and magnitude of the thermal discharge would not lead to significant change in either species composition or population levels in the estuary and, overall, a localised, long-term but **minor adverse** impact would be anticipated.

IMPACT: Thermal Regime Change on Migratory Fish

19.6.170 Migratory fish may be influenced by thermal change through a number of potential pathways (as for other, resident fish), but it is perhaps the potential for migratory behaviour to be affected that is of greatest importance (Ref. 19.21). For those species for which the Severn Estuary is of importance, the following aspects of are significance:

- River lamprey migrate from estuaries to spawn in rivers when water temperature reaches 10 - 11ºC, usually in March and April (Refs. 19.21 and 19.180), however spawning may continue at higher temperatures (Ref. 19.181).
- Sea lamprey usually migrate from the sea and spawn in British rivers in late May or June, when the water temperature reaches at least 15ºC (Ref. 19.182). Adult sea lamprey have been shown to survive in a wide range of temperatures from 4-20ºC (Refs. 19.21 and 19.183).
- Migration of shad from the sea to estuaries appears to be triggered by temperature (Ref. 19.182). Temperature requirements for both twaite and allis shad migration have been shown by a number of workers to be similar and range from 10 - 16ºC (Refs. 19.21 and 19.182). Allis shad eggs have been shown to be sensitive to water temperatures below 16 - 18ºC, therefore it has been hypothesised that climate change may make some British rivers more favourable for allis shad than in the past (Ref. 19.182). Temperature has been shown to affect larvae development and year- class strength, in that temperatures at the higher end of the range have encouraged spawning activity and enhanced subsequent larval survival and growth (Ref. 19.182). Temperature preferences for larvae are dependent on size to some degree with preferences between 17 and 21.5ºC identified by Ref. 19.184 in the Elbe estuary. Overall, an increase in temperature may be beneficial for warm-water species such as shad and lampreys and of some detriment to cold-water species such as salmon (Ref. 19.21).
- Fish are known to migrate into and out of thermal effluent discharges, and it is reported that greater fish abundances can be found at outfall locations than at adjacent locations, however this is influenced by seasonal migrations (Refs. 19.21 and 19.185). The presence of thermal effluent discharges could potentially locally exclude some species with low tolerance to temperature, which may result in local changes in species composition and community structure (Ref. 19.185). The author of Ref. 19.73 demonstrated that salmon migrating at sea and eels in estuaries use temperature fronts, however there appears to be little evidence to suggest that thermal effluent discharges can interrupt migration (Refs. 19.21 and 19.73). The authors of Ref. 19.186 reviewed evidence of thermal barriers to fish and were unable to find firm evidence of the reality of thermal barriers in rivers and estuaries, except near to the lethal limit. There remains potential, however, for avoidance behaviour within some species when undesirable temperatures are encountered, for example sea trout smolts are known to avoid temperature increments of >6°C thermal effluents (Ref. 19.187).

- Sea trout smolts are known to avoid thermal interfaces where the temperature rise is above 6℃ (Ref. 19.237).

19.6.171 Possible thermal occlusion of migratory pathways thus remains one of the primary considerations when assessing thermal effluent effects on diadromous fish. Temperature increases affecting migratory fish species and thermal standards for marine environments are discussed in Ref. 19.21. A maximum uplift of 2^{o}C is recommended for the edge of mixing zones within SACs which include sensitive species such as salmonids; and an uplift of less than or equal to 3^{o}C is recommended for other status classes.

19.6.172 The best practice guidelines for prevention of thermal barriers to fish migration state that no more than 25% of the cross-sectional area of an estuary or river should exceed a temperature of 2℃ above ambient for more than 5% of the year (Refs. 19.31 and 19.186). Hence predicted excesses above ambient were analysed for each of the Transects A to D (**Figure 19.23**) for each GETM Model Run A to E (**Table 19.25**). Analysis of the annual results show that only Transects B (Stolford to Burnham-on-Sea) and C displayed potential failures (**Table 19.25**) (Refs. 19.59, 19.63 and 19.65). However, in both cases there were only a few annual events and neither transect indicated breaches of the criteria for more than 5% of the time and, therefore, neither of the transects failed the criteria.

19.6.173 In the interests of understanding the system and with a view to extending the logic to future climate scenarios when specific meteorological conditions may become more frequent, Transects B and C (**Figure 19.23**) were analysed in more detail. On this basis (see Ref.19.59) the future conditions most likely to produce barriers to fish migration are warm, summer conditions, on spring tides with moderate winds from the west. Even so they are unlikely to exist for more than one or two hours on each tide and only occur on spring tides. It is therefore considered unlikely that the thermal cross sectional area criteria will be breached during the lifetime of HPC.

Table 19.25: Incidence of Hourly Intervals of Occlusion of Estuarine Cross Sectional Area >25% from Annual Analysis (Ref.19.59)

No of Excess Temperature Events where the cross sectional area at >2C is > 25% of the transect						**Breach Annual %**
Transect	**Run A**	**Run B**	**Run C**	**Run D**	**Run E**	**Run E**
A	0	0	0	0	0	
C	0	0	0	7	28	0.39%
B	0	0	0	0	4	0.05%
D	0	0	0	0	0	
No of Excess Temperature Events where the cross-sectional area >= 2C is in the range 0.1% - 25% of the transect						
Transect	**Run A**	**Run B**	**Run C**	**Run D**	**Run E**	
A	0	0	0	0	0	
C	0	0	0	26	54	
B	157	715	75	766	1461	
D	0	0	0	0	0	

19.6.174 Migratory fish passage is thus not predicted to be hindered in the Inner Bristol Channel, Bridgwater Bay area or the River Parrett and both these water bodies are predicted to remain passable at all states of the tide.

19.6.175 While it is thus possible that the predicted thermal change could lead to an alteration in the behaviour of migratory fish, it is not considered likely that this would have any significant effect on either their ability to migrate or would influence their cues for migration. The expected temperature change would not be sufficient to block migratory pathways through the Inner Bristol Channel towards the Severn Estuary or rivers draining into the estuary (e.g. the Parrett, Wye, Usk). It is clear that the migratory fish populations (both from a conservation and fisheries perspective) are of importance. However, given their overall tolerance to temperature change, their ability to select their preferred temperatures and the relatively localised nature of the predicted >2℃ change, it is considered that the potential magnitude of change is low, and the sensitivity of migratory species is medium. Hence, overall, the impact would be **minor adverse**.

IMPACT: Thermal Plume on Corallina and Sabellaria

19.6.176 Where the thermal plume impinges upon intertidal or shallow subtidal areas, there is likely to be a shift in the zonation of benthic macrofaunal communities as a result of their differential tolerance to temperature rise, upper shore species being more tolerant than lower shore or shallow-subtidal species (Refs. 19.72 and 19.189). Species and communities of the deeper subtidal would not experience temperature rises of an extent likely to have any adverse impact, as they will not suffer any direct contact with the plume-water.

19.6.177 The intersection of the thermal plume with the seabed and intertidal areas, as modelled by GETM, is shown in **Figures 19.24** to **19.26**.

19.6.178 The benthic communities or habitats occurring within the vicinity of the HPC plume include four species that might be of concern if sensitive to an increase in temperature:

- The bivalve *Macoma balthica* on the intertidal flats, as a potentially significant food resource for littoral-feeding birds or demersal fish or decapods.
- The shrimp *Crangon crangon*, a significant food resource for birds and fish, and a significant predator on the intertidal.
- The *Corallina* run-off biotope, as it is both rare in this region (and in the UK) and itself provides a habitat for many other species.
- *Sabellaria alveolata*, a common species but one that produces biogenic reef habitat (again to the benefit for other species) along the lower shore.

19.6.179 Both *Corallina* run-offs and *Sabellaria alveolata* tubes and reefs are present across the Hinkley Point intertidal. *S. alveolata* is a Lusitanian species restricted in its distribution in the UK by winter cold temperatures, and indeed shows the greatest development of reefs within the outflow of the existing Hinkley Point Power Stations. *Corallina officinalis* agg. is naturally tolerant of warmer (and colder) waters than those in Bridgwater Bay, occurring from Norway to Morocco, as well as in mid- to low-shore permanent rock-pools which can be subject to extremes of temperature at low tide.

19.6.180 The modelling outputs predict that the extent of the thermal plume for HPC alone will have no greater influence on the Hinkley shore than that of HPB – see **Figures 19.24** to **19.26** and **Figure 19.27**. This suggests that both existing *Corallina* and *Sabellaria* communities would not be subject to an increase in thermal load and, consequently, **no impact** with regard to these ecological interests is anticipated. While a simultaneous operation of HPC and HPB would result in some increase in average temperatures on the Hinkley frontage, available data on both *Corallina* and *Sabellaria* (e.g. see Refs. 19.14 and 19.73) suggest that such an increase would be unlikely to have any ecological consequence for these species.

IMPACT: Thermal Plume on Macoma balthica

19.6.181 The bivalve *Macoma balthica* is dominant in both intertidal and subtidal infaunal communities at Hinkley Point (Refs. 19.23 and 19.28). This species is also considered to be an important prey item for birds and benthic fish and crustacean species (Ref. 19.14). *M. balthica* has a wide geographic range, with southern limits on the coasts of the Bay of Biscay, although local populations will be adapted to the ambient temperature regime. For example, studies on populations in the Wadden Sea (Ref. 19.190) and in the Baltic Sea (Ref. 19.191), both colder waters than are found at Hinkley, recorded reduced population sizes and increased offshore migration in response to raised temperatures, in the former case over the longer term (possibly a result of climate change) and in the latter case in response to a thermal discharge of 10ºC ∆T.

19.6.182 Studies conducted as part of BEEMS contrasted the condition of *M. balthica* populations across a geographical temperature gradient, finding no relationships between latitude and condition, age or structure of the populations (Ref. 19.50). However, a wealth of literature has shown warmer winter temperatures are associated with reductions in fecundity, recruitment, condition and earlier recruitment (Ref. 19.14).

19.6.183 Growth of *M. balthica* is reported to cease at 15ºC (Ref. 19.192) and its growth period in the Wadden Sea is limited to between the time of first spawning in early spring and the point at which mean temperatures reach 15 ºC. A reduction in growth period may occur with limited food availability and increased summer temperatures. Increased temperatures as a result of the thermal plume could be expected to bring forward the 15ºC growth threshold.

19.6.184 Ref. 19.14 suggests that under an operational scenario of HPB and HPC running together at full capacity a worst case reduction in growth period of approximately five days would occur. Slightly less than half of Stert Flats would be affected by a change in the *M.balthica* growing period for the most extreme scenario (HPB + HPC at full load), whilst Berrow Flats would experience a reduction of 1 day only (2% of its growth period) – see **Figures 19.24** to **19.26**.

19.6.185 Initial studies (Ref. 19.23) were carried as part of the BEEMS programme into the characterisation of populations outside and within the HPB plume. It was found that there were no significant differences in biomass, length or condition between stations inside and outside the area of influence of the thermal plume for any of the survey datasets. However, the surveys upon which this initial finding were based contained only a few sites within the expected intersection of the HPB plume.

19.6.186 Potential impacts of the HPB thermal plume on the Stert Flats *M. balthica* populations were investigated using more detailed seasonal measures of abundance, biomass and size from 2010 (Ref. 19.249). Data from 15 stations across the flats were gathered in April, July and October 2010 and January 2011. Mean and standard deviation of *M. balthica* abundance, shell and tissue ash-free dry-weight (AFDW), length and juvenile Tellinacea abundance were utilised in a cluster analysis for each season. With this analysis each cluster represents a distinct population 'type' distributed across the flats. The cluster groups were overlaid on a map, **Figure 19.38**, showing the current estimation of the HPB thermal plume extent (calculated from water and sediment temperature sensor measurements taken across Stert Flats during spring and summer 2011; the map has been drawn using night-time temperatures, in order to reduce the influence of naturally-occurring changes in sediment temperature caused by solar irradiance).

19.6.187 Nine sites in the Severn Estuary, including Hinkley Point, were identified as likely habitats for *Macoma*. The sites were visited to identify the occurrence of *Macoma* and, if present, quantify population parameters over the high and/or mid-shore levels (Ref. 19.249). Individual length and age data (obtained by counting growth rings) were then processed for five sites between Hinkley Point, in the south, and Clevedon, in the north (Hinkley Point, Weston-Super-Mare, Kewstoke, Wick-Saint-Lawrence and Clevedon).

19.6.188 The results of this investigation (Ref. 19.249) showed that there was no clear correspondence between *M. balthica* population 'types' (cluster groups) on Stert flats and thermal uplift from HPB for any of the four seasonal surveys undertaken in 2010. The cluster groups did not appear to correspond to the thermal uplift contours. Nor did they clearly correspond to shore level or distance from the River Parrett. Based on this assessment, there was no apparent signal of contemporary thermal impacts on the intertidal *M. balthica* populations in the study area.

19.6.189 This same study (Ref. 19.249) confirmed that *M. balthica* populations are present elsewhere in the Severn Estuary. The presence of the species has been confirmed at each of intertidal sites between Hinkley Point and Clevedon and also further up-river of this point. The data showed that there are significant differences in both size and age between the various sites visited. These data also showed that the *M.balthica* population close to Hinkley Point and the area of influence of the HPB plume did not have the smallest or youngest individuals in the Severn; they show other populations with different or the same size and age characteristics, with the Hinkley Point population being within the measured range of variability and not at one extreme. The presence of other populations in the vicinity of Stert Flats suggests that any potential local thermal plume impacts could be mitigated by recruitment to these flats from elsewhere in the estuary.

19.6.190 The conclusion of these studies is that the current weight of evidence does not support the proposition that the HPB plume is affecting the structure of *M.balthica* populations in Bridgwater Bay.

19.6.191 In considering the impact of HPC alone (with the influence of HPB being the existing baseline), where HPC will contribute thermal inputs over a relatively small spatial extent of Stert Flats, the magnitude of this effect is considered to be low (involving a very low level of change). The moderate sensitivity of this species combined with its high value provides a combined receptor sensitivity and value of medium. The resultant impact associated with HPC would thus be of **minor adverse** significance.

IMPACT: Thermal Plume on Benthic Communities on Stert Flats

19.6.192 Other benthic species that have a significant functional role on Stert Flats, such as the small but highly abundant gastropod *Hydrobia* and the polychaetes *Hediste* and *Nephtys*, are not regarded as particularly temperature sensitive. Aside from being prey to other species, *Macoma* has an additional value within this system as it contributes to the bioturbation of superficial sediments. The other species present, however, also contribute to this processing suggesting that any reduction of *Macoma* in this role would be of little significance. Overall, the ecological functioning of the intertidal area exposed to the HPC plume is expected to be unchanged, with the receptor being of low sensitivity and the effect of low magnitude, and any impact thus of **minor adverse** significance.

IMPACT: Thermal Plume on Subtidal Benthic Habitats

19.6.193 The subtidal soft sediments off Hinkley Point and Stert Flats will experience very little of the thermal plume (see **Figures 19.24** to **19.26**), suggesting a low magnitude effect. The thermal sensitivity assessments (Ref. 19.33) have found all species to have between low and moderate thermal sensitivity, rated overall as low, leading to an impact of **minor adverse** significance.

IMPACT: Thermal Plume on Microphytobenthos

19.6.194 The microphytobenthos that probably contribute the bulk of the primary productivity within this system are predicted to be unaffected by the thermal plume as their photosynthetic optimum typically falls between 20-30°C (Ref. 19.194). As many of the microphytobenthic species are found across coastal waters in most of Europe, a 3°C increase should be within the tolerance of the assemblage and so **no impact** is expected.

IMPACT: Thermal Plume on Crangon Crangon

19.6.195 The shrimp *C. crangon* is the most abundant epifaunal species around Hinkley Point (Ref. 19.33) and is a major food resource for demersal fish and intertidal birds, as well as having a significant influence on the benthic community as it's also a major predator. The wide distribution of this species extends south to the Moroccan coast of Africa and into the Mediterranean. *C. crangon* is considered to have a high tolerance to increased temperature (Refs. 19.33 and 19.193) and thus regarded as very low sensitivity to impact in this instance. In the colder waters of the Wadden Sea, shrimp abundance is higher after mild winters, and laboratory experiments have shown a temperature optimum above 20°C (Ref. 19.193).

19.6.196 The *C.crangon* populations at Hinkley Point show a slight increase in abundance over time, suggesting there is no detrimental effect of the current discharge from

HPB (Ref. 19.102) but perhaps minor benefit. The magnitude of the effect that would be associated with HPC is thus considered to be very low, and the significance of any impact would be **negligible**.

IMPACT: Thermal Plume on Adequacy of Intertidal Invertebrate Prey Resource

19.6.197 Seasonal increases in the population size of *C. crangon* might be expected to increase predation on recently-settled and juvenile *Macoma balthica*, but in practice predation in the May and June period is the most important factor in *M. balthica* spat survival, i.e. the period when the shrimp population has been shown not to be increasing, while seasonal increases in the shrimp population will relate to juveniles too small to exploit *M. balthica* as a prey species.

19.6.198 As waterfowl are primarily a terrestrial/coastal feature, the direct impacts from HPC are dealt with in **Volume 2**, **Chapter 20**, Terrestrial Ecology and Ornithology, of this ES. The indirect effects of food availability on birds as result of the thermal plume are discussed briefly below.

19.6.199 The distribution of *M. balthica* is not uniform, with greater levels of biomass being present on the lower shore. On the mid and upper shores of Stert Flats species such as *Hediste diversicolor*, *Hydrobia ulvae* and *Nephtys hombergii* provide a significant amount of the prey biomass present (see **Figure 12** in Ref. 19.51). Despite these distributional differences in prey composition the distribution of waterbirds does not mirror this pattern (see **Appendix 20B**); this suggests that the individual birds present within the area affected by the thermal plume are more generalist feeders. As *M. balthica* represents between 30% to 90% of the biomass in various areas of Stert Flats, the reduction of up to 11% of this resource, based on HPC + HPB at 100% (i.e. 3.3% to 9.9% of biomass), is relatively small and is unlikely to significantly reduce the prey resource available to the birds present. Given that there is no detectable effect on *M. balthica* due to the current HPB plume (as found above), the real-world effect is also likely to be lower than is predicted by the model.

19.6.200 Provisional outputs of a trophic model (known as the MORPH model) support the conclusions drawn above (Ref. 19.51). Initial runs of this model show that the prey resource available is adequate to support the number and types of birds recorded in the area, as individuals are able to switch to different types of prey as *M. balthica* biomass declines.

19.6.201 The evidence available suggests that potential effects on the survival and/or body condition of birds feeding on the intertidal due to changes in the invertebrate prey resource are unlikely to be discernible. Their sensitivity to the effect is thus considered to be very low and the magnitude of the effect associated with HPC alone would be low. Hence the significance of any impact would be **minor adverse**.

iii. Chemical Discharges

Introduction

19.6.202 During the operational phase a number of non-radiological waste water discharges will be made. These will be primarily due to:

Whilst commissioning (via cross-shore drain and main cooling water outfall)

i conditioning of the cooling water system and other plant; and

ii treated sewage and surface drainage.

Post commissioning (via main cooling water outfall)

iii antifouling measures in the sea water cooling system;

iv effluent from site services (demineralisation plant, laundry etc.);

v treated sewage and site drainage; and

vi hydrazine.

19.6.203 Cooling water will be abstracted from a series of near-seabed intakes some 3.3km offshore. During normal operation, seawater will be abstracted at approximately $65m^3.sec^{-1}$ for each unit and subsequently discharged at the same rate through a pair of outfall head-works, again mounted on the seabed, some 1.8km offshore. The locations of the intake and outfall tunnels are shown in **Figure 19.6**.

19.6.204 Detailed information on non-radioactive discharges during construction, commissioning and operation of HPC is provided in the **Volume 2, Chapter 18** 'Marine Water and Sediment Quality' of this ES.

IMPACT: Corallina and Sabellaria via Commissioning Wastes Discharged via Cross-Shore Discharge

19.6.205 Commissioning waste streams arise as the integrity and function of various areas of plant are tested, or established areas of plant are taken out of storage and the need arises to discharge conditioning volumes. All such discharges are of water, together with solids disturbed by the flow. These tests are classified as 'cold flush' and 'hot flush', with effluents from the latter incorporating ΔT.

19.6.206 Only 'cold-flush' tests will result in effluents being put to the temporary cross-shore discharge route described under 'Construction Impacts' above; 'hot flush' tests will await the availability of the operational cooling water discharge route and associated sea water pumping capacity.

19.6.207 The potentially sensitive receptors to effluents arising via this route due to construction have already been described. There will be an overlap in the use of the cross-shore discharge for both construction and commissioning purposes, as surface water, dewatering water and treated sewage will continue to be discharged via the cross-shore discharge until other means become available.

19.6.208 As with the construction discharges by the same route, management of the various waste streams involved will ensure that all EQS requirements are met at the point of discharge from the sea wall, and that levels of solids are controlled to the median ambient level of $250mg.l^{-1}$.

19.6.209 Given the nature of the biotopes involved (all variable salinity in character) a low sensitivity to this impact and low magnitude result in a predicted impact of **minor**

adverse. Equivalent impacts on the *Corallina* biotope and the *Sabellaria* interest (as described in Appendix 19A) are of **no impact** and **negligible** impact respectively.

IMPACT: Subtidal Habitats via Commissioning wastes discharge

19.6.210 Only once the main cooling water system is complete (cooling water pumps plus associated offshore intake and outfall infrastructure) will hot-flush testing commence, and once that plant is available no further commissioning discharges will be put to the cross-shore discharge route.

19.6.211 The availability of the main cooling water (CW) plant will permit both increased initial dilution of effluents and their discharge offshore, a distance removed from potentially sensitive habitats. As a consequence, in terms of the marine ecological interest, the resultant impact of these discharges will be of low magnitude and involve receptors of low sensitivity, resulting in an impact of **minor adverse** significance.

Operational Waste Streams: Residual biocide

19.6.212 Where the biological fouling of marine cooling water circuits by the planktonic larvae of bivalves and barnacles, or tube-building worms such as *Sabellaria*, and the adult organisms that subsequently develop, presents a risk, a means of control has to be applied by the plant operator. A variety of means of control are available (Refs. 19.196 and 19.198) but principal amongst these is low level chlorination. Under this approach a low level of oxidant, produced either by the electrochlorination of seawater or through the addition of sodium hypochlorite solution, is dosed into the cooling water stream either on a continuous or intermittent basis. An appropriate level of chlorine in the circulating cooling water controls both macrofouling (settlement bivalves and barnacles) and the build up of microfouling (biofilms) (Refs. 19.196 and 19.198).

19.6.213 The preferred option described in the GDA (Refs. 19.246 and 19.247) is therefore to select an approach based on self-cleaning bar screens at the intake and chlorination of the cooling water prior to the condensers if/as required.

19.6.214 The need for dosing is that of exercising control on a precautionary basis so as to retard biological growth within the cooling water circuit. In practice it is unhelpful to apply a lethal dose of a biocide as this will tend to release larger organisms or aggregations of organisms within the cooling water flow, readily resulting in the plant blockage the operator seeks to avoid. As a result, current best practice is to apply a chronic rather than acute toxicant which is effective within the cooling water system itself, but having little or no impact beyond the point of discharge. The use of oxidant chemistry offers an additional advantage in that the base chemistry of seawater exercises a level of demand, significantly compounding the reduction in levels of residual oxidant remaining as the discharged cooling water effluent is dispersed and diluted.

19.6.215 In variance from the GDA it is considered that dosing to $0.5 mg.l^{-1}$ of active chlorine once every 30 minutes per cooling channel will not be required. This is because operational experience at HPA and HPB suggests that the risk of biofouling is likely to be low at HPC. This long term operational experience at the site is thought to be due primarily to the extreme turbidity regime normal to the nearshore waters of Bridgwater Bay as:

- The very high turbidity levels in the waters around the seabed intake will prevent biofouling by algae.
- Flow rates within the cooling system will typically be $2m.s^{-1}$, and in combination with these high turbidity levels this will tend to discourage successful settlement.
- The very high suspended solids levels of the water extracted from Bridgwater Bay and their low available organic carbon content are understood to greatly limit the 'scope for growth' (i.e. a negative energy balance where energy used to filter food from the suspended sediment is greater than that assimilated from the filtered particles) of species such as the common blue mussel *Mytilus*.

19.6.216 Although the likelihood of biofouling is expected to be low at HPC there may be occasions when cooling water flows are reduced, such as during major outages, when organisms will be able to colonise the cooling system more readily. This is less significant at the Forebay but fouling in the water box next to the condenser is potentially serious as it could result in the blockage of condenser tubes. Reef forming *Sabellaria* is very tolerant of high turbidity and extreme disturbance and could therefore become a problem at Hinkley Point.

19.6.217 It is therefore considered important that the HPC site has the ability to chlorinate the cooling system, should this prove to be necessary, albeit not at the levels or frequency described in the GDA. When chlorination is undertaken the dosing will take place prior to the condensers but after the drumscreens, thus avoiding any dosing of the Fish Recovery and Return system (see discussion of this particular need later in this Chapter).

19.6.218 As described above, the GDA for the EPR design identifies that under normal conditions worst case chlorination will involve injecting $0.5mg.l^{-1}$ of active chlorine, applied sequentially once every 30 minutes per cooling channel to achieve a Total Residual Oxidant (TRO) level of $0.2mg.l^{-1}$. This would only be applied when the sea temperature exceeds 10°C. However, in variance from the GDA, under most circumstances at HPC it is expected that chlorination will not be required. The water quality modelling utilised in this ES (see **Volume 2**, **Chapter 18**) is based on the maximum concentration of residual oxidants downstream of the condensers being $0.2mg.l^{-1}$ if both UK EPR units are being dosed and $0.1mg.l^{-1}$ if only one UK EPR unit is being dosed.

19.6.219 The following proven approach will be adopted to minimise the amount of chlorination required:

- A strategy will be implemented based on "Cooling water management in European power stations: Biology and Control of Fouling" and best practice used by EDF Energy Nuclear Generation (formally British Energy) for its existing fleet of nuclear power stations as set out in their strategy document, Ref. 19.245. This involves the maintenance of a site specific risk based protocol to prevent biofouling. This is an important difference from the general approach described in the GDA.

- The strategy described in Ref. 19.245 describes the fouling control hierarchy as involving screening, cleaning and dosing in that order of preference. Effective screening is the first line of defence, so appropriate plant and practices will be put in place at HPC to achieve this. Screening and filtration help prevent systems becoming fouled but eventually the systems will need to be cleaned. Chemical dosing is a means of limiting fouling but is only carried out in conjunction with screening and cleaning and will not be relied on as the sole means of preventing fouling.
- Identifying the need for chlorination will be closely linked to monitoring protocols for fouling, including monitoring of the condenser efficiency, examination of growth in circuits and monitoring populations of organisms on surrounding shores.

19.6.220 The dosing strategy that will be maintained at HPC will be a risk based intermittent dosing regime that will respect both the operational needs of the plant and local environmental sensitivities.

IMPACT: Subtidal Habitats due to Chorine Discharge

19.6.221 Although it is anticipated that chlorination will be required only infrequently at HPC, the ability to chlorinate is regarded by the operator as a necessary precautionary measure. At some point in the life of the station, changed conditions (e.g. brought about gradually via climate change, or more suddenly via tidal barrage construction), chlorination might become necessary, perhaps at short notice. As a result the effects of a chlorinated discharge need to be discussed here.

19.6.222 Whether added as either sodium hypochlorite solution or produced in situ by electro-chlorination of sea water, the chlorine reacts rapidly by oxidation with the bromide (and to a lesser extent ammonia) in sea water to produce a complex mixture of mainly brominated compounds, dominated within the cooling water circuit itself by hypobromous acid, which provide the active disinfectant. Collectively these disinfecting (oxidising) compounds are known as Total Residual Oxidant (TRO), expressed as a chlorine equivalent (Ref. 19.197).

19.6.223 To provide effective antifouling control within the cooling water circuit the standard chlorine dose applied results in a TRO of $0.2mg.l^{-1}$ at the condensers. The Environmental Quality Standard (EQS) is $0.01mg.l^{-1}$ TRO requiring dilution or decay of 20x.

19.6.224 To describe the mixing zone that would be associated with HPC, the GETM model was used to predict TRO levels in the receiving water (Ref. 19.60). Simulations were run for an April to May period to represent the most typical time when chlorination might be applied (see **Figure 19.28** and **Figure 19.29**). The results indicate that the area of exceedance of the EQS (standards derived under the requirements of the Dangerous Substances Directive) associated with HPC will not extend to the ecologically sensitive areas of the intertidal habitat (se **Volume 2, Chapter 18**). On the basis of the EQS, the sensitivity of the receptor may be considered to be medium, the magnitude of effect low, and the impact significance **minor adverse**.

IMPACT: Intertidal Habitats due to Chlorine Discharge (Chronic)

19.6.225 To test whether or not the key intertidal species on the Hinkley Point mudflat might vary in their resistance of chronic TRO effects, further studies were carried out. Provisional toxicity testing with three abundant species in that area is summarised in Ref. 19.53. A conservative view of the data arising from this effort suggests the potential for some chronic toxicity to sensitive species, and in particular *Macoma*. A precautionary screening level (SL), considering the potential for sublethal effects of TRO exposure in the form of reduced feeding by *Macoma*, 0.001mg.l^{-1} TRO has thus been suggested (see Ref. 19.14). The extent of the mixing zone allied with that SL is shown in **Figure 19.28** and **Figure 19.29**.

19.6.226 Allied predictions of plume extent in relation to habitat type, assuming that both HPB and HPC are chlorinating simultaneously, are provided in **Figure 19.30** and **Figure 19.31**.

19.6.227 On the basis of the suggested SL, and presuming the application of continuous chlorination at both HPB and HPC (noting that such chlorination has not been applied at HPB for many years), the sensitivity of the receptor may be considered to be medium, the magnitude medium, and the significance of the impact **moderate adverse**.

IMPACT: Subtidal Habitats due to Chlorination By-Products Discharge

19.6.228 The acute oxidants formed by chlorination are short lived and are not persistent in natural waters. The residual complexity is the consequent production of numerous more persistent compounds formed by reaction between chlorine (bromine) and other mineral or organic constituents of natural waters. Collectively these compounds are known as chlorination by-products (CBPs) (Refs. 19.198 and 19.199). Given their intimate dependency on local seawater characteristics the actual 'fingerprint' of CBPs produced varies from site to site.

19.6.229 Bromoform is invariably the most common CBP in seawater cooled power station effluents, but other trihalomethanes, haloacetic acids, haloacetonitriles and halophenols are also found (Ref. 19.199). Given that chlorination has not occurred at the Hinkley Point site for many years the likely level of CBP production, and particularly bromoform production (although this will most probably fall into the range already documented for a range of other sites (Ref. 19.200) of 1-43µg.l^{-1} at the cooling water outfall itself), is unknown.

19.6.230 Extensive monitoring around existing nuclear power plants whilst confirming the presence of many CBPs, has shown the concentrations of CBPs measured in the cooling water outfalls to be approximately 1,000 times lower than the acute toxicity thresholds known for each. These CBPs are not bio-magnified in the food chain and are not considered a health risk (Ref. 19.200).

19.6.231 On this basis, receptor sensitivity to exposure to the plume can be regarded as low and the magnitude of the effect medium, resulting in an impact of **minor adverse** significance.

IMPACT: Intertidal and Subtidal Habitats due to Hydrazine Discharge

19.6.232 The potential use of hydrazine and the extent of any chemical plume is described in **Volume 2, Chapter 18**.

19.6.233 GETM modelling at HPC (Ref. 19.60) shows that the acute PNEC is exceeded at the surface in the immediate vicinity of the discharge and the chronic PNEC is exceeded also in the surface water (only), due to the thermal buoyancy of the plume, up to 2km from the discharge. **Figure 19.32** illustrates the extent of intersection with the bed.

19.6.234 The annual mean hydrazine concentrations are not predicted to exceed the chronic PNEC across any areas of the intertidal, so **no impact** is expected on this receptor.

19.6.235 The chronic PNEC will be exceeded for a small subtidal area around the outfall structures themselves. The sensitivity of the subtidal biotopes is considered to be low and the magnitude of impact also low, suggesting an impact of **minor adverse** significance. Further details are provided in **Volume 2**, **Chapter 18**.

IMPACT: Subtidal Habitats due to Ammonia Discharge

19.6.236 Ammonia exists as an equilibrium between free ammonia and ionised ammonium hydroxide: NH_3 + H_20 ⇆ NH_4+ +OH^{-}. The equilibrium is altered by changes in temperature, pH and salinity. Free (unionised) ammonia is the toxic form, so changes in general water quality as well as total ammonia concentration will affect the potential toxicity of the discharge.

19.6.237 The EQS for unionised ammonia is 21µg.l^{-1} NH_3-N.

19.6.238 With current water quality conditions and using the plume as a guide to mixing area (20m deep, 10km wide 20km long), and assuming no decay after discharge, the annual HPC Nitrogen discharge would lead to an average uplift in unionised ammonia levels in the plume of about 2.5µg.l^{-1}. This would be less than 1% of the background level of 360µg. l^{-1} (95th percentile) and so the magnitude is considered to be very low. The sensitivity of the receptor is low given the baseline conditions and the impact on marine ecological receptors is considered to be **negligible**.

iv. Impingement of Fish and Shrimp

19.6.239 The routine abstraction of approximately 125$m^3.s^{-1}$ of cooling water from the Bridgwater bay area of the Inner Bristol Channel for the proposed HPC will carry with it the risk of fish impingement and entrainment resulting in the loss of fish from estuarine populations. Although the cooling water intakes will be protected by coarse bar screens at their entrance to prevent the intake of larger fish and debris, a significant number of organisms (fish and crustaceans, and plankton) will inevitably enter with the cooling water.

19.6.240 Owing to their high relative abundance within local inshore waters and their relative lack of mobility in comparison to adults, the majority of fish abstracted by power station intakes are the egg, larval and juvenile lifestages.

19.6.241 The larger of these organisms (fish and crustaceans >25mm length) will be impinged and removed by fine-meshed drum-screens (currently 10mm at HPB, but 5mm for HPC), before the cooling water enters the power station cooling system, in order to prevent them blocking the condenser tubes.

19.6.242 The smaller organisms (mostly the eggs and larvae of fish and crustaceans) that pass through the drum screens will be entrained in the cooling flow and continue on through the power station cooling system to be returned via the thermal discharge back to the Bristol Channel. As noted below, significant proportions of these entrained organisms are expected to survive the entrainment process to re-enter the estuarine ecosystem.

19.6.243 A small proportion of the incoming cooling water ($12m^3.s^{-1}$ across both EPR units out of the total of around $125m^3.s^{-1}$ maximum) is filtered via separate band-screens sited adjacent to the main drum screens, supplying essential cooling supplies for auxiliary and back-up systems. This has a low duty and minimal impact compared with the main cooling water circuit and therefore, is not discussed further.

19.6.244 Comparison of data from the fish trawling sites surveyed during 2008 to 2009 suggests that, when taking the full catch across surveys as a whole, there was little difference in terms of the fish catch between offshore and nearshore zones (Ref. 19.202). Thus, impingement records from HPB provide a satisfactory basis for predicting abstraction effects for HPC. Entrainment data from HPB are sparser and plankton surveys indicate more variability between nearshore and offshore areas (Ref. 19.33), therefore HPB is not a good model and the studies supporting this ES have thus estimated impingement effects from plankton survey data alone.

19.6.245 Ref. 19.202, together with Refs 19.27 and 19.43, summarise and assess abstraction effects data from HPB and predict impingement and entrainment rates for HPC without and with proposed abstraction mitigation measures. The means of mitigation and the consequential residual impacts are discussed later in this chapter of the ES; the discussion that follows here is constrained to a consideration of unmitigated impacts.

19.6.246 Impingement predictions for HPC are based primarily on a Comprehensive Impingement Monitoring Programme (CIMP) carried out over 12 months from February 2009 to February 2010 (Ref. 19.36) and ichthyoplankton surveys off the Hinkley Point area undertaken quarterly in 2008 and again in May 2009 (Ref. 19.33). Where suitable and appropriate biological data are available, these predictions are put into the context of local commercial landings and local fish populations (spawning-stock biomass (SSB)).

Assessment of Impingement Loss (without mitigation)

19.6.247 CIMP surveys carried out during 2009 and 2010, and analyses of raw impingement catch data, followed best practice procedures set out in Ref. 19.9. This requires a sampling intensity of at least forty 24 hour impingement samples per year, collected according to a strict protocol.

19.6.248 The assessment work undertaken and detailed below has been based upon the following assumptions for an unmitigated abstraction design:

- intake design similar to HPB;
- no chlorination at the intake, within the intake tunnels;
- continual low dose chlorination into the cooling water flow from the pumping station onwards;
- 5mm drum-screen mesh; and
- no FRR system.

19.6.249 Estuarine waters contain a high proportion of juvenile fish, and around 90% of the impingement catch at HPB comprises fish of <20cm total length. Although mostly of no direct value to commercial fisheries, these individuals are important features of the populations both in terms of the protected status of some species and the subsequent potential contribution of all species to the adult fish assemblage. Egg, larval and juvenile lifestages do, however, exhibit high natural mortality rates and relatively few of the individuals lost as a result of impingement and entrainment would have been be likely to survive through to adulthood. To give an indication of the relative value of juvenile life stages to the adult population, the authors of Ref. 19.203 and 19.204 developed a measure known as 'equivalent adult value' (EAV), defined as "*the fraction of the adult lifetime fecundity of an adult that has just reached maturity which is required to replace that juvenile*" (Ref. 19.205). On this basis the author of Ref. 19.206 developed this technique for application within the assessment of power station impact assessment. This approach is further explained in Ref. 19.207, where the authors applied the method for the analysis of Sizewell power station impingement data.

19.6.250 There are a number of limitations associated with the use of EAV. Their calculation is based on the development of life-tables containing detailed information on life-history data, such as age-specific mortality, fecundity and growth rates, which are not available for all species or geographic stocks. Also, the EAV method does not take into account density-dependent factors in population dynamics. It is generally accepted, therefore, that the EAV method represents a worst-case in terms of likely lost production.

19.6.251 The predicted impingement losses for HPC described in Ref. 19.43 are scaled from recent HPB screen surveys. Predictions in this report are primarily based on the BEEMS Comprehensive Impingement Monitoring Programme (CIMP) carried out over 12 months from February 2009 to February 2010 (Ref. 19.36). For a few species, where suitable and appropriate biological data are available, these predictions have been put into the context of local commercial landings and local fish populations (spawning-stock biomass, SSB).

19.6.252 Predicted impingement rates for HPC do not take account of the difference in screen mesh size, which will be 5mm on HPC compared with 10mm on HPB. The HPC screens will therefore retain some smaller fish that would have been entrained into the cooling water system at HPB. There is no reliable method of accounting for this difference. Impingement estimates for HPC will therefore be underestimated, and entrainment rates overestimated.

19.6.253 Data from CIMP were available for up to 64 species of fish and up to 14 species of crustacean. For many of these species the predicted impingement is based upon very small numbers of individuals caught on the screens of existing power stations during limited (40 x 24 hr) sampling intervals at an abstraction rate of $30m^3.s^{-1}$. The predicted impingement has been calculated by scaling the numbers up to a full year at the proposed cooling water abstraction rate of $125m^3.s^{-1}$. For example, only two Allis shad *(Alosa alosa)* were caught, but after scaling up, this leads to a predicted impingement of 68 individuals per year. Such impingement predictions for species caught infrequently are subject to more uncertainty.

19.6.254 For some species of commercial and/or conservation importance, sufficient data are available to make an assessment of stock data and the impact of predicted impingement on the local fish populations in the Bristol Channel and Severn Estuary areas. **Table 19.26** lists the 15 species that constitute about 88% (by number) of the total numbers of fish and shrimp impinged at HPB, providing a prediction of the HPC catch without mitigation. **Table 19.27** shows predicted HPC catch in the context of spawning stock biomass (SSB) or stock size (numbers), as appropriate.

Table 19.26: Predicted Total Annual Impingement (numbers of fish as, EAV, and total number of shrimp) of Key Species at HPC and HPB for Selected Species for an Abstraction Rate of $125m^3.s^{-1}$ via HPB-type Intake Structures, Without Mitigation (Data from Ref. 19.43)

Species: Common Name	EAV Annual Impingement at HPC, Current (HPB) Intake Design	EAV Annual Impingement at HPB
Sprat (largest numbers)	3,380,850	936,386
Whiting (BAP)	288,078	79,253
Sole (BAP)	32,429	8,599
Cod (BAP)	32,063	8,733
Herring (BAP)	44,792	12,570
Plaice (BAP)	493	129
Blue whiting (BAP)	160	46
Eel (Eel management plan)	1,304	351
Twaite shad (SAC designated)	2,276	646
Allis shad (SAC designated)	68	22
Sea lamprey (SAC designated)	207	42
River lamprey (SAC designated)	82	18
Salmon (SAC designated)	0	0
Sea trout (SAC designated)	0	0
Brown shrimp (*Crangon crangon)* – the main crustacean impinged	Estimated annual impingement (no.) 19,135,756	Estimated annual impingement (no.) 4,911,592

Commercial Species

19.6.255 **Table 19.26** shows impingement rates for key, commercial fish species recorded at HPB and rescaled values for HPC, calculated as Equivalent Adult values (EAVs). The rescaled numbers assume replication of the HPB intake design, with no mitigations. Impingement rates of individual species are considered below in the context of known stock data (Ref. 19.43).

19.6.256 **Figure 19.33** shows the distribution of the ICES statistical rectangles referred to in the analysis that follows.

IMPACT: Sprat due to Impingement

19.6.257 Until recently there has been little information on sprat in the Bristol Channel. From 2003, regular biannual Environment Agency (unpublished data) multi-method surveys in the Estuary above Weston-super-Mare have shown sprat nurseries off Cardiff and Penarth.

19.6.258 It seems likely that the sprat encountered at Hinkley Point are part of a population that is limited to the Bristol Channel and, given the lack of any assessment for the species, it is considered that the most useful comparison for sprat is between impingement data at Hinkley Point power station and landings data reported for UK vessels fishing in the Bristol Channel; ICES statistical rectangles (see **Figure 19.33**) 32 E5–E7, 31 E5–E7 and 30 E5 (sprat = 190kg).

19.6.259 Based on the scaled-up CIMP dataset, the total annual estimated impingement of sprat at HPC, assuming a constant abstraction rate of $125m^3.s^{-1}$, would be about 3.38 million fish. Owing to a lack of biological and population data, it is not possible to derive an EAV for sprat, but, as adult sprat are comparatively small, an Equivalent Adult Value of unity is assumed, although this is likely to be a conservative assumption. With the current cooling water intake design, the Equivalent Adult numbers of sprat likely to be impinged annually at HPC without mitigation is approximately 26.4t.

Table 19.27: Equivalent Adult Value (EAV) of Predicted Annual Fish Impingement at Hinkley Point C Power Station at Maximum Cooling Water Demand of 125m^3.s^{-1}, Without Mitigation

Species	Estimated Annual Impingement at HPC (no. of fish)	EAV Annual Impingement at HPC (no. of fish)	EAV Annual Impingement at HPC (biomass - t)	Est. local spawning stock biomass (2004-8) (biomass - t)	EAV Annual Impingement at HPC (% local SSB)	Local Annual Landings (t)	EAV Annual Impingement (% Local Annual Landings)	Impact Assessment (without mitigation)
Sprat	3,380,000	3,380,000	26.40			0.19	13,894.0	Moderate
Whiting	2,100,000	288,078	51.28	1,613.00	3.18	33.48	153.0	Moderate
Sole	602,776	32,429	7.43			263.00	2.8	Minor
Cod****	371,097	32,063	140.40	975.00	14.40	65.17	215.0	Moderate
Herring	90,526	44,792	5.64			119.40	4.7	Moderate
Plaice	5,383	493	0.23	952.00	0.02	84.00	0.3	Minor
Blue whiting	1,166	160	0.02	*37,900.00	5.28×10^{-5}			Minor
Sea bass								Minor
Twaite shad	2,276				Approx. 1.24% local pop.			Moderate
Eel	1,304		0.08	133.40	0.06	26.00	0.3	Moderate
River lamprey	82				<0.07% pop.			Moderate
Sea lamprey	207				1.36% pop.			Moderate
Salmon	0			**58.62 million eggs (Min spawning stock level)		***2482 fish (comm/ recr angling)		Negligible

Notes: *Figures are given as a percentage of spawning stock biomass (SSB) and local annual landings (data from Ref. 19.43). The impact levels are as discussed in the text. SSB is a mean estimate for years 2004 to 2008, inclusive. Local annual landings refer to data from vessels fishing in the Bristol Channel, using ICES statistical rectangles. Based on the scaled-up CIMP dataset.*

* *Combined stock in ICES Subareas VIII and IX and Divisions VII d-k (the "southern areas")*

** *Conservation limit for the Rivers Severn, Wye and Usk combined.*

*** *Mean annual catch (2004-08) in the Severn Estuary net fishery combined with rod catches on the Rivers Severn, Wye and Usk (whether returned to the water or not).*

**** *Cod assessment has subsequently reappraised to account for bias caused by an exceptional spike in recruitment during the period of sampling upon which this assessment was based, in 2009; the ratio of annual catches 2008:2009 was 5.8% and that for the mean of 2004-2008:2009 was 7.3% (Ref. 19.260).*

19.6.260 As the catch of sprat in the local fishery is small (0.19t currently, not as a targeted fishery but incidental), this impingement is almost 140 times that of the local fishery. As no stock assessment is made for sprat, it is not possible to assess the impact of impingement on local populations.

19.6.261 Given that little information is available on the sprat population, a precautionary assessment suggests an impact of **moderate adverse** significance, based on medium magnitude and medium value.

IMPACT: Whiting due to Impingement

19.6.262 Although the basic biology of whiting is well known, it has proved difficult to estimate its abundance and to follow the dynamics of the different populations around the UK (Ref. 19.43). Part of the problem may be related to distribution and stock structure, and the extent of mixing between areas. However, it is well established that there has been an overall decline in abundance of whiting to very low levels in many areas (Ref. 19.209).

19.6.263 There have been sufficient uncertainties in the data used in exploratory assessments for the Celtic Sea whiting (Divisions VIIe–k) stock that ICES is currently unable to provide estimates of fishing mortality or SSB, although SSB shows a decreasing trend and recent recruitment is low (note that survey results indicate that the 2007 year- class may be stronger than the recent average).

19.6.264 The Environment Agency (unpublished data) has shown whiting nurseries to be present on both the English and Welsh coasts of the Bristol Channel and Severn Estuary. It seems likely that the whiting encountered at Hinkley Point are part of a population that occupies the Bristol Channel and Celtic Sea, with some limited mixing with whiting in the Irish Sea. The most useful comparison is between impingement data at Hinkley Point and landings data reported for UK vessels fishing in ICES statistical rectangles (**Figure 19.33**) 32 E5–E7, 31 E5–E7 and 30 E5 (= 33.48t, mean 2004–08). At a population level, an indicative comparison is with the SSB estimate for Divisions VIIe–k, weighted by the ratio of the above landings to total UK landings for VIIe-k. The average UK landings from this stock from 2004 to 2008 were 529t, and the average annual SSB is estimated at 25,492t (corresponding to international landings of 9,240t, as estimated by ICES). Therefore, the estimated "local" SSB = 25492 x (33.48/529) = 1613 t.

19.6.265 Based on the scaled-up CIMP dataset, the total annual estimated impingement of whiting at a new power station at HPC, assuming a constant abstraction rate of $125m^3s^{-1}$, would be about 2.1 million fish. Using the relationship between total numbers, EAV numbers and EAV weights provided by the Expert System PISCES 2009 to re-scale the impingement estimates derived from the CIMP data, and with the current cooling water intake design, the Equivalent Adult number of whiting predicted to be impinged annually at HPC without mitigation is 288,078 fish (51.28t). This equates to approximately 153% of the local whiting fishery (33.5t) and 3% of the "local" SSB (1613t).

19.6.266 On this basis, without mitigation, a **moderate adverse** impact is predicted, based upon medium magnitude and medium value.

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IMPACT: Sole due to Impingement

19.6.267 Sole stocks have shown substantial variations in abundance over the past 50 years, largely as a result of fishing and variability in breeding success (Ref. 19.210). In the more northern regions, the abundance of sole also fluctuates naturally as a result of severe mortality during very cold winters, such as in 1963. The Environment Agency (unpublished data) has shown sole nurseries to be present on the English coast off Clevedon and the Welsh coast off Peterstone, extending up the M48 crossing. The analytical age-based assessment for the sole stock in the Bristol Channel and Celtic Sea (Divisions VIIf and VIIg, **Figure 19.33**) is based on landings, two commercial catch per unit effort (CPUE) series and one survey index. There is also a confirmatory short UK Fisheries – Science Partnership time-series for this and an adjacent area available to the authors of this assessment. The general trends in the estimates of stock numbers, fishing mortality and recruitment have been similar in recent assessments. The stock is currently considered by ICES to be fished sustainably and to have full reproductive capacity (Ref. 19.209). SSB in 2008 (2200t) is estimated to be above the precautionary biomass limit set by ICES to protect fish stocks. The average (2003–2007) total annual international catch in VIIf, g (not including discarding) was 1,114 t; UK landings were 263 t; and the SSB estimate was 3,240 t.

19.6.268 The sole at Hinkley Point are part of a population that occupies the Bristol Channel and Celtic Sea, with relatively limited mixing with adjacent sole populations. The most valid comparison for sole is between impingement data for the Hinkley Point and landings data reported for UK vessels fishing in the Bristol Channel and Celtic Sea (Divisions VIIf and VIIg), and with the SSB estimate for this stock. Comparison with a more locally restricted fishery or population, in ICES statistical rectangles 32 E5–E7, 31 E5–E7 and 30 E5, say, would ignore the extensive mixing of early life-stages of sole throughout the Bristol Channel and Eastern Celtic Sea.

19.6.269 Based on the scaled-up CIMP dataset, the total annual estimated impingement of sole at a new power station at HPC, assuming a constant abstraction rate of $125m^3.s^{-1}$, would be 602,776 fish (Appendices B2 and B3). Using the relationship between total numbers, EAV numbers and EAV weights provided by the Expert System PISCES 2009 (Ref. 19.43) to re-scale the impingement estimates derived from the CIMP data, and with the current cooling water intake design, the Equivalent Adult numbers of sole likely to be impinged annually at HPC without mitigation is 32,429 fish (7.43t). This equates to approximately 3% of the local sole fishery (263t) and 0.23% of the VIIf,g SSB (3,240t).

19.6.270 On this basis, without mitigation, a **minor adverse** impact is predicted, based on medium magnitude and low value.

IMPACT: Cod due to Impingement

19.6.271 The assessment for cod in ICES Divisions VIIe–k (Western English Channel, Celtic Sea and Bristol Channel) is based on commercial landings, three surveys and four commercial CPUE series. Discard data are not included in the assessment, although a correction for high-grading for the years 2003 to 2005 in the French fisheries has been made. The main uncertainties in this assessment are partial information available on recent quota-induced changes in discarding, and under-reporting and area misreporting of landings. The results of the 2008 assessment are broadly consistent with those of 2007 in terms of trends in fishing mortality, SSB and recruitment, although there was a change in the perception through an upward revision via the fisheries assessment process of the 2005 and 2006 year- classes by 74% and 67%, respectively, and an upward revision of SSB in 2007 by 14%.

19.6.272 Ref. 19.209 considers cod in Divisions VIIe–k (**Figure 19.33**) to be overfished, but currently harvested sustainably. The stock has had a truncated age structure over several decades, and its dynamics have been strongly recruitment-driven, i.e. the stock increased in the past in response to good recruitment and decreased rapidly during times of poor recruitment. Fishing mortality has been very high since the mid-1980s, but has declined since 2002 and is now below the precautionary level of fish mortality set by ICES to protect fish stocks at Fpa (0.68). SSB has been below the absolute biomass limit (beyond which, there are considered too few spawning adults for the population to recover) set by ICES, Blim (6,300t) since 2004, but most recently was estimated to be slightly above the limit. Recruitment since 2002 has been well below the long-term average. The average (2003 to 2007) total annual international catch in VIIe–k (including a high-grading estimate) was 4,175t; UK landings were 343t; and the estimated SSB was 5,133t.

19.6.273 The thermal tolerance of cod is not well known, but scientific evidence (Ref. 19.248) points to the species being cold-adapted, i.e. it prefers lower sea temperatures to warmer ones, especially during its spawning season. Indeed, the Celtic Sea stock management unit of cod lies at the southern limit of the known distribution of cod in the North Atlantic and environs. Very recent data on cod (from eight of the stocks in the NE Atlantic) tracked with electronic data-storage tags (Ref. 19.251) indicate that climate warming will mainly affect cod populations at their early life-history stages and also the prey species on which cod depend, but that cod can exist in a thermal range of -1.5 to 19°C (a much narrower 1-8°C in their spawning season). Such ranges would mark cod down as remarkably thermo-tolerant, but the results of other analyses, despite high levels of uncertainty in the basic data, suggest that some of the southern cod stocks might well disappear within the current century if general predictions of climate warming translate to reality. Ref. 252, for instance, evaluated the likely response of all known and managed cod stocks to climate change (warming) in the period up to 2100 and, although it stresses that oceanographic variables other than temperature (e.g. plankton production, prey and predator fields, and industrial fishing) will play a role in future trends of the cod stocks, its prognoses for the southern stocks of cod such as the Celtic Sea stock are not positive.

19.6.274 Ref. 19.43 states that the cod found at Hinkley Point are part of a population that occupies the Bristol Channel and the eastern Celtic Sea and that has limited mixing with adjacent cod populations. The international stock assessment for cod in this region is for ICES divisions VIIe-k (Western Channel, Celtic Sea and Bristol Channel) and therefore includes cod in the western English Channel and Irish coastal waters, which are thought by some scientists to comprise largely separate stocks from those in the Bristol Channel and eastern Celtic Sea.

19.6.275 The international annual catch estimate for cod in ICES Areas VIIe-k was an average of the 2003-2007 data of 4175t, of which the UK's share was 343t, compared with an

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estimated VIIe-k spawning stock biomass (SSB, i.e. mature fish, not the sizes being impinged at Hinkley Point) of 5133 t for the same period.

19.6.276 The 'local' UK catch in 2004-2008 was 65.2t ('local' being as recorded from rectangles 32E4-E7, 31E4-E7, 30E4-E5, and 29E4, i.e. from Fishguard in the north to the entrance to the English Channel in the south, and west to west of both Lands End and the western landfall of Wales). The 'local' catch takes place well outside the Bridgwater Bay area, which functions as a nursery for 0-group fish that will not join the adult stock until they much older.

19.6.277 Ref. 19.43 assumed that the stock in the local area could be approximated by the ratio of the UK catches in the local area to the whole VIIe-k area i.e. the "local" SSB would be of the order of 5133*65.2/343t or 975t. Without independent stock assessments of the various areas independently, this is the considered best assumption that can be made.

19.6.278 The SSB estimate was based on analyses back-calculated from catches and survey data up to 2010, but the same data already show that there was a major recruitment spike of the 2009 cod year class (spawned February-April 2009), already possibly seen as being the second highest recruitment in that stock of cod in the historical time-series (Ref. 19.260). The long term time-series maintained at HPB tends over the years to mirror the spikes in cod recruitment observed through fisheries management studies fairly well, and the CIMP data for 2009/10 (Ref. 19.36, which includes an analysis of length frequencies) clearly show those juvenile cod being impinged in large numbers at that time. It is inappropriate to base future impingement prediction likelihood on data collected solely at the time of this clear spike (Ref. 19.260). A revised SSB reflecting the impact of the 2009 recruitment on the overall Celtic Sea cod stock would not be viewed as scientifically sound until those cod started to appear in the commercial catches in large numbers, which will not be until 2012. Prior to 2009 the last cod recruitment spike in both the long term HPB data and the national fisheries database was in 2000, but the total cod numbers impinged in that (also good recruitment) year were only 37% of those in 2009.

19.6.279 In order to use datasets that are synchronous in time with the catch and stock assessment data, this assessment should ideally be using either 2008 or earlier impingement data or an average for the period 2004-2008 to predict future HPC impingement of juvenile cod. On the basis of monthly time-series of cod numbers impinged at HPB for the periods January 2003 to March 2010, the ratio of annual catches is as follows:

- 2008:2009 : 5.8% of 2009 catch;
- Mean 2004-2008:2009 : 7.3%.

19.6.280 Taking the worst case figure of 7.3%, the HPB and HPC catches are reduced to:

- HPB: 0.29% of local SSB;
- HPC: 0.24% of local SSB;
- HPB+HPC: 0.51% of local SSB.

19.6.281 On this basis, without mitigation, a **minor adverse** impact is predicted based upon low magnitude and the medium value of the receptor.

IMPACT: Herring due to Impingement

19.6.282 Except where a fishery exploits spawning herring (e.g. at Llangwm in Milford Haven), larval surveys are the main tool to locate and assess inshore spawning populations, but insufficient numbers of small larvae have been found to assess the status of these small spawning groups of herring. Only MMO landings statistics from local fisheries are available.

19.6.283 It seems likely that the herring encountered at Hinkley Point are part of a population (or populations) that is limited to the Bristol Channel and adjacent inshore waters and, given the lack of any assessment, it is considered that the most useful comparison is between impingement data for the Hinkley Point and herring landings data reported for UK vessels fishing in ICES statistical rectangles (**Figure 19.33**) 32 E5–E7, 31 E5–E7 and 30 E4–E5 (119.4t, mean for 2004 to 2008).

19.6.284 Based on the scaled-up CIMP dataset, the total annual estimated impingement of herring at HPC, assuming a constant abstraction rate of $125m^3.s^{-1}$, without mitigation, would be about 90,526 fish. Using the relationship between total numbers, EAV numbers and EAV weights provided by Expert System PISCES 2009 to re-scale the impingement estimates derived from the CIMP data, and with the current cooling water intake design, the Equivalent Adult number of herring likely to be impinged annually at Hinkley C is 44,792 fish (5.64t). This equates to approximately 5% of the local herring fishery (119.4t). As no stock assessment is carried out for herring in the area, it is not possible to assess the impact of impingement on local populations.

19.6.285 On this basis, without mitigation, a **moderate adverse** impact is predicted based upon medium magnitude and medium value.

IMPACT: Plaice due to Impingement

19.6.286 Ref. 19.209 advises that the plaice stock in the Celtic Sea (Divisions VIIf,g) had reduced reproductive capacity and was overfished. SSB peaked in the period 1988 to 1990, following a series of good year- classes, then declined rapidly and, since 2002, has been below or around the biomass limit (1,100t). There have been some very weak year- classes since the late 1990s. The average (2003 to 2007) total annual international catch in VIIf,g (not including discarding) (**Figure 19.33**) was 461t; UK landings were 84t; and the SSB estimate was 952t.

19.6.287 Plaice encountered at Hinkley Point are part of a population that occupies the Bristol Channel and Celtic Sea, with some limited mixing with plaice in the Irish Sea. The Environment Agency (unpublished data) has shown plaice nurseries to be present off Cardiff Flats. However, given that ICES conducts separate assessments for ‘stocks’ in VIIf,g and VIIa (Irish Sea), Ref. 19.43 considers that the most useful comparison for plaice is between impingement data for the Hinkley Point and landings data reported for UK vessels fishing in the Bristol Channel and Celtic Sea (Divisions VIIf and VIIg), and with the SSB estimate for this stock. Comparison with a more locally restricted fishery or population, in ICES statistical rectangles 32 E5–E7, 31 E5–E7

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and 30 E5, say, would ignore the extensive mixing of plaice life stages throughout the Bristol Channel and Eastern Celtic Sea, and with adjacent plaice populations.

19.6.288 Based on the scaled-up CIMP dataset, the total annual estimated impingement of plaice at HPC, assuming a constant abstraction rate of $125m^3.s^{-1}$, would be about 5,383 fish (Appendices B2 and B3). Using the relationship between total numbers, EAV numbers and EAV weights provided by the Expert System PISCES 2009 to re-scale the impingement estimates derived from the CIMP data, and with the current cooling water intake design, the Equivalent Adult numbers of plaice likely to be impinged annually at HPC without mitigation is 493 fish (0.23t). This equates to approximately 0.3% of the local plaice fishery (84t) and 0.02% of the Celtic Sea SSB (952t).

19.6.289 On this basis, without mitigation, a **minor adverse** impact is predicted, based upon a medium magnitude of effect and low value.

IMPACT: Blue Whiting due to Impingement

19.6.290 The ICES assessment of the stock status of blue whiting is based on an analysis of catch-at-age data from commercial fisheries from 1981 to 2009, and three acoustic surveys that between them cover the distributional area of the spawning stock (Ref. 19.43). These show that recruitment of the 2005 to 2009 year classes has been low (following ten years of above average recruitment) and there has been a significant decrease in SSB since 2004, although the estimated abundances for recent years have changed greatly with successive annual assessments. For example, the SSB estimate for 2009 is estimated in 2010 to be about 42% lower than the estimate made in 2009. The Ref. 19.43 assessment values (which have built on previous work) are used here.

19.6.291 There is no evidence that blue whiting in the Bristol Channel and Celtic Sea are discrete from the population that occupies the whole of the west coast of North-West Europe (including the Norwegian Sea), which ICES treats as a single stock for assessment purposes. It is considered that the most useful comparison is between impingement data at Hinkley Point and landings data reported for all vessels fishing the combined stock in Subareas VIII and IX, and Divisions VIId-k (the " southern areas") (= 37,900t, mean 2004 to 2008). At a population level, the mean SSB estimate for the whole stock in the years 2004 to 2008 was 5,360,000t, which is near the long-term mean for the stock.

19.6.292 Based on the scaled-up CIMP dataset, the total annual estimated impingement of blue whiting at HPC, assuming a constant abstraction rate of $125m^3.s^{-1}$, without mitigation, would be about 1,166 fish. Using the relationship between total numbers, EAV numbers and EAV weights for whiting (which we have assumed will be similar for blue whiting) provided by the Expert System PISCES 2009 to re-scale the impingement estimates derived from the CIMP data, and with the current cooling water intake design, the Equivalent Adult numbers of blue whiting likely to be impinged annually at HPC is 160 fish (0.02t). This equates to <0.1% of the blue whiting fishery (37,900t) and <0.1% of the corresponding SSB (5,360,000t).

19.6.293 On this basis, without mitigation, a **minor adverse** impact is predicted based upon medium magnitude and a low value.

IMPACT: Sea Bass due to Impingement

19.6.294 Environment Agency (unpublished data) surveys have shown sea bass nurseries extending from Cardiff Flats eastwards to Arlingham, near Gloucester. However, few sea bass are taken on the HPB screens.

19.6.295 On the basis that the magnitude of impact is very low and a receptor of medium value, the significance of any impact is considered to be **minor adverse**.

IMPACT: Crustacean (including C. crangon) due to Impingement

19.6.296 The coastal areas (out to six nautical miles) off the North Devon coast and off the South Wales coast west of the River Rhymney come under the jurisdiction of the Devon and the South Wales Sea Fisheries Committees (SFC), respectively. The sea area of the Bristol Channel east of the Devon and Somerset border around to the mouth of the River Rhymney in South Wales falls outside the geographic boundaries covered by any SFC and, consequently, is an area where fishing activity remains largely unknown. It is suspected that there may be some artisanal crustacean fisheries, for example stake-netting or push-netting for brown shrimps, because healthy populations are known to exist, but the absence of any fisheries authority in the area suggests that it is of relatively little importance from a fisheries perspective. The South Wales SFC suggests that there is little or no potting activity east of Porthcawl on the Welsh coast, and Devon SFC is similarly unaware of any significant potting or trawling activity east of its border.

19.6.297 The official reported landings of shellfish, as recorded by the MMO (Ref. 19.27), show no brown or pink shrimps from this area in recent years (from 2000). The same data since 2005 show that reported annual landings of brown crab from the Bristol Channel area (as defined by ICES rectangles 30E5, 31E5–E7 and 32E5, **Figure 19.33**) are typically of the order of 200t, but less than 11t (in 2007) was taken in rectangle 31E6, the eastern portion of which is in the area adjacent to the Somerset coast and in the vicinity of Hinkley Point. The level of spatial resolution described by an ICES rectangle prevents us from specifying whether these crabs were taken close to the power station or, more likely, in the extreme west of the area off the North Devon coast. Reported annual landings of velvet swimming crabs *(Necora puber)* and common prawns from the Bristol Channel as a whole since 2005 are 3.5t and <200kg respectively, with just 30kg of velvet swimming crabs (in 2009 only), and no common prawns coming from rectangle 31E6. Most of the landings of these crustaceans in the Bristol Channel area are made into Devon and Cornwall, or to Welsh ports on the Pembrokeshire coast. A population estimate for the brown shrimp and the adjacent Stolford mudflats ($20km^2$) in the 1980s (Ref. 19.100) put the stock level at between $3x10^6$ to $5x10^7$ individuals (approximately 3-50t biomass).

19.6.298 In a national context, the reported landings of these crustaceans into England and Wales in 2008 were: brown crabs, 11,403t; velvet swimming crabs, 332t; common prawns, 33t; brown shrimps, 861t; shore crabs, 21t; and pink shrimps, 13t.

19.6.299 The annual shrimp *(C. crangon)* catch for HPC is predicted to be 19,135,756 individuals (**Table 19.26**), equivalent to around 19t.

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19.6.300 On this basis, without mitigation, a **moderate adverse** impact is predicted based upon medium magnitude and medium value.

Specifically Designated Conservation Species

IMPACT: Salmon due to Impingement

19.6.301 Although estimates of the upstream run of adult salmon are obtained using electronic fish counters or upstream traps on a number of catchments in England and Wales, there are no such data available for rivers entering the Severn Estuary. However, estimates of spawning escapement (numbers of spawning adult fish) are obtained from catch data and exploitation rates, and these are used to assess individual river stock status against conservation limits (CLs: the minimum spawning stock level below which further reductions in spawning numbers are likely to result in significant reductions in the number of juvenile fish produced in the next generation). The CL for each river is defined in terms of eggs deposited.

19.6.302 The River Severn CL is 12.85 million eggs, and the egg deposition estimated for 2008 was 16.56 million, 120% of the CL (mean 131%, 2004 to 2008). The River Wye CL is 35.66 million eggs, and the egg deposition estimated for 2008 was 22.58 million, 63% of the CL (mean 61%, 2004 to 2008). The River Usk CL is 10.11 million eggs, and the egg deposition estimated for 2008 was 21.36 million, 211% of the CL (mean 189%, 2004 to 2008). From these values we can estimate the number of smolts produced, using average egg-to-smolt survival data.

19.6.303 The mean annual catch (2004 to 2008) of salmon from the Severn Estuary net fishery was 837 fish (the long-term average is approximately 3,000 fish), with rods taking an average of 336, 682 and 987 fish from the Rivers Severn, Wye and Usk, respectively.

19.6.304 For the purposes of evaluating the impact of impingement of salmon smolts or adult fish on the intakes at Hinkley Point, data on catches or estimates of abundance for the Severn Estuary and its major rivers, the Severn, Wye and Usk, cover the overwhelming majority of salmon that might be vulnerable. Over the five-year period of 2004 to 2008, the mean annual catch of salmon from the commercial net fishery in the Severn Estuary was 837 fish, and recreational anglers caught an annual average of 2005 salmon from the Rivers Severn, Wye and Usk combined. Although 55% of salmon reported caught by anglers on these rivers were released alive, any impact of power station mortalities should be compared with the total catch (not fish killed), because recreational fisheries are valued per salmon caught.

19.6.305 No salmon were recorded in the long-term impingement monitoring programme at Hinkley Point between 2005 and 2009 and none were recorded in the CIMP (see Ref. 19.27).

19.6.306 On this basis, without mitigation, the predicted impact is considered to be **negligible**.

IMPACT: Twaite Shad due to Impingement

19.6.307 Spawning populations of twaite shad are confined to four rivers in the UK, namely the Rivers Tywi, Usk, Wye and Severn (including its tributary the River Teme). The twaite shad is a protected species, but there is only sparse population data for them in the Severn Estuary, so the potential for the estimation of shad stock sizes from current sampling techniques is limited and, as such, few estimates have been made. However, as part of the recent Severn Tidal Power Feasibility Study Strategic Environmental Assessment, an attempt has been made to estimate shad population size and age distribution using a simplified age-structured matrix model (Ref. 19.212).

19.6.308 The model described in Ref. 19.212 applies a matrix incorporating life-history parameters (adult survival rates; sex ratio; fecundity at weight/age; spawning propensity; and density-dependence) to predict the number of adult female shad within the River Severn RBD. The model incorporates a density-dependent egg deposition function based on a stock–recruitment relationship derived by M. Aprahamian (pers. comm., cited in Ref. 19.212) for adult females aged six years and applies forecasting and hindcasting methods using documented life history parameters to predict adult population size in a given year. For the purposes of this study, adults are considered to be aged between three and nine years old.

19.6.309 The model estimate indicates an average population size of approximately 92,000 female shad. Given a sex ratio of 1:1, the total mean population of twaite shad aged between three and nine years in the Severn RBD is therefore estimated to be 184,000, although variation in year-class strength may result in estimates ranging between 112,000 and 596,000.

19.6.310 Based on the scaled-up CIMP dataset, the total annual estimated impingement of twaite shad at a new power station at Hinkley Point, assuming a constant abstraction rate of $125m^3.s^{-1}$, without mitigation, would be about 2,276 fish (Ref. 19.43). As it is not currently possible to derive an EAV for twaite shad because of the absence of the necessary life history data, we have not rescaled the impingement estimates derived from the CIMP data. Therefore, with the present cooling water intake design, the equivalent adult numbers of twaite shad likely to be impinged annually at HPC (2,276 fish) equates to approximately 1.24% of the estimated local twaite shad population (184,000 adults).

19.6.311 On this basis, without mitigation, a **moderate adverse** impact is predicted, based upon a medium magnitude of effect and medium receptor value.

IMPACT: Eel due to Impingement

19.6.312 The Environment Agency monitors fish populations extensively within the Severn River Basin District (RBD), although the (mostly) multispecies electric fishing surveys used may underestimate the true density of eel (Ref. 19.213). The data suggest that eels are currently well distributed throughout the lower and middle parts of the catchments, and the Environment Agency has concluded that the eel population in the Severn downstream from Worcester has shown little change since the early 1980s, over the period when average recruitment to Europe has declined substantially (by 95% or more; Ref. 19.214).

19.6.313 The density and the biomass of eel in the middle reaches of the Severn and Warwickshire Avon catchments were low during the 1980s, but have not been

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surveyed in recent years. Similar survey data for the Bristol Avon catchment and Somerset rivers within the Severn RBD indicate a general decline in densities and biomasses between 1991 and 1993, and 1994 and 2006, by 37% and 48%, respectively.

19.6.314 A modelling approach to estimate the proportional impact of estuarine glass eel fisheries on the population is available (see Ref. 19.215 and 19.216) and, although it could be used here, it requires extensive sampling of glass eels during spring, when they enter the estuary.

19.6.315 In the absence of data on historical production of eel in England and Wales, a standard production rate of 16.9kg per hectare has been applied by the Environment Agency in estimating historic production and hence setting the 40% escapement biomass target (6.76kg per hectare) required under the European Eel Regulation 110/2007. This production rate was selected with reference to estimated production rates for the Bann (Northern Ireland) and Loire (France) catchments, reported by Ref. 19.217. Using the Environment Agency's Probability Model (Ref. 19.218), silver eel output from the Severn RBD is estimated to be about 8.4kg per hectare, which equates to about 133.4t of silver eel per year (Ref. 19.219). As such, the Severn RBD is tentatively assessed as exceeding its management target for silver eel production at this time. Note, however, that this model estimate is based on estimates of local yellow eel densities for 109 sites in the Severn catchment, extrapolated to the entire wetted area and converted to silver eel equivalents using a "silvering index", and therefore has a high degree of uncertainty.

19.6.316 Given Hinkley Point's location on the south coast of the Inner Bristol Channel seawards of the River Parrett, the potentially susceptible population consists of glass eels/elvers migrating upstream to freshwater, silver eels migrating downstream from freshwater, and any yellow eels living in the marine environment of the local area. Comparisons of glass eel and yellow/silver eel mortalities through impingement with population estimates are theoretically possible, but the models to permit this are still being developed and it is uncertain anyway which are the relevant 'populations'. The European eel is currently considered to comprise a single reproductive stock throughout its distribution range (and spawns in the Sargasso Sea off the Gulf of Mexico), and individual river and adjacent coastal marine populations appear to mix considerably.

19.6.317 The most useful indicator of impact is a comparison between impingement data for eels (although these are not differentiated by life stage) at Hinkley Point and estimates of the reported catch of each life stage 2005 to 2008 in the Severn Estuary RBD. A total of 774kg of glass eels was declared as caught in the Severn RBD in 2005, 684kg in 2006 and 1254kg in 2007. The declared annual catches of yellow eels in the years 2005 to 2007 were 4,088, 2,785 and 892kg respectively, and 419, 968 and 133kg of silver eels.

19.6.318 Based on the scaled-up CIMP dataset, the total annual estimated impingement of eels at HPC, assuming a constant abstraction rate of $125m^3.s^{-1}$, would (without mitigation) be about 1,304 fish, equivalent to 0.08t of adult eels. As it is not currently possible to derive an EAV for eels because of their complex life history, the impingement estimates derived from the CIMP data are not rescaled. With the present HPB cooling water intake design, the equivalent adult numbers of eels likely to be impinged annually at HPC (i.e. 0.08t) equates to <0.3% of a potential eel fishery (26t) and <0.06% of the local SSB (133.4t).

19.6.319 On this basis, without mitigation, a **moderate adverse** impact is predicted, based upon a low magnitude effect and the high sensitivity of the receptor. The impact of entrainment is considered separately below.

IMPACT: River and Sea Lamprey due to Impingement

19.6.320 More than half the UK SAC designations for the presence of either one or both of river and sea lamprey are situated on the Welsh coast, including the Rivers Wye and Usk. The most recent condition assessment round in 2007 classified all but the River Usk as unfavourable for river lamprey and all but the River Wye as unfavourable for sea lamprey. Stock status information is restricted to SAC rivers and is primarily in the form of ammocoete (larval lamprey) densities and distribution. The River Usk has the greatest *Lampetra* spp. ammocoete population across all British SAC rivers, and the River Wye has the greatest sea lamprey ammocoete population (Ref. 19.220).

19.6.321 Although river and sea lamprey are believed to spawn and reside within the River Severn, no assessment has been undertaken of their stock. However, as part of the Severn Tidal Power Feasibility Study Strategic Environmental Assessment, an estimate of lamprey population size and age distributions was derived (Ref. 19.212) using measurements of life-history traits collated from the literature to construct a generic life table for sea lamprey and river lamprey. Lampreys were assumed to represent one discrete population, given the species' capacity to disperse, as evidenced by their lack of homing and wide juvenile movement within several rivers throughout the UK. The life cycle of lamprey was represented by a stage-structured model and constructed with vital rate data and information on: average age at metamorphosis (ammocoete and parasitic juvenile); average ammocoete density per m^2 of optimal and suboptimal habitat; metamorphosis success (ammocoete to parasitic juvenile); ammocoete survival; and sex ratio.

19.6.322 Markov Chain Monte Carlo (MCMC) simulations were used to estimate the mean population size from the model output and provide a likely average population size of adult lamprey in the Rivers Usk and Wye. These estimates have been based on best guesses of available habitat of 1% per metre length of river for both optimal and suboptimal habitat. The population estimates are shown in **Table 19.28** (Ref. 19.212).

Table 19.28: Population Estimates of Lamprey (Mean ± s.d.) (Ref. 19.212)

	River Lamprey	Sea Lamprey
Usk	27,667 ± 4,696	3,069 ± 455
Wye	88,442 ± 14,326	12,200 ± 1,836
Total	116,109	15,269

19.6.323 Based on the scaled-up CIMP dataset, the total annual estimated impingement of river and sea lamprey at HPC, assuming a constant abstraction rate of $125m^3.s^{-1}$, without impingement, would be about 82 and 207 fish (Ref. 19.43), respectively. As it is not currently possible to derive an EAV for lamprey because of their complex life

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history, the impingement estimates derived from the CIMP data have not been rescaled. Therefore, with the present HPC cooling water intake design, the numbers of lamprey likely to be impinged annually at HPC equate to <0.07% of the river lamprey population and 1.36% of the estimated sea lamprey population.

19.6.324 On this basis, without mitigation, a **moderate adverse** impact is predicted based upon low magnitude and the high sensitivity of the receptor.

IMPACT: Fish Assemblage due to Impingement

19.6.325 The range of fish species assessed in some detail above is reasonably representative of the fish assemblage as a whole. In sum, a medium sensitivity and medium magnitude of effect may be assigned resulting, without mitigation, in an impact upon the local estuarine/marine fish assemblage of **moderate adverse** significance. See Ref. 19.14 for further discussion.

v. Entrainment

19.6.326 The aquatic organisms at risk of passing through the filtration system fall into three categories:

- Holoplankton representing those organisms that permanently exist within the plankton which are dominated by copepods within the Bristol Channel as with many other estuaries in the UK.
- Meroplankton representing those organisms which temporarily reside within the plankton including decapods, molluscs, echinoderms, annelids, shrimps, eggs and larvae (fish and invertebrate).
- Juvenile fish of a size small enough to allow them to pass through the drum screen mesh.

Assessment of Entrainment Loss (without mitigation)

19.6.327 The estimation of entrainment impacts associated with HPC (Ref. 19.27) has been carried out in accordance with best practice guidance contained in Ref. 19.18. Assumptions on cooling water system design are as for the Assessment of Impingement Losses, above.

19.6.328 The six anadromous species designated under the Severn Estuary, River Wye and River Usk SACs are: Atlantic salmon, twaite shad, allis shad, river lamprey, sea lamprey and sea trout. Being anadromous, the early life stages of the SAC species salmon, and the BAP species, sea trout are not likely to be vulnerable to entrainment as they will remain within freshwater during this life stage.

19.6.329 In addition, the juvenile life stages of these species present within the Inner Bristol Channel will be of sufficient size to avoid their passage through the 5mm drum screen mesh and would thus be subject to impingement mortality instead (Table 19.29) and likewise be subject to any means of mitigation associated with that impinged catch (see below). Lamprey transformers, glass eel, elvers and juvenile shad could however be vulnerable to entrainment as they may be present in the area at a size small enough to allow them to pass through a mesh size of either 5mm.

Table 19.29: Smallest Sizes of Various Fish Species Excluded by a 5mm Screen Mesh (Ref. 19.238)

Species	Smallest Size Excluded (Length, mm)
Eel, lamprey, pipefishes	100
Herring, salmon, common goby, sand-smelt, poor cod, whiting, sprat, grey mullet	40
Sea bass, shad, pouting	35

19.6.330 The previous entrainment studies at HPB and plankton studies within the vicinity of the site suggest that the eggs and larvae of the following key species are potentially at risk of being entrained through the cooling water system: sea bass, cod, eel, flounder, haddock, herring, lemon sole, plaice, pout, sole, sprat, gobies and whiting.

19.6.331 Entrainment estimates were determined on the basis that fish eggs and larvae would be entrained in direct volumetric proportion to their densities within the Bristol Channel within the vicinity of Hinkley Point (ICES rectangles 29E4, 30E4, 31E4, 30E5, 31E5 and 31E6, **Figure 19.33**). This assumption may be over-pessimistic. Ref. 19.221 found that the densities of fish larvae in Southampton Water were greater than those entrained from the entire water column, indicating that larvae were able to avoid entrainment and that actual entrained numbers were significantly lower than would be expected from offshore plankton surveys. At Bradwell Power Station on the Blackwater Estuary in Essex, entrainment monitoring for sole eggs and fry sampled just a single egg during seven weeks on-site. Whether the differences observed in this study or the previous studies are a result of the sampling techniques or a result of patchy distribution of plankton is unknown, but it has been suggested that it may in part be due to stratification of larvae in the water column (Ref. 19.222).

Entrainment of Other Zoo- and Phytoplankton

19.6.332 Other types of plankton will enter with the cooling water and are not likely to resist entrainment, although patchiness and stratification may affect their susceptibility. BEEMS surveys at HPB indicate that crustacea form an important component of entrained holoplankton (e.g. the seasonal mysid *Schistomysis spiritus*). Phytoplankton levels, primarily comprised of diatoms, are low in the Bridgwater Bay area of the Bristol Channel, owing to high turbidities, and consequently zooplankton are limited. As noted earlier in this Chapter, copepods are the dominant zooplankton in the waters off Hinkley Point.

19.6.333 Aquatic organisms entrained through the travelling screen mesh and into the cooling water system are at risk of a number of mechanical, hydraulic, pressure, temperature and chemical related stressors during this passage. The survival of entrained individuals is dependent upon the species, their developmental stage and size, physiological condition and the design of the cooling water system.

IMPACT: Entrainment of Phytoplankton

19.6.334 In a series of experiments at Fawley power station the author of Ref. 19.250 demonstrated that, in the absence of chlorination, primary production was enhanced

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by increased water temperature up to a discharge temperature of 23ºC but thereafter was progressively inhibited. No significant net loss in phytoplankton productivity was found at discharge temperatures of up to 27ºC. The author concluded that the entrainment effects of mechanical damage and thermal shock on phytoplankton were negligible.

19.6.335 That same study found that primary productivity was reduced by approximately 60% with a chlorination level of 0.2mg.l^{-1} and a Δt of 10ºC. It was not clear if the phytoplankton cells were killed or temporarily inhibited. For experimental reasons cells had to be cultured in chlorinated water for 3 hours, which is not representative of the short exposures in a power station (e.g. 18 minutes for HPC). Such exposure may have increased the measured effects.

19.6.336 Ref. 19.250 describes results from laboratory experiments on the effects of thermal shock upon the diatoms *Phaeodactylum tricornutum* and *Gyrosigma spencerii*. Neither species were significantly affected when cultured at 12ºC or 16ºC by thermal shocks of up to 17ºC. Both species were killed at ambient temperatures of 24ºC and a Δt of 15ºC. Growth was inhibited at a Δt of 10ºC and Δt of 12ºC respectively. The LT50 (lethal temperature to 50% of the species) was 36.5ºC and 37ºC respectively.

19.6.337 The flagellate *Dunaliella tertiolecta* was more resistant and survived an exposure time of 40 minutes at a final discharge temperature of 41ºC; cell growth stopped for 5 days and then recovered to densities similar to the control within 12 days.

19.6.338 The 98%-ile predicted discharge temperature of HPC is 32.9°C (i.e. below the below expected LT50 values (Ref. 19.250)). No loss of productivity is expected at a discharge temperature of 31ºC. At 34ºC there is a possibility of a small reduction in growth, but this may not be noticeable in the enhanced productivity of the warmer receiving waters. In the absence of chlorination the thermal effects of entrainment on primary production are thus expected to be **negligible**.

19.6.339 If chlorination resulting in an in-circuit level of 0.2mg.l^{-1} TRO were employed by HPC, the available evidence (Ref. 19.250) suggests that an approximate 60% reduction in productivity would be expected in entrained phytoplankton. Making worst case assumptions that the effected cells were killed and that HPC extracts 1% of the available source (plume) volume per day (Ref. 19.27) within the zone of abstraction, then 0.7% of the phytoplankton cells in that plume volume would be killed per day. Assuming phytoplankton are uniformly distributed over the entire Inner Channel, HPC could kill 0.05% of the Inner Channel phytoplankton abundance per day. The overwhelming majority of phytoplankton production and consumption by copepod zooplankton takes place outside of the Inner Channel and outside of the influence of HPC (Ref. 19.255).

19.6.340 The predicted recirculation of the HPC discharge water into the intakes is slight (Ref. 19.38). Moreover the reduced phytoplankton abundance in the HPC discharge water would rapidly be restocked from phytoplankton cells from elsewhere in the Channel that are outside of the HPC abstraction zone. Under such circumstances the impact on phytoplankton productivity would be **negligible**.

IMPACT: Entrainment of Zooplankton (1) copepods

19.6.341 A comprehensive review of entrainment survival for over 20 power stations in the USA determined a mean survival rate for a range of aquatic organisms and lifestages of over 50% (Ref. 19.223). Survival rates were highest for macroinvertebrates (72 to 92%) and lowest for sensitive fish species such as herring (mean values approaching 25%). Effects from physical, temperature and chemical stressors differed between the species. As would be expected survival was lowest for the delicate early larval stages and highest in early juveniles. For clupeids survival rates of juveniles ranged from zero to 81.5% with an average of 25%. Similar survival rates were also observed for clupeid larvae ranging from zero to 70%.

19.6.342 Ref. 19.224 describes the development of an entrainment mimic unit (EMU) designed to mimic realistically the conditions of entrainment passage through the cooling water system of a coastal power station under laboratory conditions as a means of assessing likely mortalities of entrained organisms. The apparatus allows the assessment of the effects of the four key stressors of entrainment: temperature, pressure, biocide and mechanical effects, alone and in combination. Their original experiments on larvae of the Pacific oyster *(Crassostrea gigas)* gave a baseline comparison of the technique to a standard bioassay technique (the D-stage larval test) and demonstrated the suitability of the apparatus and experimental protocols to assess the impacts of power-station entrainment.

19.6.343 A study reported in Ref. 19.250 calculated that the natural mortality of the copepod *Eurytemora affinis* in the Inner Channel was approximately 33 yr^{-1} i.e. 8.6% per day. This value was not atypical for copepods found in similar temperatures. Annual mortality ranges for *Acartia* spp. were reported as 17-58 yr^{-1} with higher figures of up to 257 yr^{-1} reported for tropical latitudes.

19.6.344 As noted above, the dominant members of the plankton at Hinkley Point are members of the genus *Acartia* and an assessment of the likely impact upon this genus alone thus has value in terms of indicating the likely scale of impact on the local holoplanktonic assemblage as a whole. After Ref. 19.250, this assessment makes the following assumptions: 1.1% of plume volume entrained per day (Ref. 19.27); entrainment mortality 20% (from EMU experiments, Ref. 19.200); ratio of plume volume to volume of Inner Channel =7.2%; copepods uniformly distributed throughout the Inner Channel. The entrainment mortality in the summer at Hinkley Point will represent 0.016% of the Inner Channel population per day. Ref. 19.253 and further studies described by Ref. 19.250 show that the population of *Acartia* spp. is distributed over the entire Central and Inner Channels in the summer and, therefore, the percentage of the Bristol Channel population that will be killed by HPC is less than 0.004%. Given the natural productivity of the species this will cause a **negligible** impact.

IMPACT: Entrainment of Zooplankton (3) Sabellaria larvae

19.6.345 As noted earlier in this Chapter, reefs of the tube building worm, *Sabellaria alveolata,* are found to the west of Hinkley Point and along the low shore directly in front of the station, as well as on some low shore areas of Stert Flats.

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19.6.346 As described by Ref. 19.250, there is evidence from laboratory experiments that *S.alveloata* spawns briefly in July and the larvae spend a minimum of six weeks and a maximum of eight months in the plankton. Field observations on larval settlement have proved variable from year to year but peaks have been detected off the Cornish coast in September to November and December. On the French Atlantic coast peak larval densities have been reported from October to March and spawning has been reported in the Bay of Mont-Saint-Michel in early May with a settlement time of 12 weeks and then September with a settlement period in the 8ºC warmer water of four weeks.

19.6.347 Larvae settle principally on old colonies and detect the cement used by tube building worms of *S.alveolata* or *S.spinulosa*. Natural mortality has been estimated by field measurement to be 0.09 d^{-1} (range 0.089 to 0.097 d^{-1}). These values were in the range of marine invertebrate mortalities described elsewhere (Ref. 19.250) (mean of 23 species 0.23 d^{-1}, range 0.016 to 0.82). There is evidence for vertical migration with larvae moving towards the surface during the flood tide during the day as well as at night.

19.6.348 *S.alveolata* growth is promoted by high levels of suspended sediment and higher water temperatures. In the UK it is at or near the northern edge of its thermal range and it can suffer high mortalities in cold winters.

19.6.349 The planktonic life stage of *S. alveoloata* is the only stage vulnerable to entrainment. There are no published data on the entrainment mortality of *Sabellaria* larvae. Ref. 19.44 found no adult mortality for *S. spinulosa* after a 28 day exposure to chlorine at 0.1mg.l^{-1} at 15ºC ambient. Ref. 19.52 reports an EC50 for a 5min exposure at 0.3mg l^{-1} for the polychaete *Phragmatopoma californica* (temperature not specified). In the absence of more data a 50% mortality has been assumed for HPC with chlorination at 0.2mg l^{-1} TRO.

19.6.350 Modelling of the potential abstraction of *Sabellaria* larvae released from potential spawning areas in Bridgwater Bay by particle tracking in the HPC GETM model (Ref. 19.261) predicts a 0.05% chance of larval abstraction per day for four intakes. Assuming 50% entrainment mortality, the predicted worst case loss of *S.alveolata* larvae is 0.025% per day. Natural mortality is approximately 9% per day (Ref. 19.250). In practice the risk of abstraction will be less than calculated because no account has been taken of larval dispersion into the wider channel. The resultant increase in natural mortality from 9% to 9.025% is considered to be of **negligible** significance.

IMPACT: Entrainment of Zooplankton (4) mysids

19.6.351 From Refernece 19.250 the main mysids found in the Inner Bristol Channel and the Hinkley Point forebay have been observed to be (by % number): *Schistomysis spiritus*, 66%; *Mesopodopsis slabberi*, 20%; *Gastrosaccus spinifer*, 11%; *Neomysis integer*, 4%.

19.6.352 Mysids are part of the hyperbenthic community and are normally found within 1m of the seabed. Maximum concentrations are found just below the low water mark in summer and near to the 5 to 10m contour in winter. They indiscriminately feed on fine particulate matter including detritus, algae, zooplankton and sand grains. Mysids are good swimmers and can maintain 10 body lengths.s^{-1}. They can maintain their position even in strong currents by sheltering on the seabed. Mysids are an important part of the diet of *C.crangon* and fishes in the 3-15cm length category.

19.6.353 Ref. 19.250 reports very limited data availability on entrainment mortality for mysids and thus, as a precautionary measure, a 100% mortality rate is assumed in this instance. After Ref. 19.250, this assessment makes the following assumptions: 1.1% of plume volume entrained per day (Ref. 19.27); entrainment mortality 100%; ratio of plume volume to volume of Inner Channel =7.2%; mysids uniformly distributed throughout the Inner Channel.

19.6.354 On the basis of this assessment, the additional mortality in the Bristol Channel from entrainment losses associated with HPC will be 0.08% d^{-1} (predominantly to juveniles). The natural mortality of mysids is 4% d^{-1} (adults) to 6% d^{-1} (juveniles); hence there will be a **negligible** increase in mysid mortality due to entrainment.

IMPACT: Entrainment of Zooplankton (5) Crangon

19.6.355 Ref. 19.240 concluded that, in combination, the stresses of entrainment under standard power-station operating levels would result in approximately 20% mortality of brown shrimp larvae (from the combination of total residual oxidant (TRO), and rise in temperature (ΔT).

19.6.356 Using morphometric measurements a study reported by Ref. 19.250 determined that the Bristol Channel *C. crangon* population (east of the line Nash Point to Porlock Bay) is distinct from its south-western sea neighbour. *C. crangon* is impinged at HPB throughout the year with peak abundance in the period July to November and minimum abundance in April/May. At Bridgwater Bay *C. crangon* (mostly juveniles) migrate with the rising tide onto the high intertidal flats. At low water the population is concentrated near the low water mark and HPB catches are largest; typically 7 times those at high water. Spawning takes place twice a year in January and late spring/early summer; the females migrate offshore to the west to release their eggs. Mature males remain offshore to mate with returning females. The January spawning leads to egg hatching at the end of March/early April with metamorphosis and settlement on the intertidal area in early to mid May. The early May spawning hatches in early June with settlement in mid July.

19.6.357 *C. crangon* larvae are not been found in the monthly plankton sampling at HPB. This is in agreement with Ref. 19.253 who found highest density of *C. crangon* larvae in the Outer Bristol Channel. The size of the annual recruitment is therefore determined by environmental factors outside of Bridgwater Bay and not the influence of HPB or HPC. The lifecycle stages of *C. crangon* that are vulnerable to impingement and entrainment are thus juveniles and predominantly mature females that utilise the lower parts of Stert flats.

19.6.358 With a 10mm inlet screen mesh at HPB, approximately 38% of *C. crangon* that are drawn into the cooling water system have been estimated as being impinged and the rest are entrained and pass through the condensers (after Ref. 19.250; figures calculated using typical length frequency distribution of *C. crangon* and reported

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impingement probabilities). With the proposed 5mm drum screen mesh of HPC approximately 90% of the animals will be impinged and 10% entrained.

19.6.359 Bamber has produced results from EMU experiments using *C. crangon* larvae (Ref. 19.225). These experiments showed no effect from pressure, mechanical damage or direct effects for a ∆T of 12ºC or from chlorination. The work did show that elevated temperatures increased the animal's sensitivity to chlorine. Typical power station mortality with chlorination was estimated to be 25% (at a final discharge temperature of 23ºC).

19.6.360 No results from juvenile or adult *C. crangon* are available. Ref. 19.250 reports an estimated maximum temperature for *C. crangon* to survive of 30ºC based upon physiological considerations. However this estimate is not the same as the critical temperature for survival in a 20 minute entrainment exposure. Ref. 19.21 summarises thermal ULT for invertebrates as falling within the range 30-33ºC and for decapods as a mean of 32.9ºC. As a result, in the months of July or August, there may be some thermally induced mortality associated with HPC. The EMU derived 25% mortality applied to larvae, but *C. crangon* larvae are not abstracted at Hinkley Point. In principle it would be expected that juveniles and adults would be less sensitive to chlorine but in the absence of additional data the 25% mortality has been used in entrainment calculations for HPC with or without chlorination.

Table 19.30: *Crangon Crangon*: Annual Impingement and Entrainment Impact of HPC Options Compared with HPB.

Station	Impinged (m)	Loss (m)	Loss (t)	Entrained (m)	Loss (m)	Loss (t)	Total Loss (m)	Total Loss (t)
HPB	**4.9**	**4.9**	**3.6**	**12.9**	**0**	**0**	**4.9**	**3.6**
HPC 10mm mesh, No Cl	19.1	3.8	2.8	50.3	0	0	3.8	2.8
HPC 10mm mesh Cl at 0.2mg.l^{-1}	19.1	3.8	2.8	50.3	12.6	2.6	16.4	5.5
HPC 5mm mesh, No Cl	**43.0**	**8.6**	**3.9**	**26.4**	**0**	**0**	**8.6**	**3.9**
HPC 5mm mesh, Cl at 0.2 mg.l^{-1}	**43.0**	**8.6**	**3.9**	**26.4**	**6.6**	**0.4**	**15.2**	**4.3**

(m)=millions; (t)=tonnes

19.6.361 Ref. 19.250 provides an analysis of the annual impingement and containment impact of HPC (**Table 19.30**) and notes that the existing Bristol Channel population of *C. crangon* is density limited. Any reduction in local biomass due to HPC will rapidly be filled by a population that grows on average by 5% per day during the summer. The evidence from the HPB impingement surveys is that the production/biomass ratio has increased over the past 27 years.

19.6.362 Ref. 19.250 also notes that the estimated production at Stert flats is 1781kg.km^{-2}, i.e. the production from Stert/Berrow flats is 85 tonnes and the 200km^2 of the Bristol Channel inter-tidal flats is 356 tonnes. Estimated losses from HPB at present would thus amount to 1% of the annual production of *C. crangon* within the Bristol Channel, HPC with no chlorination 1.1% and with chlorination 1.2%.

19.6.363 There is therefore no significant difference between the total predicted losses from HPC (with its 5mm inlet mesh) and the existing HPB station. If HPC needs to chlorinate, losses could be further reduced from those shown above by adopting a 50:50% chlorination duty cycle. Under such circumstances the total losses would reduce to 1.1% of the Bristol Channel production.

19.6.364 On the basis of the findings described above, an impact of **minor adverse** significance upon *C. crangon* is predicted on the basis of very low sensitivity and a medium magnitude effect.

IMPACT: Entrainment of Zooplankton (6) ichthyoplankton

19.6.365 **Table 19.31** shows that entrainment survival rates for fish eggs may be high (80+%) and that survival rates for fish larvae are lower and more variable.

Table 19.31: Survival rates of entrained fish and crustacean from EMU cooling water passage simulation experiments (Ref. 19.225)

Species	Life Stage	Entrainment Survival Rate at 0.2ppm TRO and approximately10°C ΔT	Prime Causes of Mortality
Sole (*Solea solea*)	eggs postlarvae	93% 8%	pressure, thermal stress thermal stress and chlorine toxicity
Turbot (*Psetta maxima*)	eggs post larvae	93% 30%	pressure, thermal stress thermal, mechanical and pressure stress
Sea bass (*Dicentrarchus labrax*)	eggs larvae	54% 56%	thermal stress thermal stress and chlorine toxicity
Eel (*Anguilla anguilla*)	larvae*	52%	TRO
Shrimp (*Crangon crangon*)	larvae	75%	thermal stress and chlorine toxicity
Lobster (*Homarus gammarus*)	larvae	92%	mechanical stress

Note: **Eel tested at 2ppm TRO*

19.6.366 Ichthyoplankton varies spatially throughout the Bristol Channel, being highest for eggs in the spawning areas (particularly around Trevose Head, some 100 miles along the coast to the West of Hinkley Point, for most commercial species), and may also be high nearshore where larvae and post-larvae begin to recruit to nursery areas (e.g. for sea bass, see Ref. 19.226). In this respect, the water entrained at Hinkley Point will not be representative of other areas of the Bristol Channel, although the inner reaches of the Severn Estuary are well mixed. The Trevose Head spawning grounds are used here as a reference area.

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19.6.367 Ichthyoplankton surveys off the Hinkley Point area were undertaken quarterly in 2008 and again in May 2009 (Ref. 19.33). Eggs and larvae of just 14 species were detected in very low numbers (**Table 19.32** shows which species were detected during 2008/9). However, those surveys were designed to increase understanding of the subtidal ecology of the area and not just the ichthyoplankton community, so the timing of the surveys in 2008 were not optimal for the main fish spawning season.

Table 19.32: Presence (+) of Fish Eggs and Larvae Detected in Ichthyoplankton Surveys off Hinkley Point in 2008 and 2009

Species	Eggs	Larvae
Anchovy	+	
Dover sole	+	+
Rockling spp.	+	
Solonette	+	+
Sea bass	+	+
Gurnard spp.	+	
Dragonet		+
Herring		+
Sprat		+
Sandeel		+
Goby spp.		+
Mackerel	+	
Pilchard	+	
Scaldfish	+	

19.6.368 In order to obtain a better estimate of ichthyoplankton communities at the site, intensive monthly surveys were undertaken between February and June 2010 (Ref. 19.34). Despite this greatly increased sampling effort, the eggs and larvae of only 18 species were detected, although much better temporal and spatial density estimates were obtained. The 2010 surveys confirmed the findings of the 2008 and 2009 surveys that the Hinkley Point area has a very limited ichthyoplankton community and therefore the risk of entrainment loss is both low and is limited to a narrow range of species.

19.6.369 Although eggs and larvae of 18 species of fish were detected in the BEEMS intensive plankton survey off Hinkley Point in 2010 (Ref. 19.34), comparison with abundances at the Trevose spawning area have only been made for European sea bass, Dover sole, and sprat because these are the only ones of commercial interest identified during the BEEMS plankton surveys that can be compared with those species present.

19.6.370 The estimated entrainment of eggs and larvae over the period February to June 2010 given in **Table 19.33** has been made assuming:

- no exchange between the pool and adjacent sea areas;

- uniform distribution and abundance of ichthyoplankton throughout the water column; and
- the mean ichthyoplankton abundances from the 2010 surveys close to Hinkley Point power station occur within the identified 'pool'.

Table 19.33: Predicted Entrainment of Fish Eggs and Larvae between February and June 2010 at Hinkley Point C (based on the Ref. 19.34) in relation to the abundance in the Trevose spawning area

Species/ Species Group	Eggs	Larvae	A: Total**	B: Trevose	A/B
Sandeels		9,075,949	9,075,949		
Solenette	368,278	2,496,257	2,864,536		
Five-bearded rockling		333,687	333,687		
Herring		414,615	414,615		
European sea bass	47,282,931	41,981,786	22,051,122	29,206,261,000	0.11%
Rockling	18,546,479	799,420	19,345,899		
Gobies		10,351,234	10,351,234		
Butter fish		389,819	389,819		
European flounder		2,711,333	2,711,333		
European plaice		3,322,735	3,322,735		
Pilchard	2,891,002	386,310	3,277,311		
Dover sole	9,461,839	1,929,208	1,659,991	274,633,000,000	0.001%
Soles*	450,281	369,308	819,589		
Sprat		7,114,303	7,114,303	478,943,000,000	0.001%
Sea scorpion		474,262	474,262		
Unidentifiable fish	5,004,020	21,322,227	26,336,246		

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Species/ Species Group	Eggs	Larvae	A: Total**	B: Trevose	A/B
European anchovy	12,141,963		12,141,963		
Dragonets	383,685		383,685		

* *Indicates eggs and larvae that, due to damage, could not be confirmed as Dover sole, but were identified as belonging to the family Soleidae.*

** *For Dover sole and sea bass, the results have been adjusted so as to account for estimated survival based on EMU experiments.*

19.6.371 These entrainment estimates can be compared and put into context with the abundance of ichthyoplankton at the Trevose Head ground by examining the mean abundance of the same species in the Trevose spawning area (Ref. 19.227), ICES rectangles 29–31E4, 30–31E5 and 31E6 (**Figure 19.33**), assuming that:

- the mean abundances of eggs and larvae from the 1990 surveys were within the ICES rectangles 29–31E4, 30–31E5 and 31E6;
- the mean abundances of eggs and larvae from the 1990 surveys are still a reasonable approximation of the current situation; and
- the assumptions about the distribution and abundance of ichthyoplankton within the Trevose spawning area will be the same as that within the 'pool', i.e. uniform distribution and abundance throughout the water column.

19.6.372 Within the period February to June 2010, the predicted numbers of eggs and larvae of sea bass entrained by HPC are predicted to be <0.45% of the mean abundance within the Trevose spawning ground. For sole and sprat the numbers of entrained eggs and larvae over the same period are predicted to be <0.005% of the mean abundance within the Trevose spawning ground. Although the figures assume 100% mortality of all entrained organisms, previous EMU studies have indicated that this is not likely to be the case (but see the caveats above), in which case the impacts of entrainment mortality on local populations would be reduced further. Ongoing EMU trials under the BEEMS programme are investigating entrainment survival rates for relevant species and life stages and using exposure conditions based on the HPC cooling circuit design.

19.6.373 For certain species of conservation interest, such as shads (twaite and Allis) and lampreys (marine and river), that spawn and live as larvae in the freshwater tributaries of the Severn Estuary, entrainment of these early life history stages at HPC is expected to be negligible.

19.6.374 On the basis of the findings described above, an impact of **minor adverse** significance upon the ichthyoplankton is predicted on the basis of low sensitivity and low magnitude.

IMPACT: Entrainment of Zooplankton (7) glass eels

19.6.375 The majority of any glass eels abstracted by HPC will be entrained as they will be small enough to pass through the 5mm inlet screen mesh (Ref. 19.250). Glass eels enter the Bristol Channel in February to April and assuming the same efficiency as in the Gironde, the eels will migrate through the estuary at approximately 3 to 4km.d^{-1} using selective tidal stream transport.

19.6.376 The natural mortality of glass eels (i.e. excluding fishing mortality) has been estimated to be in the range 0.0233 – 0.0049 d^{-1}.

19.6.377 Glass eels entrained at HPC would be subject to mortality from:

- mechanical damage from the impellors n the cooling water pumps;
- thermal shock ; and
- exposure to chlorination for an 18 minute period inside the plant at 0.2mg.l^{-1} at the inlet to the condenser (If HPC uses chlorination).

19.6.378 Ref. 19.250 reports that the expected mortality from the temperature and chlorination regime described above would be negligible. HPC will employ cooling water pumps that are the same or close equivalents to those designed for Flamanville 3. These pumps were modelled in the STRIKER programme that has been widely applied to other pump mortality calculations (Ref. 19.225). The predicted mortalities ranged from 1.6% for a 70mm glass eel to 1.8% for an 80mm eel. The total entrainment mortality due to the cooling water pumps assuming a worst case 80mm eel is 1.8%.

19.6.379 After Ref. 19.250, this assessment makes the following assumptions: 1.1% of the plume volume is abstracted per day (Ref. 19.27); the mortality of entrained eels is 1.8% to 15%, i.e. the daily mortality is 0.02% to 0.165% of eels within the plume volume. Assuming that glass eels use the whole Channel to migrate, the daily mortality in the Inner Channel due to entrainment would be 0.0014% to 0.012%. Taking a mean value for natural mortality of 0.01 d^{-1} (or 0.995%), entrainment through HPC would increase the mortality of glass eels to within the range 0.996% to 1.007%. Such increases are considered to be of **negligible** significance.

19.7 Cumulative Assessment

a) Construction

i. Introduction

19.7.1 This section considers whether any of the identified effects associated with individual components of the HPC development could be additive or combine in such a manner that they could lead to a change (e.g. increase in effect or alteration in an area affected) that would be different to that determined for the individual components alone. The potential for cumulative impacts with other components of the HPC Project, namely Combwich Wharf, are considered in **Volume 11** Cumulative Effects. It should be recognised, however, that because of the spatial separation between the individual project components, their temporal extent and their localised effects on marine ecology, the potential for any interaction and therefore for such cumulative effects to occur is very limited.

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ii. Cross-shore Works

19.7.1 Works across the shore include: jetty construction, operation and removal; drilling of the horizontal tunnels for the cooling water structures; and seawall construction. The impacts of these activities will be additive in terms of the areas impacted, save where access corridors coincide.

19.7.2 During construction of the seawall, excavation works may lead to an increase in suspended sediments in the water column. However, the seawall is located on the uppermost part of the shoreline, above MHWS, and any discharges from the construction area, even if they contained relatively high suspended sediment concentrations, would be rapidly dispersed under high tide conditions. It is anticipated that background conditions would be achieved close to the points of discharge. Even under low tide conditions, it is not anticipated that the seawall works would contribute sufficient suspended sediment to reach the *Corallina* community present on the lower to mid shore. Should some discharge reach the area of *Corallina* it is likely to replicate events occurring naturally during rainfall events and the materials would be quickly re-suspended and transported elsewhere by the tide. Therefore, a combined impact due to the seawall construction with either the jetty piling works or the drilling of the horizontal tunnels (see below) is not predicted to occur.

19.7.3 Drilling of the horizontal tunnels is anticipated to take place during the operational stage of the jetty, and as such there would be no possibility for interaction between the construction stages. It is also anticipated that any discharge from the drilling works would occur over an area of the foreshore to the east of the jetty and would not impact upon the same intertidal area. Consequently, while a greater overall extent of foreshore supporting *Corallina* would be affected cumulatively, the same area of foreshore would be unlikely to be impacted by both activities. Following the end of the drilling works, the foreshore would not be disturbed again by activities until the dismantling of the jetty.

19.7.4 Overall it is concluded that while the foreshore at Hinkley Point may be subject to a number of construction related disturbance events, the totality of these events would be one of prolonging the overall period of effect across distinct parts of the foreshore, rather than intensifying impacts, such that a longer term loss or change in habitat function would occur. With the application of best practice described above and in **Section 19.8** below, specifically the use of constrained corridors for working and access, management of waste solids and liquids, appropriately designed roadbeds and use of appropriate vehicles to limit compaction of the cross-shore rock superficial limestone platforms (as also discussed in **Volume 2**, **Chapter 17**), the accumulated residual impact is predicted to be **minor adverse**.

iii. Sub-tidal Works

19.7.5 The offshore works which could result in cumulative impacts include the installation of jetty piles, dredging associated with the berthing pocket of the jetty, and the installation of the vertical shafts for the cooling water system.

19.7.6 The jetty will be in its operational phase during the installation of the vertical shafts and, hence, no cumulative impacts on marine life through increased suspended sediments or disturbance will arise. The capital dredging for the berthing pocket will also have been complete, but there is the potential for maintenance dredging of the berthing pocket to overlap with the installation of the vertical shafts.

19.7.7 Sensitive benthic habitats which could be impacted by this work include *Sabellaria spinulosa*, although there is no observed occurrence of this reef within 500m of the jetty. There is the possibility that some sub-tidal *Sabellaria* is present around the vertical shaft sites, however, given the habitat type involved this would not include any reef formations. It is therefore considered that, with the application of best practice, there will be **no cumulative impact** from increased suspended sediments on sensitive habitats due to the proposed sub-tidal works.

iv. Cross-shore Discharges

19.7.8 All cross-shore discharges will be via a single point of discharge specifically selected to avoid low water cross-shore flows intersecting with sensitive receptors.

19.7.9 The assessments included above relate to the cumulative effect of both construction and early commissioning discharges being passed via the same route. The accumulated residual impact, with mitigation, thus remains **minor adverse**.

b) Operation

i. Impingement and Entrainment

19.7.1 The AEV methodology applied in this instance has not involved the integration of impingement and entrainment losses for the very simple reason that ichthyoplankton have been found to occur at Hinkley only in very low numbers. As a result, the conclusion reached for the cumulative impact of impingement and entrainment remain identical, prior to mitigation, to those given above for impingement alone for each of the individual species considered.

19.7.2 As noted above, the larvae of the brown shrimp *C. crangon* do not occur locally so it is the consideration of adult and juvenile individuals alone that contribute to the impact of HPC on the population of this species.

19.8 Management Controls and Mitigation Measures

a) Introduction

19.8.1 The following sections contain a description of the specific mitigation measures considered to be appropriate, along with specific mitigation for each operation activity, where required, to reduce identified significant adverse impacts on marine ecology to acceptable levels.

19.8.2 As described in the **Construction Method Statement** which forms **Annexe 2** to this ES, a suite of Environmental Management Plans will be implemented to ensure that best working practices and required environmental mitigation measures are implemented. An Environmental Management and Monitoring Plan (EMMP) will provide the overall framework of environmental requirements and Construction

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Environmental Management Plans (CEMPs) will show how the contractor(s) will comply with the EMMP and any SSMPs.

19.8.3 Recognised best practice and regulatory guidance will apply wherever appropriate, for example by use of Environment Agency Pollution Prevention Guidance notes (PPGs).

19.8.4 In terms of the marine ecological sensitivities described earlier in this chapter, a clear example of the need to apply best practice will be in the control of works in the intertidal area, where appropriate means will be applied both to limit physical damage to fragile limestone pavement areas, and guard against the release of potentially polluting materials.

19.8.5 Likewise, the need to apply best practice will also apply to the management of offshore works.

19.8.6 The primary means of obtaining mitigation is through appropriate engineering design and subsequent management of plant. To accomplish this requires both a width of experience in building and operating such plant in a wide variety of circumstances over many years, together with a detailed multidisciplinary understanding of the environment into which new plant is to be introduced.

19.8.7 A significant element of HPC has been that precisely the same studies that have provided an understanding of potential environmental impacts have been employed in supporting considerations of detailed plant design where any element of that design or function encroaches upon, or depends upon, the structure and functioning of these marine systems.

b) Construction

i. Introduction

19.8.1 The primary means of mitigating impacts on the ecology of the local coastal environment during the construction of HPC will be appropriate engineering design combined with the application of best practice in terms of the management of construction and subsequently the plant itself.

ii. Habitat Loss and Change

19.8.2 Works on the seawall will be limited to a defined corridor along the top of the intertidal area and all associated works managed so as to prevent more widespread disturbance to the middle and lower intertidal areas and, in particular, the loss of control of any solid or liquid arisings from the works.

19.8.3 In bringing rock armour to the site by sea and landing these materials on the intertidal shore by barge, the following constraints would apply:

- barge deliveries would be limited to the within the inner perimeter shown by **Figure 19.36** (upslope of *Sabellaria* biotope, east of [*Fucus serratus*]/[*Ascophylum*] platform, west of [*Fucus serratus*]/[*Ascophylum*] platform); and

- unloading and transport of materials towards the sea wall construction zone will also be limited to that area.

At no point would vessels be permitted to ground against the intertidal shore outwith that inner perimeter.

19.8.4 There will be limited impact in terms of disturbance to the biotopes involved within the berthing area (hydrolittoral soft rock; [*Macoma*] and [*Arenicola*] in muddy sand shores; [*Fucus vesiculosus*] on variable salinity mid eulittoral boulders and stable mixed substrata/[Fucus serratus] and [large *Mytilus edulis*] on variable salinity lower eulittoral rock; [*Fucus spiralis*] on sheltered variable salinity upper eulittoral rock; [*Pelvetia calanaliculata*] on sheltered variable salinity littoral fringe rock; barren littoral shingle). These biotopes and habitats are widely distributed and common on local rocky shores and all would be expected to recover quickly from any superficial and localised loss of flora or fauna due to disturbance.

19.8.5 Unless managed sensitively, works to construct the temporary aggregate jetty will cause disturbance to the limestone and shale fabric of the cross-shore rocky platform which supports the *Corallina* turf interest. The extent of this damage will be limited by restricting the works to within a predefined corridor extending no further than 20m to either flank of the line of the jetty. There is also likely to be a need to make good the microtopography of the shore and reinstate longshore drainage channels should localised damage occur. As a consequence, piers will be introduced from seaward rather than landward as far as it is practicable to do so. Damage to the superficial geology will be limited by use of an appropriate temporary roadbed established within the access corridor, rendering the magnitude of impact low.

19.8.6 The use of jack-up rigs over the lower shore could cause similar damage to the rock surface, though over a much reduced area. Where works pass across the area of the limestone platform that dominates the middle and lower intertidal areas, any damage to the existing microtopography and the associated long-shore drainage routes will be restored after both construction and removal of the jetty, rendering the magnitude of effect very low.

19.8.7 The temporary aggregate jetty will be piered throughout its length with the express purpose of limiting hindrance to the passage of wave and tide. The open structure of the jetty means it will have a very limited effect on sediment transport on the foreshore and the subtidal and the associated ecological interests.

19.8.8 The FRR discharge line will not be driven across the shore surface but introduced by microtunneling from landward under the seawall and intertidal shore to reach a seabed outfall. Thus, aside from the temporary aggregate jetty, no cross-shore structures are to be introduced.

19.8.9 As described below, there will be a need to put construction and commissioning discharges across the shore from a discharge point at the head of the shore. In order to avoid areas of habitat that would be particularly sensitive to such flows, a number of possible outfall configurations have been tested in relation to biotope mapping. The location selected will not lead to flows entering the limestone platform

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drainage network leading to *Corallina*, and that flow will involve only limited areas of low sensitivity – see **Appendix 19.1** and **Figure 19.19**.

19.8.10 The connection between the HPC Development Site itself and the offshore cooling water intake and outfall headworks will be via tunnels bored under the shore and seabed from landward and, aside from these headworks themselves, there will be no structures on the seabed.

iii. Physical Disturbance

19.8.11 The mitigation measures for physical disturbance are the same as those outlined for loss of habitat above.

iv. Changes in Water Quality

19.8.12 Again, in terms of the potential for waste streams, the primary means of mitigating impacts on the ecology of the local coastal environment during the construction of HPC will be appropriate engineering design combined with the application of best practice.

19.8.13 Until such time as the cooling water system becomes available the intention is that construction and commissioning related effluents will be discharged across the intertidal area from a single dedicated discharge point. That discharge point has been selected on the basis of hydraulic modelling, which identified a location and route across the shore that avoided potentially sensitive and valuable biotopes – see **Appendix 19.1** and **Figure 19.19**.

v. Noise and Vibration

19.8.14 As noted in earlier sections, and for conservative purposes within this assessment, percussive piling is presumed for works associated with the aggregate jetty and the installation of cooling water headworks offshore.

19.8.15 Some risk of impact applies to both specific fish populations present in the immediate locality when such operations begin (particularly hearing specialists such as sprat and herring), and any marine mammals. The guidance provided by JNCC (Ref. 19.96) has been applied in terms of establishing a network of acoustic sensors offshore, but that guidance also suggests an appropriate ‘soft-start’ protocol for piling, and this will be adopted as a matter of precaution.

19.8.16 Soft-start is the incremental in crease in pile power over a set time period until full operational power is achieved. The soft start duration will be a period not less than 20 minutes. If there is a break in the piling operations for more than ten minutes, then the soft-start procedure will be repeated.

19.8.17 Once pile driving is initiated then the potential for physical damage effectively ceases as any fish within the zone of influence (ensonification) would move out of the area to avoid the increase in noise levels/pressure.

19.8.18 There are indications from initial use of the acoustic sensor network that porpoises are present in the area, albeit in low numbers. The decision whether or not to employ marine mammal observers during these works and apply the appropriate controls (Ref. 19.96) will be taken on the basis of further findings from this study in consultation with the relevant regulatory authorities.

vi. Artificial Lighting

19.8.19 The impacts predicted due to the presence of artificial lighting on the foreshore have been assessed as negligible and, therefore, no mitigation measures are required to minimise the impacts.

c) Operation

i. Introduction

19.8.20 The primary means of mitigating impacts on the ecology of the local coastal environment during the operation of HPC will be appropriate engineering design combined with the application of best practice in terms of the management of the plant itself.

ii. Thermal Discharges

19.8.21 As noted above, the primary means of mitigation is appropriate engineering design. In this instance, extensive oceanographic and ecological studies permitted the development and testing of a series of numerical hydrodynamic models (see **Appendix 18A to Volume 2, Chapter 18**) which, in turn, permitted the testing of a series of alternate intake and outfall configurations, shown in **Figure 19.7**.

19.8.22 By means of these tests an intake and outfall configuration was found that avoided recirculation of sea water from either the HPB or HPC outfalls, and accomplished a degree of separation of the two thermal plumes, thus limiting the compounding of any impacts on potentially sensitive areas, particularly the intertidal shores of Bridgwater Bay.

iii. Chemical Discharges

19.8.23 Although the impact of low level chlorination for the control of biological fouling within the cooling water circuits has been assessed as having a minor impact in relation to the EQS, a precautionary SL based upon provisional toxicity data suggests the need for a more conservative approach.

19.8.24 As a result, an application will be made for a permit to dose oxidant to the HPC cooling water systems but with an understanding that both the dose involved and the duration of the dosing period will be limited such in order to comply with the precautionary SL.

19.8.25 As the scope for growth of potentially fouling species such as the blue mussel *Mytilus* is already very limited, and that long-term experience at Hinkley Point suggests that the need for such dosing is infrequent, a limited dosing regime will prove operationally sufficient should the need ever arise.

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iv. Impingement of Fish and Shrimp

Regulatory Guidance

19.8.26 Environment Agency (best practice) guidance for mitigation of abstraction impacts at nuclear new build sites is given in Ref. 19.229; earlier material supporting this most recent guidance is Ref. 19. 230. This guidance is not mandatory, but adherence to it establishes common ground between the regulator and developer and helps to avoid development of unsuitable designs which might be damaging to marine/estuarine biota or might delay permitting of the project. The conservation agencies, NE and CCW, were also party to the development of the intake screening guidance and thus its application it is intended to meet their conservation objectives also.

19.8.27 For large, direct-cooled plant, the guidance recommends the following cooling water intake design features:

- Location of the cooling water intake away from fish spawning grounds.
- Maintenance of low velocities (target ≤$0.3 m.s^{-1}$) at all tidal states (see next paragraph) via low velocity side entry (LVSE) intake design.
- A cap ('velocity cap') across the top of the intake to prevent vertical intake currents, which fish find it difficult to avoid.
- Fish deterrent system fitted to the cooling water intake structure to provide avoidance cues.
- Fish Recovery and Return (FRR) system to intercept and return any fish not repelled by the intake fish deterrent system (e.g. hearing-insensitive species).

19.8.28 On the low velocity criterion, the guidance proposes a default value of $0.3 m.s^{-1}$ but allows higher values subject to a risk assessment based on fish swimming performance data provided within the guidance documents themselves. Such an assessment has been completed for HPC, as described below.

Intake Water Velocity

19.8.29 The offshore locations of the four HPC cooling water intake structures are not in the proximity of any known fish spawning grounds (Ref. 19.43). The intake design has been developed along the principles outlined in Environment Agency guidance, referenced there as the 'low-velocity side-entry' (LVSE) intake design (see **Figure 19.34**). Such a design has not previously gone beyond small-scale laboratory testing and the design developed for HPC has had to take account of factors other than fish protection, including the need for seismic qualification, harmonic stability and constructability, and hydraulic performance. Using numerical hydraulic modelling, the design adopted for HPC (see **Figure 19.34**) was tested against the LVSE concept-design and shown to offer more uniform low-velocity profiles and therefore to perform better than the LVSE reference design (Ref. 19.231).

19.8.30 The low-velocity intake design developed for HPC provides substantially lower velocities around the tidal cycle than the open-all-round cooling water intake structure of the HPA and HPB. Ref. 19.232 considered the effect of tidal stream velocities adding to pumped intake velocities at this type of offshore intake and showed that at Sizewell A, fish impingement peaked at maximum flood and ebb tidal velocities. At Hinkley Point, tidal stream velocities reach at least 1.5m.s^{-1}, and velocities for fish escape may exceed this value with the pumping effect added. An analysis of the effect of intake velocity differences between the proposed HPC low-velocity design and the HPB 'baseline' case on the ability of different species of fish to escape showed that, for the same 1.5m.s^{-1} tidal velocity, the EA LVSE reference design would result in velocities that would allow a further 16.1% of the fish impinged to escape (i.e. could reduce the impingement by 16.1%), while the HPC design would increase this reduction of impingement to a value of 52.2% (**Table 19.34**). These figures are given per unit of cooling water flow.

Table 19.34: Analysis of the HPB Impingement Catch showing % of Fish that would Remain Vulnerable to Capture with the Reduced Intake Velocities Modelled for the EA's LVSE Design and the Proposed HPC Intake Design

Intake Design	Tidal Velocity m.s^{-1}	% of Hinkley 'HPB' Fish below Escape Velocity						
		Shad	Sea bass	Sole	Whiting	Herring	Cod	All Six Species
HPC	1.5	41.8	27.8	38.5	50.9	30.6	49.8	47.8
EA LVSE Reference Design	1.5	79.5	54.2	77.9	85.8	79.6	85.0	83.9

Note: *Values were calculated using published swimming performance data and modelled velocities (Ref.19.231). Figures for 'All Six Species' are weighted according to annual catches at HPB.*

Acoustic Fish Deterrence

19.8.31 Acoustic fish deterrents (AFDs) will be fitted either to or near each of the four intake heads as the primary mitigation against fish entrapment. Environment Agency guidance (Ref. 19.229) advocates the fitting of AFDs at such cooling water intake structures to repel hearing-sensitive fish. These include pelagic species such as herring, sprat and shads, and moderately hearing-sensitive demersal fish such as cod and whiting. Epibenthic species, including flatfish, eels and lampreys are less sensitive and little influenced by AFDs, so the main mitigation against capturing these species will be through an onshore FRR system (see below).

19.8.32 The AFD system at HPC will be of the sound-projector-array (SPA) type (Ref. 19.230). The number and positioning of sound projectors will be determined by acoustic modelling using PrISM™ software, as per Environment Agency guidance (Ref. 19.230). This will also ensure that the soundfield will be confined to the immediate area of the intake head, avoiding the risk of any acoustic disturbance in the wider estuarine environment.

19.8.33 AFD underwater sound frequencies will be in the 20-500Hz hearing-sensitive range of most fish (Refs. 19.233, 19.234 and 19.235). Clusters of sound projectors may be deployed on vertical rails or piles, allowing them to be raised above water level periodically for replacement and servicing. Additional sound projectors would be installed to provide a level of redundancy which will allow for any sound projector failures between service events. The condition and sound output status of the AFD

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system would be continuously monitored and logged remotely via an offshore telemetry link.

19.8.34 Performance data for AFDs are summarised by Ref. 19.230 and include data for estuarine and coastal power stations. AFD efficiency values taken from this source are shown in **Table 19.34** for key fish species found at Hinkley Point. Figures range from 0.95 (95%) for sensitive clupeids to 0.16 (16%) for insensitive flatfish. In all cases, these efficiency values were obtained from trials at power stations such as Hartlepool and Doel (Belgium) that do not benefit from having low-velocity intake designs, so improvements would be expected where lower velocities allow more fish to escape.

19.8.35 In practice the design and establishment of a system such as an offshore AFD deployment is a complex procedure involving a degree of uncertainty, requiring appropriate management. Both the necessary design tools (the underwater acoustic modelling capability coupled to a detailed understanding of fish behaviour) and the technology (the sound projectors) are readily available. A technical working group has been established within EDF in order to evolve the initial conceptual design towards the final installation and the outputs from this group will be discussed with the regulators involved as that effort progresses.

19.8.36 Any such system will require commissioning, and experience to date suggests that this commissioning process allied with appropriately designed trials is a key step to securing the required standard of performance

Fish Recovery and Return System

19.8.37 Drum screens within the onshore cooling water pumphouse area are designed primarily to exclude debris that might clog the steam condensers within the turbine hall. The drum screen system selected for HPC is suitable for FRR and will follow or improve upon the detailed Environment Agency guidance on FRR system design. In particular, it will include the following features:

- smooth-finish 5mm drum screen mesh;
- fish bucket design suitable for retention of eel, lamprey and other fish and crustacean species;
- continuous screen rotation at an elevation rate at least 1.5m per minute;
- low- (<1 bar) followed by high-pressure (usually >3 bar) backwash sprays;
- hopper geometry to minimise the risk of fish recycling within the screenwell; and
- smooth-finish troughs with horizontal and vertical bend radius ≥3m.

19.8.38 After considering various options, including a variety of cross-shore routes and return via the main cooling water outfall tunnel, the chosen route for fish return to the subtidal estuary will be via a dedicated bored tunnel driven from landward, under the seawall and intertidal shore, to a specific point on the tidally scoured rock exposure below LAT but above the subtidal muddy plain. In selecting this position there has been a need to balance a series of requirements, not least that the relatively small outfall structure does not become clogged due to progressive siltation with relative sea level rise over the design life of HPC.

19.8.39 A number of additional factors have been taken into account (Ref. 19.236) including:

- the need for an exit point that will permit a discharge line and outfall design that will not entrain solids from seaward, or block over periods of outage;
- the need for a location that will be sustainable over the life of the site, given trends in relative sea level and possible landward encroachment of the subtidal muddy plain;
- the length of the discharge tunnel;
- the risk of re-impingement of discharged fish by the HPB intake;
- avoidance of the HPB thermal plume; and
- potential predation by sea birds, fish or marine mammals.

19.8.40 The fish return tunnel will discharge continuously at a point approximately 550m offshore, some 150m beyond and 1m below the LAT mark, as shown on **Figure 19.37**.

19.8.41 Ref. 19.236 estimates <1% risk of fish re-entering a cooling water intake on a single ebb-flood tide. A relatively short simulation was used as it was considered that animals which survived any longer will have responded and will start to exhibit their own behaviour; animals not exhibiting near normal behaviour within this time are likely to have been predated.

19.8.42 Ref. 19.236 also considered the effect on migratory fish that are drawn in from an intake point 3km offshore and discharged further inshore, showing that fish discharged from the release point quickly re-disperse offshore.

19.8.43 Ref. 19.230 gives typical survival rates for FRR systems ranging from <10% for delicate pelagic species such as herring, sprat and smelt, to between 50 and 80% for demersal species such as cod, whiting and gurnards and >80% for epibenthic fish such as flatfish, gobies, rocklings and crustacean. Lampreys and eels would also fit into this last category, whereas shads would fall into the pelagic group. The values given assume that screens are fitted with FRR fish buckets, low-pressure fish backwash sprays in advance of the high pressure backwash units and are rotated continuously, in line with EA guidance. These values are incorporated within **Table 19.35** below.

19.8.44 Ref. 19.230 advises against addition of biocides upstream of the fish return point or in the fish return water supply, to preclude the potential toxicity risk. Otherwise, where biocides need to be used for operational reasons, a toxicity risk assessment would need to be carried out to ensure that the fish being returned will not be subjected to acute or sublethal toxic risk. It is not envisaged that biocides will be used routinely at HPC but should the need arise, their use will be managed in order to prevent toxic impact within the FRR itself.

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19.8.45 In addition to the main cooling water system drum screens, band-screens will be also be installed in the cooling water pumping station to screen the auxiliary cooling supply. Although these band screens will put materials to the FRR, the likelihood is that the condition of any returned fish or shrimp by that route will not be as high as via the drum screens. Against a total volume flow of approximately $125m^3.sec^{-1}$, these band screens would be responsible for screening no more than $12m^3.sec^{-1}$.

Combined Effect of Intake Mitigation Measures

19.8.46 **Table 19.35** lists the factors used in calculating mitigation performance. Where mitigation factors are not given in Environment Agency guidance, they have been taken from other referenced studies, or values from the nearest similar species (e.g. blue whiting based on whiting, plaice based on flounder values). In the case of FRR mitigation factors, survival rates given in Environment Agency guidance as "<10%" or ">90%" have been allocated mitigation factors of zero and 90% respectively; where, for demersal fish, these have been given a range of survival values of between 50 and 80%, a mitigation factor of 0.5-0.8 has been used. The HPC low velocity side entry intake (LVSE) mitigation factors are taken from Ref. 19.43.

Table 19.35: Assumed Proportional Effects of Intake System Mitigations (Mitigation Factors)

Species	AFD Efficiency F_{AFD}	Catch Reduction with Low Velocity Side Entry (LVSE) Intake F_{LVI}	Survival through FRR F_{FRR}
Sprat (largest numbers)	0.88	0.34	0.00
Whiting (BAP)	0.55	0.49	0.50 -0.80
Sole (BAP)	0.16	0.36	0.80
Cod (BAP)	0.55	0.51	0.50 -0.80
Herring (BAP)	0.95	0.34	0.00
Plaice* (BAP)	0.16	0.76	0.80
Blue whiting* (BAP)	0.55	0.49	0.50 -0.80
Eel (Eel management plan)	0.16	1	0.80
Twaite shad* (SAC designated)	0.88	0.383	0.00
Allis shad* (SAC designated)	0.88	0.383	0.00
Sea lamprey* (SAC designated)	0.06	1	0.80
River lamprey** (SAC designated)	0.06	1	0.80
Salmon (SAC designated)	n/a	n/a	n/a
Crangon	0.00	1	0.80

19.8.47 The order in which the mitigation factors are applied is important. The AFD is the first mitigation experienced by approaching fish (crustaceans are assumed not to be sensitive to the AFD) and this factor is therefore applied first. The effect of reduced velocity is then applied to reduce the number of fish entering the intake. Finally, the mitigation factor for survival rate in the FRR system is applied to give an overall estimate of losses associated with cooling water abstraction.

19.8.48 The AFD and FRR mitigation factors described in **Table 19.34** have been incorporated in the assessments that follow and, in aggregate, describe the minimum performance standard that the operator would expect to meet through implementation of these measures at HPC.

19.9 Residual Impacts

a) Introduction

19.9.1 Following implementation of the proposed mitigation and management measures, impacts have been re-assessed, where appropriate, to determine the residual impact. These are outlined below for each of the described impacts.

b) Construction

i. Habitat Loss and Change

19.9.2 Following implementation of the proposed mitigation measures above, the impacts of physical construction in terms of habitat loss will be reduced to a very low magnitude, with a **minor adverse** residual impact remaining where sensitivity (most obviously in terms of the *Corallina* swards) is high.

ii. Physical Disturbance

19.9.3 The impacts associated with physical disturbance to marine ecology, following the implementation of mitigation measures, will be constrained to **minor adverse** significance.

iii. Changes in Water Quality

19.9.4 Following mitigation measures outlined above, the residual impacts of construction and commissioning discharges on local marine ecological interests will be constrained to a **minor adverse** level of significance, with a low magnitude and extent affecting only habitats of low sensitivity,

iv. Noise

19.9.5 The residual impact of underwater noise on sensitive receptors during construction, following the implementation of mitigation measures, will be constrained to one of **minor adverse** significance.

v. Artificial Lighting

19.9.6 **No impacts** to marine ecology were identified during construction from artificial lighting and, therefore, the residual impact is unchanged.

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c) Operation

i. Chemical Discharges

19.9.7 On the basis that appropriate limits may be set on any application of a dosing regime, by constraining the magnitude of the impact to low whilst retaining the understanding of medium sensitivity, the residual significance of the impact concerned will reduce from moderate to **minor adverse**.

ii. Impingement of Fish and Shrimp

19.9.8 **Table 19.36** summarises estimates of fish and crustacean losses attributable to HPB and HPC cooling water abstraction for the key commercial and conservation species and for shrimps. Predicted entrainment rates (**Table 19.33**) are considered to be too small in relation to Bristol Channel stocks to merit further consideration.

19.9.9 The great majority of fish caught at Hinkley Point are juveniles. This assessment thus depends upon a calculation of Adult Equivalent Value (EAV) based upon known fisheries-related or conservation-related estimates of population and age structure in order to scale the level of impact involved.

Table 19.36: Predicted Total Annual Impingement (numbers of fish, EAV) at HPC and HPB for Selected Species assuming an Abstraction Rate of 125m^3.s^{-1} via Current Intake Structures and via Low-Velocity Side Entry (LVSE) Intake Structures with AFD and with a FRR System (data from Ref. 19.43)

Species: Common Name	HPC, Current (HPB) Intake Design	HPB	HPC with Low-Velocity Intake and AFD (increase from current HPB)		HPC with Low-Velocity Intake and AFD and FRR (increase from current HPB)	
Sprat (largest numbers)	3,380,850	936,386	405,702	-(57%)	405,702	-(57%)
Whiting (BAP)	288,078	79,253	129,635	(64%)	64,818	-(18%)
Sole (BAP)	32,429	8,599	27,241	(218%)	5,448	-(36%)
Cod (BAP)*	32,063	8,733	14,428	(65%)	7,214	-(17%)
Herring (BAP)	44,792	12,570	2,240	-(82%)	2,240	-(82%)
Plaice (BAP)	493	129	414	(221%)	83	-(36%)
Blue whiting (BAP)	160	46	72	(55%)	36	-(22%)
Eel (Eel management plan)	1,304	351	1,304	(272%)	261	-(26%)
Twaite shad (SAC designated)	2,276	646	273	-(58%)	273	-(58%)
Allis shad (SAC designated)	68	22	8	-(63%)	8	-(63%)
Sea lamprey (SAC designated)	207	42	207	(398%)	41	(0%)
River lamprey (SAC designated)	82	18	82	(355%)	16	-(9%)
Salmon (SAC designated)	0	0	0	(0%)	0	(0%)

Species: Common Name	HPC, Current (HPB) Intake Design	HPB	HPC with Low-Velocity Intake and AFD (increase from current HPB)		HPC with Low-Velocity Intake and AFD and FRR (increase from current HPB)	
Sea trout (SAC designated)	0	0	0	(0%)	0	(0%)
Brown shrimp (*Crangon crangon* – the main crustacean impinged	19,135,756	4,911,592	19,135,756	(290%)	3,827,151	-(22%)

* *Cod assessment has subsequently been reappraised to account for bias caused by an exceptional spike in recruitment during the period of sampling upon which this original assessment was based, in 2009; the ratio of annual catches 2008:2009 was 5.8% and that for the mean of 2004-2008:2009 was 7.3% (Ref. 19.260).*

Sprat

19.9.10 With the AFD and LVSE intake design, the numbers of adult sprat impinged annually at HPC could be reduced to approximately 3.16t, which is about 17 times the local fishery. Sprat are delicate bodied species and as a result the FRR system is unlikely to reduce impingement mortality. With mitigation, the residual impact of cooling water abstraction on sprat populations is considered to be **minor adverse**.

Whiting

19.9.11 With the Acoustic Fish Deterrence (AFD) and low velocity side entry (LVSE) intake design, the reduction in annual impingement numbers of whiting is reduced to approximately 23t and 1.4% of the local standing stock biomass (SSB). The Fish Recovery and Return (FRR) system is expected to reduce mortality of this species by 50% and as a result the post- -mitigation residual impact is considered to be **minor adverse**.

Sole

19.9.12 The mitigation measures discussed above are likely to reduce annual impingement numbers to 6.24t, as a demersal species the FRR system could reduce impingement by about 96% (Ref. 19.241), but using a more conservative figure of 80% the residual impact would be reduced to **minor adverse**.

Cod

19.9.13 Under the current assessment, based on CIMP data in 2009-10, AFD and the LVSE intake design could reduce impingement numbers of this species to approximately 63.1t which is about 6.48% of the local SSB. As a demersal species the FRR could reduce impingement mortality by about 94% (Ref. 19.241). However, the cod assessment has recently been reappraised to account for bias caused by an exceptional spike in recruitment during that particular period of sampling. The ratio of annual catches at HPB over 2008:2009 was 5.8% and that for the mean of 2004-2008:2009 was 7.3% (Ref. 19.260). Thus, on a worst case basis, the HPC catch prior to mitigation would be 0.24% of the local SSB. As a result, with mitigation, the magnitude of impact is estimated as very low. In combination with a receptor value/sensitivity of moderate this suggests an impact of **minor adverse** significance.

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Herring

19.9.14 The AFD and low velocity intake is likely to reduce impingement mortality of herring by approximately 0.24t equating to about 0.24% of the local fishery, the FRR is unlikely to bring any benefit to this delicate bodied species. Taking into the consideration the AFD and LVSE mitigation measures the residual impact on this species post-mitigation is considered to be **minor adverse**.

Plaice

19.9.15 Equivalent adult numbers of plaice impinged annually at HPC could be reduced to around 00.19t with the use of AFDs and the low velocity intake, with the FRR impingement mortality could be reduced by a further 80%, the residual impact on this species is therefore considered to be **minor adverse**.

Blue whiting

19.9.16 With the AFD, the EAV of blue whiting is reduced to 72 fish equating to <0.1% of the blue whiting fishery. Due to a lack of information on the swimming speed of this species it is not possible to assess the impact of the low velocity intake. Assuming the effectiveness of the FRR is similar to whiting, a very similar species, the FRR could reduce impingement mortality by up to 50%, meaning the post-mitigation residual impact is assessed to be **minor adverse**.

Eel

19.9.17 Eels are unlikely to benefit from the low velocity intake, however they are considered to be a robust fish and the FRR could reduce impingement mortality by up to 100%. Assuming a more conservative estimate of 80%, the residual impact on this species post-mitigation is **minor adverse**.

Shad

19.9.18 The AFD and LVSE intake design impingement mortality of twaite shad could be reduced to approximately 273 fish, about 0.15% of the local estimated population. As a delicate bodied species similar to herring and sprat, the FRR is unlikely to reduce impingement mortality further and the post-mitigation residual impact is expected to be **minor adverse**.

Lamprey

19.9.19 Lamprey are unlikely to benefit from the AFDs and low velocity intake design, however they are considered to be a robust fish and a suitable FRR could reduce impingement mortality by up to 100%. Assuming a more conservative estimate of 80%, the residual impact on lamprey post-mitigation is considered to be **minor adverse**.

Shrimp Populations

19.9.20 Impingement rates of C. crangon at HPB are very high. It is known that *C. crangon* feed on the intertidal mudflats at high tide. As the tide recedes they migrate to the shallow subtidal and are found in a concentrated band in the shallow subtidal

(Ref. 19.102). Thus, the natural behaviour of *C. crangon* is likely to concentrate it in the vicinity of the intake structure at certain times. Other intertidal mudflat will be found much further away from the intake. The HPC intake structures are also being constructed further offshore than those at HPB. Overall the magnitude of the impact has been assessed as medium.

19.9.21 Even though *C. crangon* cannot actively avoid entrainment and impingement, the literature suggests that the larvae will have high survival rates following entrainment. (Ref. 19.240). Impingement rates of *C. crangon* are predicted to be reduced with the use of FRR.

19.9.22 Such species are both highly fecund and mobile so recolonisation rates following disturbance are typically rapid. Recent data suggests that numbers observed via SEDS at HPB have been increasing which suggests the current abstraction activities are not affecting the mudflat communities (Ref. 19.102). These understandings suggest a high degree of resilience. Sensitivity is thus considered to be very low.

19.9.23 With low sensitivity and medium magnitude of impact, a **minor adverse** impact is predicted.

Fish Assemblage

19.9.24 The proposed HPC has been specified with low velocity side-entry (LVSE) intake structures and a Fish Recovery and Return system. If these proposed impingement mitigation measures function as designed, the impingement losses at HPC are calculated to be similar to those of the existing HPB.

19.9.25 The resulting HPC impingement losses will have a negligible effect on the spawning stock of the protected migratory species that use the Severn Estuary and have been captured on the intake screens of HPB (European eel, sea lamprey and twaite shad). The catches of Allis shad and salmon on the HPB intake screens are too small to allow a reliable impingement loss to be calculated.

19.9.26 The impact on the commercially important fish species that represent the majority of the existing impingement losses (sprat, whiting, sole, plaice, herring and blue whiting) is considered to be negligible. For whiting, sole, plaice and blue whiting the impingement losses will have a negligible effect on the spawning stock. Sprat is the dominant (>97%) clupeiform fish impinged at HPB and the population trend for this group since 1981 has remained stable. As HPC (with mitigation) will only impinge 28% more that the current HPB, the conclusion is that HPC (with mitigation) is unlikely to have any significant impact on local sprat population.

19.9.27 For herring the impingement losses are less than 2% of the local fishery and will therefore have negligible impact on the local population.

19.9.28 The impact on cod will represent 0.24% of the local SSB (Ref. 19.260). This level of loss is equivalent to 0.06% of the Total Allowable Catch of cod recommended by ICES for 2011 for Divisions VIIe-k (3,420t) and is unlikely to have any detectable effect on the local cod population when considered against the background natural variability in SSB. The predicted losses of cod from a mitigated HPC are 12%

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greater than those currently caused by HPB. HPB has had no measurable effect on the local abundance trend for cod since 1981.

19.9.29 The predicted impingement losses on crustaceans (as represented by the impact on the brown shrimp *C. crangon* the main crustacean impinged) are also expected to be similar to those of HPB.

19.9.30 On the basis that impacts on all species examined above are predicted to be minor, and that these species provide a reasonable cross section of the local fish assemblage as a whole, the residual impact on the fish assemblage as a whole as a result of HPC operations is also assessed as **minor adverse**.

iii. Entrainment

19.9.31 Predicted entrainment rates (**Table 19.31**) are considered to be too small in relation to Bristol Channel stocks to merit further consideration. The residual impact following the implemented of mitigation is assessed as **minor adverse**.

19.10 Proposed Monitoring Measures

a) Introduction

19.10.1 Monitoring will be undertaken to inform the need for adjustment to the mitigation measures applied and check the continuing validity of assumptions.

19.10.2 The listing below is indicative; detailed surveillance and allied contingency protocols will be subject to further development.

b) Technical Review Procedure

19.10.3 In consultation with the relevant regulatory bodies EDF Energy will establish and maintain a technical working group to:

- maintain active stewardship of the objectives involved in the monitoring described both above and described in **Volume 2**, **Chapters 18** and **19**;
- advise upon the appropriate level of detail of these efforts, and
- review outcomes, advising on any necessary consequent action.

19.10.4 The technical working group will be made up of a number of recognised technical specialists, an independent chairman, and be supported by a secretariat, all operating under agreed Terms of Reference. An interface with regulatory technical nominees will be maintained throughout and their active involvement as observers of the technical review process encouraged.

19.10.5 The group will report to EDF Energy. It is envisaged that this technical review procedure will continue to operate throughout the period of HPC construction and into the early years of generation.

c) Construction

i. Corallina run-offs

19.10.6 Considerable care will be required in order not to compromise the cross-shore rock platform physics of the habitat upon which the *Corallina* run-offs depend. Thus, as stated within **Volume 2 Chapter 17**, to guard against untoward effects on the longshore drainage regime and the sensitive habitats associated with these, monitoring will assess both the establishment of the remedial measures involved and the longer term consequence of these activities.

ii. Cetaceans and Noise

19.10.7 Although the numbers would appear to be low, especially close to the site itself, recent evidence from acoustic monitoring in the Hinkley Point area contradicts previous assumptions that small cetacea do not frequent the area.

19.10.8 Acoustic monitoring will thus be continued both to secure the local baseline and, subsequently, to test for the relative presence or absence of small cetacea over the periods of construction when significant noise disturbance (from percussive piling) is likely. The acoustic array will not be maintained beyond the construction period.

19.10.9 Expert advice will be obtained on whether or not, with the acoustic monitoring network already in place, and data on seasonal and spatial distribution available, any further measures will be necessary to manage these works through active surveillance of cetacean presence, as implied by current guidance (Ref. 19.155).

iii. Discharge to Intertidal Area

19.10.10 All construction and some commissioning discharges will be put to a single cross-shore discharge. Although hydraulic modelling has shown that this combined discharge will be constrained both in terms of route and width and that the impacts are predicted to be minor, these understandings will be confirmed through periodic monitoring of the intertidal area involved.

iv. Scour

19.10.11 A limited degree of seabed scour will be associated with the offshore components of the temporary aggregate jetty, the cooling water intake structures, the cooling water outfall structures, and the discharges arising from these latter structures. Likewise, there is the possibility of linear bathymetric features developing in association with the jetty berthing pocket.

19.10.12 The aerial extent of scour associated with these structures and features will be monitored by sidescan and swathe sonar survey following station commissioning, and the need to revisit this effort reviewed on the basis of initial findings. Associated ground truthing (grab sampling) will permit mapping of the resultant habitat and biotope distributions in the immediate vicinity will be appropriate.

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d) Operation

i. Numerical Modelling

19.10.13 There has inevitably been is a very considerable dependency, within the assessment developed both in this Chapter and **Volume 2**, **Chapter 18**, upon the outputs of numerical hydrodynamic models.

19.10.14 Whilst the primary hydrodynamic models have been subject to considerable challenge over the course of their development, and as a fully validated and calibrated ensemble represent current best practice in terms of constraining uncertainty, they are nonetheless estimates of reality rather than observations.

19.10.15 As a result, and in accord with Environment Agency guidance for NNB (Ref. 19.68), it will be appropriate to conduct field investigations in two circumstances: when a single EPR unit is fully operational and once both units are operating together. The standard for such investigations is set by Ref. 19.20 and 19.68. This monitoring will capture the behaviour of the thermal plumes under known tidal and meteorological conditions, allowing comparison of the results with previous estimates. Additional model runs may prove necessary in order to replicate the field conditions found at the time.

19.10.16 There will be a need to gather a sufficient body of empirical data on these operations before it becomes possible to validate certain of these models. Until that point only observational data will be available.

19.10.17 **Appendix 18A** to **Chapter 18** describes the development of the existing numerical hydrodynamic models and the extent of compliance with current Environment Agency guidance appropriate to considerations of New Nuclear Build in the UK (Ref. 19.68), That guidance also requires that the models will continue to be 'available for use over the period of at least 10 years from the date of commissioning of the power station, and beyond that for as long as there is (are) no suitable alternative)s) available'.

ii. Efficacy of Fish Protection Measures

Acoustic Fish Deterrence (AFD)

19.10.18 Precautionary estimates have been used is assessing the mitigaiton benefit of the acoustic fish deterrent (AFD) systems that will be deployed around the HPC cooling water intakes.

19.10.19 There will be a need to prove that the minimum performance standard, based upon these estimates, has been met early in the operational life of the station. Thus, trials defined by current guidance on best practice (Ref. 19.19) will be carried out at that time and any adjustments made to the AFD systems and the trials then extended system should this prove necessary.

19.10.20 Such trials would carried out over a period of weeks or a few months and involve the enumeration and identification of fish impinged on the CW screens. Over this period the AFD systems would be switched on and off on alternate days. The trials would cease only once specific statistical criteria on the difference between 'AFD on' and 'AFD off' days, for a range of species, have been met.

19.10.21 The nature of the AFD deployment, as a series of active instrument packages requiring routine maintenance, means that instrumented monitoring of the performance of this equipment would be needed for the life of the plant, coupled with a routine maintenance cycle. Once initial proving trials have been secured, this requirement would be limited to confirming the appropriate underwater sound field is being maintained via telemetry from the offshore instrument packages themselves. If any unexpected deterioration is observed that might hazard the minimum performance standard, this would bring forward the maintenance cycle on the AFD system involved.

Low Velocity Side Entry (LVSE) Intake Design and Position

19.10.22 The HPC intake design is novel, although with a strong basis of understanding from both previous trials, numerical modelling studies, and expert advice. The intakes are also, following advice on best practice for fish protection (Refs. 19.229 and 19.230), located well offshore.

19.10.23 In practice, given the fixed nature of the installations, it will not be possible to discriminate the actual benefits of the HPC LVSE intake design from any benefit of offshore location, but the sum of that benefit may become apparent through maintaining fish impingement monitoring of the HPB drum screens over the period of the AFD trials described above, both on 'AFD on' and 'AFD of' days, either for their full duration or until specific statistical criteria are met.

Fish Recovery and Return (FRR) Efficacy

19.10.24 As with the AFD, a precautionary estimate of system efficacy has been incorporated in the assessments mentioned earlier in this chapter.

19.10.25 There will be a need to prove that the minimum performance standard, based upon these estimates, has been met early in the operational life of the station. Thus trials defined by current guidance on best practice (Ref. 19.19) and based on previous experience (Ref. 19.207 and 19.241) will be carried out at that time and any adjustments then made to the system in order to secure that standard, should this prove necessary.

iii. Fish Monitoring Programme

19.10.26 A fish impingement/entrainment programme will be developed and implemented, using best practice developed through BEEMS and elsewhere. This will include tests of the AFD system, such as those described above, to define the benefits of both the AFD system itself and the LVSE intake design and location against the HPB base, should HPB still be operating. This will inform enhanced operation of the AFD and FRR systems as necessary as well as informing sustainable decision making at other sites.

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19.10.27 The comprehensive impingement monitoring programme (CIMP), utilised to estimate likely impingement catches of HPC for this ES, will be re-established for a single annual period at HPC in order to confirm these previous estimates.

iv. Chlorination

19.10.28 The primary means of constraining the operational need to control biological fouling through oxidant dosing is via continuing surveillance both of local intertidal shores and for the presence of epifaunal growth within the cooling water circuits themselves.

19.10.29 Such surveillance is currently maintained by HPB and elements of this, adapted as appropriate given the difference in plant design (primarily the offshore position and low flow nature of the HPC intake design), will be adopted by the HPC operator.

v. Trends and Variance in Local Populations

19.10.30 There will be an advantage both to the operator and others in furthering medium to long-term so as to maintain an understanding of key populations.

Invertebrate Populations on Stert Flats

19.10.31 The existing baseline of seasonal studies of *Macoma* and other key invertebrate species on Stert Flats will be extended in order to elaborate on the existing understanding of within-year and between-years variance. After an initial three year period a reduced sampling strategy will be implemented in order to track longer term trends in these populations.

vi. Severn Estuary Data Set (SEDS)

19.10.32 By the end of 2011 there will be a time series of fish impingement data based upon 31 years of continuous monthly sampling at Hinkley Point.

19.10.33 This database was instigated within the CEGB with an understanding that only with the establishment of at least one such long-term database in the UK would the scientific community and plant operators be able to describe the baseline of longer term change against which developments such as HPC might best be understood.

19.10.34 Although the use of fish protection measures at HPC, which in combination will reduce the catch per unit volume to one a third of that experienced at HPB, will mean that a like for like continuation of this exercise on the new station will not strictly be possible, there will be considerable value in continuing such sampling for the longer term. The implementation of the CIMP programme described above will, should the two stations operate in parallel, will provide a means of calibration between the different station catch rates.

19.11 Summary of Impacts

a) Introduction

19.11.1 Impacts have been assessed after taking into consideration aspects of project design and management and generic mitigation measures which would be required as part of the development. Following this approach the vast majority of impacts have been predicted to be of negligible to minor significance, although some are considered to be of moderate significance before mitigation. In these instances specific mitigation has been identified, as discussed in the previous sections of this Chapter. The predicted residual effects as they stand are presented in **Table 19.37** and **Table 19.38** below.

b) Construction

19.11.2 A summary of the potential impacts on marine ecology associated with the construction of HPC, setting out impacts prior to mitigation, the mitigation proposed, and the subsequent residual impacts is presented in **Table 19.37**.

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Table 19.37: Assessed Impacts of Significance during the Construction Phase

Sensitivity	Significance Pre-mitigation	Reason	Mitigation	Residual Significance
Habitat Loss and Change				
Intertidal habitats: general	Minor	Jetty construction and removal	Best practice in managing works on the shore	Minor
Corallina biotope	Minor	Jetty construction and removal	Best practice in managing works on the shore	Minor
Intertidal habitats	No Impact	Seawall construction	Best practice in managing works on the shore	No Impact
Subtidal habitats	Negligible	Vertical cooling water shaft construction	Best practice in managing works offshore	Negligible
Subtidal fauna	Negligible	Vertical cooling water shaft construction	Best practice in managing works offshore	Negligible
Sabellaria reef	No Impact	Vertical cooling water shaft construction	Best practice in managing works offshore	No Impact
Subtidal habitats	Minor	Capital and maintenance dredging	Best practice in managing works offshore	Minor
Physical Disturbance				
Intertidal habitats	Minor	Jetty construction and removal	Best practice in managing works on the shore	Minor
Intertidal habitats	Minor	Sea wall construction	Restricted working corridor; best practice in managing works on the shore	Minor
Intertidal habitats	Moderate	Barge delivery of rock armour to shore	Restricted landing area	Minor
Sabellaria reef	No impact	Jetty construction and removal	Jetty alignment is remote from reef areas	No impact
Corallina biotope	Minor	Due to pile driving activity and plant movement on the intertidal	Best practice in managing works on the shore (constrained corridor, avoidance of compaction of surface) coupled with restoration of microtopography	Minor

Sensitivity	Significance Pre-mitigation	Reason	Mitigation	Residual Significance
Subtidal habitats	Negligible	Scour allied with jetty piers	Impacts are highly localised with very limited ecological consequence	Negligible
Intertidal habitats	Minor	Introduction of waste materials and particulates from seawall construction	Best practice in managing works on the shore	Minor
Seawall: *Corallina* biotope	No impact	Introduction of waste materials and particulates from seawall construction	Best practice in managing works on the shore; seawall is remote from Corallina run-off areas	No impact
Subtidal habitats	Negligible	Vertical cooling water shaft construction	Best practice in managing works offshore	Negligible
Subtidal habitats – suspended sediments	Negligible	Vertical cooling water shaft construction	Best practice in managing works offshore	Negligible
Subtidal habitats	Minor	Capital and maintenance dredging	Best practice in managing works offshore	Minor
Changes in Water Quality				
Subtidal habitats	Negligible	Capital and maintenance dredging	Best practice in managing works offshore	Negligible
Corallina biotope	Negligible	Capital and maintenance dredging	Isolated due to tidal regime	Negligible
Sabellaria reef	Negligible	Capital and maintenance dredging	Best practice in managing works offshore	Minor
Subtidal habitats	Negligible	Vertical cooling water shaft construction	Best practice in managing works offshore	Negligible
Corallina biotope	Minor	Construction site discharges: composition	Appropriate discharge location selected on basis of intertidal biotope distributions; additional mitigation by effluent treatment	Minor
Sabellaria reef	Minor	Construction site discharges: composition	As above	Minor

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Sensitivity	Significance Pre-mitigation	Reason	Mitigation	Residual Significance
Intertidal habitats	Minor	Construction site discharges: composition	As above	Minor
Intertidal due to sedimentation	Minor	Construction site discharges: scour	Appropriate discharge location selected on basis of intertidal biotope distributions; additional mitigation by effluent treatment	Minor
Intertidal due to salinity changes	Minor	Construction site discharges: variable salinity	As above	Minor
Fish	Minor	Construction site discharges: suspended solids	Best practice in managing works on the shore	Minor
Corallina biotope	Minor	Seawall construction	Best practice in managing works on the shore	Minor
Sabellaria reef	No impact	Seawall construction	Best practice in managing works on the shore	No impact
Fish	No impact	Seawall construction	Best practice in managing works on the shore	No impact
Noise and Vibration				
Fish: hearing generalist minus swim bladder (lampreys, dab, sole, plaice)	Negligible	Percussive pile driving generating underwater noise which can cause avoidance reactions or physical injury to fish	Use of 'soft start' approach to piling	Negligible
Fish: hearing generalist minus swim bladder (lampreys, dab, sole, plaice)	Negligible	Noise and vibration associated with dredging	Best practice in managing works offshore	Negligible
Fish: hearing generalist minus swim bladder (lampreys, dab, sole, plaice)	Minor	Noise and vibration associated with construction of horizontal tunnels	Best practice in managing works offshore	Minor
Fish: hearing generalist plus swim bladder (salmon, sea trout, eel, cod,	Minor	Percussive pile driving generating underwater noise which can cause avoidance reactions	Use of 'soft start' approach to piling	Minor

Sensitivity	Significance Pre-mitigation	Reason	Mitigation	Residual Significance
whiting)		or physical injury to fish		
Fish – hearing specialists (shads, sturgeon, herring, sprat)	Moderate	As above	Use of 'soft start' approach to piling	Minor
Marine mammals	Minor	As above	As above	Minor
Artificial Lighting				
Intertidal habitats	No impact	Lighting on aggregate jetty during construction and/or operation	N/A	No impact
Water column	Negligible	As above, plus offshore construction works for the placement of cooling water headworks	N/A	Negligible

c) Operation

19.11.3 A summary of the potential impacts on marine ecology associated with the operation of HPC, setting out impacts prior to mitigation, the mitigation proposed, and the subsequent residual impacts is presented in **Table 19.38**.

Table 19.38: Assessed Impacts of Significance during the Operational Phase

	Significance Pre-mitigation	Reason	Mitigation	Residual Significance
Thermal Discharges				
Non-migratory fish	Minor	Thermal regime change	Majority are tolerant to temperature variations	Minor
Migratory fish	Minor	Thermal regime change plus thermal occlusion of migratory pathways	Selected intake/outfall configuration	Minor
Benthic habitats: *Corallina* biotope and *Sabellaria* reef	No impact	Intersection of thermal plume with intertidal and shallow subtidal areas	As above	No impact
Benthic habitats: *Macoma balthica*	Minor	As above	As above	Minor

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	Significance Pre-mitigation	Reason	Mitigation	Residual Significance
Benthic habitats: ecological functioning on Stert Flats	Minor	As above	As above	Minor
Benthic habitats: subtidal	Minor	Intersection of plume with subtidal areas	As above	Minor
Microphytobenthos	No impact	Intersection of thermal plume with intertidal areas	As above	No impact
Crangon crangon population	Negligible	Thermal plume	As above	Negligible
Adequacy of intertidal invertebrate prey resource to avifauna	Minor	Intersection of thermal plume with intertidal areas	As above	Minor
Chemical Discharges				
Intertidal habitats: *Corallina* biotope and *Sabellaria* reef	Moderate	Commissioning waste streams via cross-shore discharge	Appropriate positioning of discharge location. Effluent sentencing and pre-treatment	Minor
Subtidal habitats	Minor	Commissioning waste streams via cooling water system outfall	Effluent sentencing and pre-treatment	Negligible
Chlorine EQS (acute)	Minor	Operational discharge of residual biocide	Selected intake/outfall configuration	Minor
Site specific Screening Level (chronic)	Moderate	Operational discharge of residual biocide	Selected intake/outfall configuration. Constrained dosing regime	Minor
Chlorination by-products	Minor	Operational discharge of residual biocide	Selected intake/outfall configuration. Constrained dosing regime	Minor
Subtidal habitats and water column immediately around outfall headworks	Minor	Operational discharge of hydrazine	Hydrazine discharges will be constrained	Minor
Subtidal habitats and water column immediately around outfall headworks	Negligible	Operational discharge of morpholine	Low toxicity	Negligible
Subtidal habitats and water column immediately around outfall headworks	No impact	Operational discharge of ethanolamine	Low toxicity	No impact

	Significance Pre-mitigation	Reason	Mitigation	Residual Significance
Trophic functioning	Negligible	Operational discharge of nitrogen and phosphorous	Very low volumes to be discharged	Negligible
Subtidal habitats and water column immediately around outfall headworks	Negligible	Operational discharge of ammonia	Very low volumes to be discharged	Negligible
Impingement of Fish and Shrimp				
Sprat	Moderate	Population mortality	AFD + low velocity intake design	Minor
Whiting	Moderate	Population mortality	AFD + low velocity intake design + FRR	Minor
Sole	Minor	Population mortality	FRR	Minor
Cod	Minor	Population mortality	AFD + low velocity intake design + FRR	Minor
Plaice	Minor	Population mortality	FRR	Minor
Blue whiting	Minor	Population mortality	AFD + low velocity intake design + FRR	Minor
Sea bass	Minor	Population mortality	AFD + low velocity intake design + FRR	Minor
Crustaceans incl. *Crangon crangon*	Moderate	Population mortality	FRR	Minor
Salmon	Negligible	Population mortality	AFD + low velocity intake design + FRR	Negligible
Twaite shad	Moderate	Population mortality	AFD + low velocity intake design + FRR	Minor
Eel	Moderate	Population mortality	FRR	Minor
River and sea lamprey	Moderate	Population mortality	FRR	Minor
Fish assemblage	Moderate	Population mortality; functioning	AFD + low velocity intake design + FRR	Minor
Entrainment				
Ichthyoplankton	Minor	Population mortality	5mm mesh limits entrainment forcing diversion to FRR	Minor

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	Significance Pre-mitigation	Reason	Mitigation	Residual Significance
Other zooplankton including mysids	Minor	Population mortality; functioning	5mm mesh limits entrainment forcing diversion to FRR	Minor
Phytoplankton	Minor	Population mortality; functioning	5mm mesh limits entrainment forcing diversion to FRR	Minor

Notes: AFD: Acoustic Fish Deterrence System; FRR: Fish Recovery and Return System

19.12 Conclusions

19.12.1 An extensive series of marine ecological studies, calling upon longer term efforts and project-specific investigations, has secured a good understanding of the marine environment local to the Hinkley Point site.

19.12.2 Early design considerations carried out using numerical modelling tools developed on the basis of these marine studies have enabled the consideration of a variety of cooling water intake and outfall configurations. Subsequently, these same studies have been utilised in optimising finer detail of the cooling water system designs, leading to a series of means of mitigating potentially untoward impacts, as described above.

19.12.3 In summary, with appropriate design and management of HPC construction and operation, all impacts upon marine ecological receptors can be rendered limited to no greater than minor adverse significance.

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CHAPTER 20: TERRESTRIAL ECOLOGY AND ORNITHOLOGY

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20. TERRESTRIAL ECOLOGY AND ORNITHOLOGY

20.1 Introduction

20.1.1 This chapter of the Environmental Statement (ES) provides an assessment of the potential impacts on terrestrial and freshwater ecology, and on ornithology (collectively referred to as biodiversity within this Chapter) arising from the construction and operation of Hinkley Point C (HPC – the proposed development) and associated highway improvement works (see **Chapter 2** of this volume of the ES for a detailed description of the proposed development). Although it assesses impacts on freshwater ecology, impacts upon coastal and marine ecology are assessed separately in **Chapter 19** of this volume of the ES. Where required, mitigation measures are identified to prevent, reduce and where possible off-set any potential adverse impacts that are identified to be of significance.

20.2 Scope of Assessment

20.2.1 The scope of the assessment has been determined through a formal Environmental Impact Assessment (EIA) scoping process undertaken with the Infrastructure Planning Commission (IPC). It has also been informed by ongoing consultation with statutory consultees (including Natural England (NE), the Environment Agency (EA), Sedgemoor District Council (SDC), West Somerset Council (WSC) and Somerset County Council (SCC)), Somerset Wildlife Trust, the local community and the general public in response to the Stage 1, Stage 2, Stage 2 Update and M5 Junction 24 and Highway Improvements consultations.

20.2.2 The assessment of impacts on biodiversity has been undertaken adopting the methodologies described in Section 20.4 of this chapter.

20.2.3 The baseline conditions, against which the likely environmental impacts of the proposed development are assessed, have been determined through desk-based data collection and field surveys, and are described in Section 20.5 of this chapter.

20.2.4 Section 20.6 of this chapter sets out the assessment of the impacts on biodiversity arising from the proposed development. The development has been designed, where possible, to incorporate measures that will prevent, reduce or off-set potential adverse impacts. No other measures are proposed as mitigation in relation to the impacts of the development on biodiversity that are identified in this ES. However, a series of additional good practice measures has been identified (see Section 20.7), which will contribute to reducing impacts that are of no more than minor adverse significance and hence that do not require mitigation.

20.2.5 The impacts of the development are summarised in Section 20.8 of this chapter.

20.2.6 The objective of this chapter is to meet the requirements of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 (Ref. 20.1) in relation to flora and fauna and for the:

- collection of baseline information on biodiversity;
- identification of biodiversity receptors that could be significantly affected by the proposed development, and the definition of these potential impacts (i.e. 'scoping');
- assessment of the magnitude and significance of the potentially significant impacts of the proposed development incorporating design measures that have been devised in response to the findings of the assessment (but that are not dealt with separately as mitigation measures);
- identification of mitigation measures that would avoid or reduce adverse impacts and measures that offset adverse impacts; and
- assessment of residual impacts (i.e. after the implementation of the proposed mitigation measures).

20.3 Legislation, Policy and Guidance

20.3.1 This section identifies and describes legislation, policy and guidance of relevance to the assessment of biodiversity impacts associated with the construction, operation and post-operational phases of the proposed development.

20.3.2 As stated in **Volume 1, Chapter 4** of this ES, the Overarching National Policy Statement (NPS) for Energy (NPS EN-1) (Ref. 20.2) when combined with the NPS for Nuclear Power Generation (NPS EN-6) (Ref. 20.3) provides the primary basis for decisions by the IPC on applications for nuclear power generation developments that fall within the scope of the NPSs.

20.3.3 Notwithstanding this, the IPC may consider other matters that are both important and relevant to its decision-making. This could include Planning Policy Statements (PPSs), Planning Policy Guidance Notes (PPGs), and regional and local policy documents. However, if there is a conflict between these and the NPS, the NPS prevails for the purposes of IPC decision making.

20.3.4 Further, the Planning Act 2008 provides that the IPC must, in making its decision on an application, have regard to any Local Impact Report (LIR) prepared by relevant local authorities. It is anticipated that the LIRs will rely in part on PPSs, PPGs, and regional and local policy to provide a context for their assessment. On this basis, regard has been given to these documents (where they are relevant to the technical assessment), since they are likely to inform the LIRs prepared by the relevant local authorities.

a) International Conventions

i. The Convention on Biological Diversity 1992 (Ref. 20.4)

20.3.5 The Convention on Biological Diversity (the Convention) focuses on the conservation of all species and ecosystems. It requires the development of national strategies, plans or programmes for the conservation and sustainable use of biodiversity. In accordance with this, the UK has developed Biodiversity Action Plans (BAPs), which provide guidance for the conservation and management of biodiversity. In 2010, the parties to the Convention agreed the Nagoya Protocol. This provides a transparent legal framework for the effective implementation of one of the three objectives of the Convention, namely the fair and equitable sharing of benefits arising out of the utilisation of genetic resources.

20.3.6 At Nagoya, the parties to the Convention adopted the Strategic Plan for Biodiversity 2011-2020 (Ref. 20.5) with the purpose of inspiring broad-based action in support of biodiversity over the next decade by all countries and stakeholders. The Strategic Plan, which includes 20 targets, known as the Aichi Targets, serves as a flexible framework for the establishment of national and regional targets, and promotes the coherent and effective implementation of the three objectives of the Convention on Biological Diversity.

ii. The Convention on Wetlands 1971 (Ref. 20.6)

20.3.7 The Convention on Wetlands (commonly referred to as the Ramsar Convention) originally focused on the conservation and wise use of wetlands, primarily as habitat for waterbirds. However, the scope of implementation of the Convention has been broadened to cover all aspects of wetland conservation in recognition of the importance of wetland ecosystems for biodiversity conservation. Under the Convention, each country is required to designate sites (‘Ramsar sites’) that meet the Criteria for Identifying Wetlands of International Importance, which are based on Article 2.2 of the Convention.

b) European Legislation

i. Council Directive 2009/147/EC on the Conservation of Wild Birds (the European Union (EU) Birds Directive) (Ref. 20.7)

20.3.8 The EU Birds Directive requires Member States to take the requisite measures to maintain the population of all species of naturally occurring wild birds in the States’ European territory at a level that corresponds to various requirements. Member States shall take special conservation measures concerning the habitat of species mentioned in Annex I of the Directive, and shall take similar measures for regularly occurring migratory species that are not listed in Annex I. Under the Directive, the most suitable areas for the conservation of these species (whether on land or at sea) are classified as Special Protection Areas (SPAs). In England and Wales the Directive is implemented under the Wildlife and Countryside Act 1981 (as amended) (Ref. 20.8) and the Conservation of Habitats and Species Regulations 2010 (Ref. 20.9).

ii. Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the EU Habitats Directive) (Ref. 20.10)

20.3.9 The EU Habitats Directive requires Member States to maintain or restore, at favourable conservation status, natural habitats and species of wild fauna and flora of Community interest (i.e. those listed in Annexes I, II, IV and/or V of the Directive). Member States are also required to contribute to a coherent European ecological network of protected sites by designating Special Areas of Conservation (SACs) for the natural habitat types listed in Annex I and habitats of the species listed in Annex II.

20.3.10 Under the Directive, the conservation status of a habitat is defined as favourable when: its natural range, and the areas it covers within that range, are stable or increasing; the species structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and the conservation status of its typical species is favourable. The conservation status of a species is defined as favourable when: population dynamics data indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats; its natural range is neither being reduced nor is likely to be reduced for the foreseeable future; and there is, and would probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

20.3.11 In England and Wales, the Directive is implemented through the Conservation of Habitats and Species Regulations 2010 (Ref. 20.9).

c) National Legislation

i. The Conservation of Habitats and Species Regulations 2010 (the Habitats and Species Regulations) (Ref. 20.9)

20.3.12 The Habitats and Species Regulations, which replace the Conservation (Natural Habitats, &c.) Regulations 1994 (Ref. 20.11), are the principal means by which the EU Habitats Directive and EU Birds Directive are transposed into national law for England, Wales and the territorial seas. The Habitats and Species Regulations, *inter alia*, provide for the designation and protection of European sites, and the protection of European protected species.

20.3.13 Under the Habitats and Species Regulations, a person who does any of the following in respect to a European protected animal species (those listed in Schedule 2) is guilty of an offence:

- deliberately captures, injures or kills any wild animal of a European protected species;
- deliberately disturbs wild animals of any such species;
- deliberately takes or destroys the eggs of such an animal; or
- damages or destroys a breeding site or resting place of such an animal.

20.3.14 It is also an offence under the Habitats and Species Regulations deliberately to pick, collect, cut, uproot or destroy a wild plant of a European protected species (those listed in Schedule 5).

20.3.15 However, these actions can be made lawful through the granting of licences by the appropriate authorities. Licences may be granted for a number of purposes (such as science and education, conservation, preserving public health and safety), but only after the appropriate authority is satisfied that there are no satisfactory alternatives and that such actions would have no detrimental effect on the maintenance of the conservation status of the species concerned.

ii. The Wildlife and Countryside Act 1981 (the WCA) (Ref. 20.8)

20.3.16 The WCA (as amended, including by the Countryside and Rights of Way Act 2000 (Ref. 20.12)) strengthens provisions under the National Parks and Access to the Countryside Act 1949 (Ref. 20.13) to designate, protect and manage Sites of Special Scientific Interest (SSSIs) and to establish National Nature Reserves (NNRs) in England and Wales. These sites can be established on land down to the low water mark. SSSIs and NNRs can be designated for their flora, fauna or geological interests.

20.3.17 The WCA (subject to specified exceptions) makes it an offence to:

- intentionally kill, injure or take any wild animal included in Schedule 5;
- intentionally or recklessly:
  - damage or destroy any structure or place which any wild animal specified in Schedule 5 uses for shelter or protection; or
  - disturb any such animal while it is occupying a structure or place which it uses for shelter or protection or;
  - obstruct access to any structure or place which any such animal uses for shelter or protection;
- intentionally:
  - kill, injure or take any wild bird; or
  - take, damage or destroy the nest of a wild bird included in Schedule ZA1; or
  - take, damage or destroy the nest of any wild bird while that nest is in use or being built; or
  - take or destroy an egg of any wild bird.
- intentionally or recklessly:
  - disturb any wild bird included in Schedule 1 while it is building a nest or is in, on or near a nest containing eggs or young; or
  - disturb dependent young of such a bird.
- intentionally pick, uproot or destroy any wild plant included in Schedule 8.

iii. Protection of Badgers Act 1992 (Ref. 20.14)

20.3.18 Under the Protection of Badgers Act, it is an offence (subject to specified exceptions) to:

- wilfully kill, injure or take, or attempt to kill, injure or take, a badger; or
- cruelly ill-treat a badger; or
- interfere with a badger sett by doing any of the following things:
  - damage a badger sett or any part of it; or
  - destroy a badger sett; or
  - obstruct access to, or any entrance of, a badger sett; or
  - cause a dog to enter a badger sett; or
  - disturb a badger when it is occupying a badger sett.

iv. The Hedgerows Regulations 1997 (Ref. 20.15)

20.3.19 The Hedgerows Regulations make it an offence to remove or destroy certain hedgerows without the permission of the local planning authority.

v. The Natural Environment and Rural Communities (NERC) Act 2006 (Ref. 20.16)

20.3.20 Section 40 of the NERC Act sets out a requirement for every public authority (including local authorities), in exercising their functions, to have regard, so far as is consistent with the proper exercise of those functions, to the purpose of conserving biodiversity.

20.3.21 Section 41 of the NERC Act requires the Secretary of State to publish a list of habitats and species which are of principal importance for the purpose of conserving biodiversity in England. The list, which includes 56 habitats and 943 species, has been drawn up in consultation with NE, as required by the NERC Act.

vi. Countryside and Rights of Way (CRoW) Act 2000 (Ref. 20.12)

20.3.22 The CRoW Act provides for public access on foot to certain types of land, amends the law for public rights of way, increases protection for SSSIs, strengthens wildlife enforcement legislation and provides for better management of Areas of Outstanding Natural Beauty (AONB).

d) National Planning Policy

i. Planning Policy Statement 1: Delivering Sustainable Development (PPS1) (2005) (Ref. 20.17)

20.3.23 PPS1 was published in 2005 and sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system.

20.3.24 Paragraph 5 states that planning should facilitate and promote sustainable and inclusive patterns of urban and rural development by, amongst other things: protecting and enhancing the natural and historic environment, the quality and character of the countryside, and existing communities.

ii. Planning Policy Statement 9: Biodiversity and Geological Conservation (PPS9) (2005) (Ref. 20.18)

20.3.25 PPS9 was published in 2005 and sets out planning policies on the protection of biodiversity and geological conservation through the planning system. The broad aim of the policies is to ensure that planning, construction, development and regeneration should have minimal impacts on biodiversity and enhance it wherever possible.

20.3.26 Key objectives of PPS9 include (page 2):

- *"to promote sustainable development by ensuring that biological and geological diversity are conserved and enhanced as an integral part of social, environmental and economic development, so that policies and decisions about the development and use of land integrate biodiversity and geological diversity with other considerations.*
- conserve, enhance and restore the diversity of England's wildlife and geology by sustaining and where possible improving the quality and extent of natural habitat and geological and geomorphological sites; and to conserve, enhance and restore the diversity of England's wildlife and geology by sustaining, and where possible improving, the quality and extent of natural habitat and geological and geomorphological sites; the natural physical processes on which they depend; and the populations of naturally occurring species which they support."

20.3.27 Paragraph 8 states that, where a proposed development on land within or outside an SSSI is likely to have an adverse effect on an SSSI (either individually or in combination with other developments), planning permission should not normally be granted. Where an adverse effect on the site's notified special interest features is likely, an exception should only be made where the benefits of the development, at this site, clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest and any broader impacts on the national network of SSSIs.

20.3.28 Paragraph 9 states that sites of regional and local biodiversity and geological interest, which include Regionally Important Geological Sites, Local Nature Reserves and Local Sites, have a fundamental role to play in meeting overall national biodiversity targets; contributing to the quality of life and the well-being of the community; and in supporting research and education.

20.3.29 Paragraph 10 states that planning authorities should not grant planning permission for any development that would result in the loss or deterioration of ancient woodland, unless the need for, and benefits of, the development in that location outweigh the loss of the woodland habitat.

20.3.30 Paragraph 12 states that networks of natural habitats provide a valuable resource and should be protected from development, and, where possible, strengthened by or integrated within it.

20.3.31 Paragraph 16 states that planning authorities should ensure that protected species are protected from the adverse effects of development and refuse permission where harm to the species or their habitats would result, unless the need for, and benefits of, the development clearly outweigh that harm.

iii. Consultation Paper on a New Planning Policy Statement – Planning for a Natural and Healthy Environment (2010) (Ref. 20.19)

20.3.32 In its final form, it is intended that this PPS will replace PPS9. The draft PPS contains policies to maintain and enhance, restore or add to biodiversity and geodiversity through the planning system. It includes policies to promote opportunities for the incorporation of beneficial biodiversity and geological features within the design of development, and to maintain networks of natural habitats by avoiding their fragmentation and isolation.

20.3.33 A key objective of this PPS is to bring together related policies on the natural environment and on open space and green spaces in rural and urban areas to ensure that the planning system delivers healthy, sustainable communities which adapt to and are resilient to climate change and gives the appropriate level of protection to the natural environment (page 10).

iv. The UK BAP (Ref. 20.20)

20.3.34 The UK Government signed the Convention on Biological Diversity at the Earth Summit in Rio de Janeiro in 1992 (Ref. 20.4). Following this, the Prime Minister announced an eight point plan for the UK which included the production of the UK BAP. The UK BAP identifies the means by which the UK should contribute to the global conservation of biodiversity over the following 20 years. As part of the UK BAP, a list of priority species and habitats was developed, the conservation of which requires specific actions to be implemented.

e) Regional Planning Policy

20.3.35 The Government's revocation of regional strategies was quashed in the High Court on 10 November 2010. However, on that same date the Government reiterated in a letter to Chief Planners its intention to revoke regional strategies through the Localism Bill. This letter was also challenged but, on 7 February 2011, the High Court held that the Government's advice to local authorities that the proposed revocation of regional strategies was to be regarded as a material consideration in their planning development control decisions should stand. The decision of the High Court was upheld by the Court of Appeal on 27 May 2011. Therefore, the regional strategies remain in place but in the case of development control decisions it is for planning decision-makers to decide on the weight to attach to the strategies (see **Volume 1, Chapter 4** of this ES for a full summary of the position regarding the status of regional planning policy).

i. Regional Planning Guidance 10 for the South West 2001-2016 (RPG10) (2001) (Ref.20.21)

20.3.36 RPG10 sets out the broad development strategy for the period to 2016 and beyond. Policy EN1 (Landscape and Biodiversity) seeks the protection and enhancement of the region's internationally and nationally important landscape areas and nature conservation sites. The protection and, where possible, enhancement of landscape and biodiversity should be planned into new development.

ii. The Draft Revised Regional Spatial Strategy (RSS) for the South West Incorporating the Secretary of State's Proposed Changes 2008-2026 (July 2008) (Ref. 20.22)

20.3.37 The draft Revised RSS for the South West looks forward to 2026 and sets out the Government's policies in relation to the development of land within the region. Chapter 7 deals with Enhancing Distinctive and Cultural Life. Policy ENV1 (Protecting and Enhancing the Region's Natural and Historic Environment) states the following:

> *"The quality, character, diversity and local distinctiveness of the natural and historic environment in the South West will be protected and enhanced, and developments which support their positive management will be encouraged. Where development and changes in land use are planned which would affect these assets, Local Authorities will first seek to avoid loss of or damage to the assets, then mitigate any unavoidable damage, and compensate for loss or damage through offsetting actions. Priority will be given to preserving and enhancing sites of international or national landscape, nature conservation, geological, archaeological or historic importance. Tools such as characterisation and surveys will be used to enhance local sites, features and distinctiveness through development, including the setting of settlements and buildings within the landscape and contributing to the regeneration and restoration of the area."*

20.3.38 Policy ENV4 (Nature Conservation) states the following:

> *"The distinctive habitats and species of the South West will be maintained and enhanced in line with national targets and the South West Regional Biodiversity Action Plan. Local Authorities should use the Nature Map to help map local opportunities for biodiversity enhancement in LDDs, taking into account the local distribution of habitats and species, and protecting these sites and features from harmful development. Priority will be given to meeting targets for maintenance, restoration and recreation of priority habitats and species set out in Appendix 1, focusing on the Nature Map areas identified in Map 7.3. Proposals which provide opportunities for the beneficial management of these areas and habitats and species generally, should be supported, including linking habitats to create more functional units which are more resilient to climate change."*

iii. Somerset and Exmoor National Park Joint Structure Plan Review 1991-2011 (2000) (Policies 'saved' from 27th September 2007) (Ref. 20.23)

20.3.39 The Somerset and Exmoor National Park Joint Structure Plan was adopted in 2000, with relevant policies saved from 27 September 2007. All policies have been saved with the exception of Policy 53, which is unrelated to impacts on biodiversity. The Plan provides a strategic base for all land use planning within the plan area for the period up to 2011.

20.3.40 Policy STR1 (Sustainable Development) states that development in Somerset and the Exmoor National Park should, amongst other things, conserve biodiversity and environmental assets, particularly nationally and internationally designated areas.

20.3.41 Policy 1 (Nature Conservation) states that the biodiversity of Somerset and the Exmoor National Park should be maintained and enhanced. The greatest protection will be afforded to nature conservation sites of international and national importance. In addition, Local Plans should include policies to maintain and enhance sites and features of local nature conservation importance including landscape features which provide wildlife corridors, links or stepping stones between habitats.

iv. The South West Biodiversity Implementation Plan (SW BIP) (Ref. 20.24)

20.3.42 The SW BIP sets out a framework of policies, priorities and actions to assist in achieving a more integrated approach to the delivery of biodiversity aims within the South West. It contributes towards the Biodiversity Strategy for England (Ref. 20.25) and aims to influence regional strategies, plans and policies.

20.3.43 The overall aims of the SW BIP are to:

- help to meet biodiversity targets for priority habitats and species in the South West;
- ensure regional strategic plans incorporate biodiversity issues for the South West;
- provide a strategic framework for the work undertaken by regional and local biodiversity partnerships in conserving biodiversity and promoting the sustainable use of biological resources; and
- develop wider support and active engagement by increasing awareness and understanding of the importance of biodiversity to the region’s health, quality of life and economic productivity.

v. Wild Somerset – The Somerset Biodiversity Strategy 2008-2018 (the Somerset Biodiversity Strategy) (Ref. 20.26)

20.3.44 The Somerset Biodiversity Strategy is intended to represent a long term blueprint for successful biodiversity conservation in Somerset. It proposes a vision for biodiversity conservation locally and sets out a series of objectives and actions aimed at making significant progress towards achieving them. It also identifies those organisations that are best placed to implement the actions, either through their own endeavours or working in partnership with others.

vi. Somerset Local BAP (LBAP) (Ref. 20.27) and West Somerset LBAP (Ref. 20.28)

20.3.45 The Somerset LBAP has been produced in conjunction with the Somerset Biodiversity Strategy and identifies targets and actions for the following biodiversity receptors across Somerset:

- ditches and ponds;
- gardens and urban greenspace;
- hedgerows and hedgerow trees;
- road verges and green lanes;
- traditional orchards;
- water and wetlands;
- wood pasture, parkland and veteran trees;
- bats;
- otter (*Lutra lutra*); and
- lapwing (*Vanellus vanellus*).

20.3.46 The West Somerset LBAP (2008) incorporates targets and actions identified in the Somerset LBAP and specifies the following ecological receptors as requiring particular biodiversity targets within West Somerset:

- coastal and marine;
- long-eared owl (*Asio otus*);
- native wildflowers of arable land;
- waxcaps; and
- woodland.

f) Local Planning Policy

i. West Somerset Local Plan (2006) (Policies 'saved' from 17 April 2009) (Ref. 20.29)

20.3.47 The West Somerset Local Plan forms part of the development plan for West Somerset. The Local Plan was adopted in April 2006 (with relevant policies ‘saved’ from 17 April 2009).

20.3.48 The Proposals Map indicates that the north-eastern corner of the development site adjacent to Hinkley A lies within a County Wildlife Site (Policy NC/3). The foreshore, which lies just outside of the northern boundary of the development site, is designated as an SSSI (Policy NC/1) and National Nature Reserve (Policy NC/1). The SSSI designation also abuts the eastern boundary of the development site. SPA and Ramsar site designations affect the foreshore ('unsaved' Policy NC/2). The development site lies outside of the defined development boundary.

20.3.49 The following saved policies are considered to be potentially relevant:

20.3.50 Policy NC/1 (Sites of Special Scientific Interest) states that development proposals which may, directly or indirectly, adversely affect SSSIs will not be permitted unless: there are no alternative means of meeting the development need, and the reasons for the development clearly outweigh the value of the development site and the national policy to safeguard the nature conservation value of the national network of such sites.

20.3.51 Policy NC/1 also states that, where the site is a National Nature Reserve (NNR) or a site identified under the Nature Conservation Review or Geological Conservation Review, particular regard will be paid to the site's national importance. Where development is permitted, the use of conditions or planning obligations to ensure the protection and enhancement of the site's nature conservation interest will be considered.

20.3.52 Policy NC/3 (Sites of Local Nature Conservation and Geological Interest) states that planning permission will not be granted for development which has a significant adverse effect on local nature conservation/geological interests or integrity of landscape features, unless the importance of the development outweighs the value of the substantive interests present.

20.3.53 Policy CO/1 (The Coastal Zone) states that development proposals in any part of the Coastal Zone, including those areas of existing developed coast, will only be permitted where: the development and its associated activities are unlikely to have an adverse effect, either directly or indirectly on heritage features, landscape character areas, nature conservation interests, including sub-tidal and marine habitats, and residential amenities; the development is unlikely to have an adverse effect on the character of the coast and maintains and where possible, enhances, improves or upgrades the environment particularly in derelict and/or despoiled coastal areas; the development requires a coastal location.

ii. West Somerset District Local Development Framework (LDF) Core Strategy (Options Paper) (January 2010)

20.3.54 The Core Strategy is at a preliminary stage of preparation and the Options Paper does not include any specific policies relating to terrestrial ecology or ornithology impacts at the development site.

iii. Supplementary Planning Guidance

20.3.55 West Somerset Council and Sedgemoor District Council have jointly prepared draft supplementary planning guidance in relation to the HPC Project. Public consultation on the Consultation Draft version of the HPC Project Supplementary Planning Document (the 'draft HPC SPD') (Ref. 20.30) commenced on 1 March 2011 and concluded on 12 April 2011. EDF Energy has submitted representations which object to the draft HPC SPD. **Volume 1, Chapter 4** of this ES provides a full summary of the position regarding the status of the draft HPC SPD.

20.3.56 With regards to the approach to masterplanning and design of the development site, Box 19 in the draft HPC SPD states, amongst other things, that appropriate mitigation measures for impacts on protected species or Biodiversity Action Plan Priority Species and nature conservation interests should be identified, including:

- Protecting the integrity of the European Natura 2000 sites (SACs and SPAs);
- Potential disturbance from the construction process leading to displacement of birds;
- Impacts on the Hinkley County Wildlife Site;
- The cumulative impacts with associated development, preliminary works, other applications for consent, and other projects, including for example, the Construction Centre, Bristol Container Port, Steart Coastal Management Project, and Oldbury power station; and
- Effects on water quality and migratory fish populations (page 37).

20.3.57 Further planning policy context is provided in the Legislative Planning Policy Context chapter (**Volume 1, Chapter 4** of this ES) and the introduction chapter (**Volume 2, Chapter 1** of this ES).

20.4 Methodology

a) Introduction

20.4.1 **Volume 1, Chapter 7** of this ES describes the generic assessment methodology for this EIA. The subject-specific methodology that has been used for the assessment in this chapter draws upon the Institute of Ecology and Environmental Management's (IEEM's) guidelines on ecological impact assessment (Ref. 20.31), but also reflects the standardisation of aspects of the assessment across all the topics that are covered in this ES. The main elements of this chapter's impact assessment methodology are listed in Section 20.2.5 of this chapter.

20.4.2 The remainder of this section outlines the methodologies that were adopted for baseline data gathering, consultation, scoping the assessment and the assessment methodology. The section concludes with information about limitations, constraints and assumptions.

b) Baseline Data Gathering

i. Desk Study

HPC Development Site

20.4.3 A desk study was undertaken in order to identify any requirement for further surveys and to inform the assessment process.

20.4.4 For the desk study, data were collected for the development site and a 3km[1] area around the development site (**Figure 20.1**). Data for this area had the potential to highlight notable species that could be present on the development site as well as indicating off-site ecological resources that could be affected by the proposed development. The desk study area was extended to 10km around the development site in relation to European nature conservation sites[2] and bat records.

20.4.5 During May 2009, information about statutory nature conservation sites within the 3km area (and 10km area for European sites) was obtained through the use of the following websites: www.magic.gov.uk; www.jncc.gov.uk; and www.naturalengland.org.uk. Also during May 2009, information about non-statutory nature conservation sites, and pre-existing biological records were obtained from the Somerset Environmental Records Centre (SERC). Information relating to designated sites was updated in April 2011. Of the large number of records received, only post-1990 records have been considered, as these are likely to be most relevant to the current conditions at the development site.

20.4.6 1:25,000 Ordnance Survey maps were studied in order to identify any water bodies located within 500m of the development site, given the possibility that any great crested newts (*Triturus cristatus*) that breed in such water bodies could utilise terrestrial habitats on the development site. The Great Crested Newt Mitigation Guidelines recommend that surveys of ponds up to 500m from a development may be required to determine the impact of the development on this species (Ref. 20.32).

20.4.7 The Nature Map created by Biodiversity South West (Ref. 20.33) was reviewed to determine if the development site lies within an identified Strategic Nature Area (SNA).

20.4.8 Information on active toad crossings (i.e. those that are known to be currently used by toads to access breeding ponds) within the study area was obtained from Froglife's Toads on Road project (Ref. 20.34).

20.4.9 Desk study data were also sought from the organisations and individuals listed in **Table 20.1**. This table also lists the data that were received.

[1] The study areas were defined to reflect the likely spatial scope of the impacts that would be caused by the proposed development, using information about the development proposals, knowledge of the local area and professional judgement. On this basis, the study area is larger for the development site than for the highway improvement sites.

[2] Under The Conservation of Habitats and Species Regulations 2010 (SI 2010 No. 490), European sites are defined as Special Areas of Conservation (SACs), candidate SACs, Sites of Community Importance and Special Protection Areas (SPAs). However, UK policy extends the requirements pertaining to European sites to include Ramsar sites and potential SPAs, and this would include proposed extensions or alterations to existing SPAs.

Table 20.1: Organisations and Individuals that Provided Ecological Baseline Data

Organisation/Individual	Data Requested	Data Received
NE	General biological information with follow-up specific request for invertebrate records	Contextual information received on nocturnal bird studies undertaken in other parts of the county, and on invertebrates on Wick Moor, located to the east of the development site.
Royal Society for the Protection of Birds (RSPB)	Contextual information	Paper on bird use of Bridgwater Bay and Steart Area (Ref. 20.35). General contextual information
British Trust for Ornithology (BTO)	Wetland Bird Survey (WeBS) data[3] (high and low tide)	WeBS core count data for years 04/05 – 08/09. Low tide count data were available for 2002/03 only.
Conservation Warden at Hinkley Point	Bird records for 'The Island' located at the mouth of the Huntspill River	As requested
Somerset Badger Group	Badger records for the study area	As requested
Somerset Bat Group	Bat records (and queries with regard to grey long-eared bat [*Plecotus austriacus*] records)	Confirmation that it holds no additional data to that received from SERC. Correspondence with Edward Wells (Chair of the SBG) with regard to specific queries. Bat survey data from the Quantocks (2010).
Somerset Ornithological Society	Bird information for the study area.	As requested
Somerset Otter Group	Otter information for the study area.	As requested
SCC Ecologists	Biological information	Great crested newt records. Information on bovine tuberculosis
SWT	General biological information relating to the study area	Confirmation that they hold no additional data to that received from SERC.
Bristol Ports Company and the Environment Agency	The findings of surveys undertaken to inform the EIA of a proposed coastal re-alignment scheme on the Steart Peninsula	Data provided in relation to bats

20.4.10 Baseline information has also been obtained from the following sources:

- Land Management Reports prepared by ADAS (Refs 20.36 and 20.37);
- West Hinkley Wind Farm Environmental Statement (Ref. 20.38);

[3] WeBS is the main scheme for monitoring the numbers of non-breeding waterbirds in the UK. The principal aims of WeBS are to identify population sizes, determine trends in numbers and distribution and to identify important sites for waterbirds. WeBS counts are predominantly undertaken by skilled volunteers.

- A history of the birds of Somerset (Ref. 20.39);
- Somerset bird reports (Somerset Ornithological Society, Refs 20.40, 20.41, 20.42, 20.43 and 20.44);
- The decommissioning environmental statement for Hinkley Point A (HPA) (Ref. 20.45);
- The National Biodiversity Network Gateway website (http://data.nbn.org.uk/); and
- National otter survey data (Ref. 20.46).

Highway improvement sites

20.4.11 Given the small size of the ten highway improvement sites, the areas for which desk study information was collected were limited to a 500m radius around each site[4].

ii. Extended Phase 1 Habitat Survey

20.4.12 An extended Phase 1 habitat survey of the development site and up to 100m beyond the boundary was conducted in May 2009, building on extended Phase 1 habitat surveys of smaller parts of the development site that were carried out in March 2007 and September 2008 (the scope of these surveys was smaller due to restricted access). The survey methodology was based on the Joint Nature Conservation Committee's (JNCC's) Phase 1 habitat survey methodology (Ref. 20.47). This involved habitats, together with notable features of biodiversity conservation interest, being identified and mapped; each notable feature of biodiversity conservation interest was described in a target note. The survey was extended (Ref. 20.48) to collect additional information on the presence/potential presence of legally protected and other notable species, and interest features such as hedgerows and water bodies. Details of the survey methodology are set out in **Appendix 20A.**

20.4.13 The same survey methodology was applied to the highway improvement sites, which were surveyed between the 1 and 5 August 2011. Based on the results of the desk study and the extended Phase 1 Habitat survey, it was concluded that no further surveys were required in relation to the highway improvement sites.

iii. Other Surveys

20.4.14 Based on the results of the desk study and the extended Phase 1 Habitat survey, it was concluded that further ecological surveys were required to inform the assessment of ecological impacts associated with the proposed HPC development. These are summarised in **Table 20.2,** with the detailed methods contained within **Appendix 20A-L and Q**.

[4] See footnote 1 for explanation of survey areas

Table 20.2: Summary of Ecological Surveys undertaken at the Development Site

Survey	Appendix Ref	Description
Hedgerow	Appendix 20A	An initial survey of hedgerows accessible at that time was undertaken in 2007, with repeat survey of all hedgerows within the development site undertaken in May 2009. All hedgerows that were likely to be at least 30 years old were assessed to determine if they met the criteria for being ecologically 'important' in respect to Paragraph 7 of Schedule 1 of The Hedgerows Regulations 1997 (Ref. 20.15).
National Vegetation Survey (NVC)	Appendix 20A	Areas of potential botanical interest within the study area (both within and adjacent to the development site) that could be affected by the works and that were identified through the extended Phase 1 habitat survey were subject to National Vegetation Classification (NVC) surveys in either 2007 or 2009. These surveys followed the standard NVC methodology (Ref. 20.49).
Woodland condition	Appendix 20A	A woodland condition survey was undertaken in May 2009. This involved collecting information about the height, naturalness, structure and diversity of each woodland compartment within, and adjacent to, the development site, in addition to a review of the management history and the production of a higher plant species list for each compartment. The survey was completed with reference to A Nature Conservation Review (Ref. 20.50)
River Corridor	Appendix 20A	A River Corridor Survey was completed for each watercourse within the development site following the guidance provided in the River Corridor Surveys – Conservation Technical Handbook (Ref. 20.51). The survey was undertaken in July 2009. During the survey, information on the physical and biological features of the aquatic, marginal, bank and adjacent land zones were recorded and mapped in order to characterise the watercourse. The River Corridor Survey also incorporated a detailed survey of the plant species present within and adjacent to the channel and identified culverts, bridges and other channel features.
Birds	Appendix 20B Appendix 20C Appendix 20Q	A breeding bird territory mapping survey, using an adapted version of the British Trust for Ornithology's Common Bird Census (CBC) methodology (Ref. 20.52), was carried out within and adjacent to the development site over four visits between April and July 2007. Additional surveys were also undertaken to determine whether any of the buildings within the development site are used by breeding barn owl (*Tyto alba*). This was completed initially using a pole-mounted camera in September 2009, to inspect the buildings for evidence that they had been occupied by barn owl during the breeding season (as a structural survey had determined that these buildings were not safe to access), followed by dusk emergence surveys in May and June 2010. Supplementary records of birds recorded outside the CBC survey (during other ecology surveys) were also used when compiling the final territory map, as was information supplied by Martin Sage of ADAS and Dick Best, EDF Energy's Hinkley Point Site Warden. Birds using inter-tidal areas and inshore marine waters in the vicinity of the development site were surveyed between April 2007 and March 2009. The surveys involved recording the locations, numbers and activities of birds present throughout the tidal cycle from observation points located along the frontage of the proposed development and to the east and west of the development site boundary. Data were recorded from five locations that overlooked areas referred to in this document as Count Sectors 1 – 5. In total 182 recording sessions were undertaken for each count sector.

Survey	Appendix Ref	Description
		In addition, further recording of birds using the inter-tidal habitats to the east of the existing Hinkley Point B (HPB) (i.e. on the Stert Flats) was undertaken between April 2010 and January 2011. From four vantage points, data were collected across a six hour period five times per month. Data were mapped using a 200 x 200m grid system. Birds foraging, loafing or roosting within agricultural fields within the survey area during daylight hours were surveyed by means of daytime field-by-field (walkover) surveys, which were undertaken between September 2007 and March 2009. In addition, surveys were undertaken to establish whether there was any nocturnal use of coastal fields within and adjacent to the development site during the passage and winter period. These surveys were conducted on a twice-monthly basis between December 2007 and May 2008, and again between August 2008 and March 2009. The behaviour of rafting shelduck was monitored in July and August 2011. Fourteen watches, each of six hours' duration, were completed from a vantage point on the shoreline close to the location of the temporary jetty.
Badger	Appendix 20D (Confidential due to information on sett locations)	Following an initial badger survey of the development site in 2007, extensive bait-marking studies (Ref. 20.53) were undertaken in 2008, 2009 and 2010 of the development site and land a minimum of 200m from the development site's boundary, to determine the use of the development site by badgers. Weekly surveys of the development site to record badger activity and active setts began in October 2010 and are on-going.
Bat	Appendix 20E Appendix 20F	A suite of bat surveys has been undertaken since 2007. All survey work has been undertaken with reference to the Bat Conservation Trust Guidance (Ref. 20.54) and has comprised the following: • bat activity transect surveys within the development site between summer and autumn 2007, in September 2008 and monthly between May and September in 2009; • bat activity transect surveys outside the development site boundary in 2010, specifically aimed at recording barbastelle (*Barbastellus barbastellus*) activity; • a winter roost assessment within the development site in early 2009 (predominantly of trees although buildings were externally assessed); • emergence and re-entry surveys of on-site buildings and woodlands containing trees with roosting opportunities, undertaken between June and August in 2009 and 2010, and during April 2011 (when only buildings were surveyed); • emergence and re-entry surveys of off-site woodland in summer 2010 specifically surveying for the potential presence of roosting barbastelle; • continuous deployment of two static Anabats (bat activity data loggers) at a range of locations between June and September 2009 (on-site), and between May and October 2010 (predominantly off-site and specifically to record barbastelle activity); • climbing inspections of trees with roost potential in 2009 and 2010; and • internal inspections of buildings using a pole-mounted camera in 2009.

Survey	Appendix Ref	Description
Dormouse (*Muscardinus avellanarius*)	Appendix 20G	Suitable habitat within part of the development site was surveyed for the presence of dormouse between June and November 2007, then continued (over a larger area when access was possible to the full development site) in 2008 and 2009. The survey methodology was designed with reference to the Dormouse Conservation Handbook (Ref. 20.55).
Otter	Appendix 20H	All water features (watercourses and water bodies) within the development site, and selected locations within approximately 5km of the development site, were surveyed for signs of otter in May 2009 (after an initial otter survey in August 2007). The survey methodology was designed with reference to Monitoring the Otter (Ref. 20.56).
Water vole (*Arvicola amphibius*)	Appendix 20H	All water features within the development site that had been identified during the extended Phase 1 habitat survey were surveyed for evidence of water vole in either August 2007 or September 2008, and again in May 2009. The survey methodology was designed with reference to the Water Vole Conservation Handbook (Ref. 20.57).
Great crested newt	Appendix 20I	In March 2009, a study was undertaken to identify all water bodies within, and within 500m of the development site. A screening assessment was then undertaken, whereby each water body identified was visited to assess its suitability to support breeding great crested newts, taking account of the Habitat Suitability Index (HSI) Guidelines (Ref. 20.58) and the connectivity between the water body and the development site. Where the screening assessment determined that a water body may provide suitable habitat for great crested newts, and it was determined that, if present, they could access the development site, then the water body was 'screened in' to a four visit presence/absence survey, which was undertaken between March and June 2009 using a methodology that was designed with reference to the Great Crested Newt Mitigation Guidelines (Ref. 20.32).
Reptiles	Appendix 20J	Areas of potentially suitable reptile habitat within and adjacent to the development site were surveyed in 2007, 2008 and 2009 to establish the presence/likely absence of reptiles and, where found to be present, to provide information for a population size class estimate. The survey methodology was designed with reference to guidance in Froglife's Advice Sheet 10 (Ref. 20.59) and additional guidance provided by the Herpetofauna Workers' Manual (Ref. 20.60) and Reptiles: Guidelines for Developers (Ref. 20.61).
Invertebrates	Appendix 20K Appendix 20L	A walkover survey in August 2008 and a freshwater invertebrate sampling visit in September 2008 were conducted to provide an initial assessment of the likely value of the development site to invertebrates. This survey work was then updated in 2009, when the watercourses within the survey area were further surveyed for freshwater invertebrates, and representative terrestrial habitats were surveyed for terrestrial invertebrates. In 2010 an invertebrate habitat assessment survey of the coastal zone was completed.

c) Consultation

20.4.15 Consultation has been undertaken throughout the EIA process and further information may be found in the Consultation Report. Consultation was undertaken with the organisations that are listed in **Table 20.3**, in order to discuss the scope of and approach to be taken to ecological surveys, the results of these surveys and the scope of any potential mitigation required.

Table 20.3: Consultation Undertaken to Inform the Assessment of Impacts on Biodiversity

Consultee	Date of Meeting	Primary Subject of Meeting
Natural England	07 June 2007	Scope of ecological surveys
	22 June 2009	
	05 March 2008	Scope of EIA (multi-disciplinary meeting)
	22 June 2009	Results of survey work, mitigation and other environmental measures
	07 October 2009	
	07 December 2009	
	23 March 2010	
	28 April 2009	Badger mitigation and licensing
	23 July 2009	
	27 October 2009	
	01 March 2010	
	23 March 2010	Mitigation and enhancement works, including development site restoration
	20 January 2011	Results of bat survey work
	24 January 2011	Mitigation and enhancement works, including restoration of the development site
	11 April 2011	Summary of work since Stage 2 consultation
	15 July 2011	Summary of ornithological data and of the assessment of disturbance and thermal effects, and discussions of modelling protocols
Somerset County Council	22 June 2009	Scope of ecological surveys
	22 June 2009	Results of survey work, mitigation and other environmental measures
	27 October 2009	
	07 December 2009	
	23 March 2010	Mitigation and enhancement works, including restoration of the development site
	24 January 2011	
	28 April 2009	Badger mitigation and licensing
	20 January 2011	Results of bat survey work
	11 April 2011	Summary of work since Stage 2 consultation
	15 July 2011	Summary of ornithological data and assessment of disturbance and thermal effects and discussions of modelling protocols
Environment	22 June 2009	Scope of ecological surveys

Consultee	Date of Meeting	Primary Subject of Meeting
Agency	05 March 2008	Scope of EIA (multi-disciplinary meeting)
	22 June 2009	Results of survey work, mitigation and other environmental measures
	07 December 2009	
	23 March 2010	Mitigation and enhancement works, including restoration of the development site
	15 July 2011	Summary of ornithological data and of the assessment of disturbance and thermal effects, and discussions of modelling protocols
Somerset Wildlife Trust	24 April 2009	Scope of ecological surveys
	01 October 2009	Results of survey work, and discussion of mitigation and conservation gain, and other environmental measures
	07 December 2009	
	23 March 2010	Mitigation and enhancement works, including restoration of the development site
	24 January 2011	
	20 January 2011	Results of bat survey work
Royal Society for the Protection of Birds	03 October 2007	Scope of ornithological surveys
	22 June 2009	
	09 February 2010	Results of survey programme, key findings, mitigation and HRA
	15 July 2011	Summary of ornithological data and of the assessment of disturbance and thermal effects, and discussions of modelling protocols
West Somerset Council (represented by Arup)	20 January 2011	Results of bat survey work
	24 January 2011	Mitigation and enhancement works, including restoration of the development site
	11 April 2011	Summary of work since Stage 2 consultation
	15 July 2011	Summary of ornithological data and of the assessment of disturbance and thermal effects, and discussions of modelling protocols

20.4.16 No surveys were required in relation to the highway improvement sites, other than the extended Phase 1 habitat survey (for which consultation was not required).

d) Scoping the Assessment

20.4.17 The first part of the assessment process was to undertake a scoping exercise. This involved differentiating the biodiversity receptors (i.e. designated sites, habitats and species' populations) that could be significantly affected by the proposed development and that therefore required more detailed assessment, from those receptors that are not likely to be significantly affected and did not require further assessment (i.e. they were 'scoped-out' of the assessment).

20.4.18 The first stage of the approach that was used for determining which receptors have the potential to be significantly affected by the proposed development involved using baseline data (collected by the desk study and field surveys) for the development site and up to 2km away (up to 10km away for European designated nature conservation sites)[5] to determine:

- which, if any of the species that have been recorded are legally protected or controlled (see **Appendix 20M**, Box 20M.2); and/or
- which, if any, sites, areas of habitat and species that have been recorded are of importance for biodiversity conservation, notwithstanding any legal protection that they may have (see **Appendix 20M**, Box 20M.1).

20.4.19 Use of these categories provides a robust and objective basis for focusing the assessment on receptors that are widely recognised to be important for the conservation of biodiversity in addition to those that are legally protected. It should be noted, however, that legally protected species may be protected for reasons other than for biodiversity conservation (e.g. badger, which is protected for welfare reasons).

20.4.20 For sites/habitats/species that are important for biodiversity conservation, the next stage of the scoping assessment was to determine whether the receptors are likely to be of sufficient 'value' that an impact upon them could be significant. In this context, value refers to a receptor being of sufficient quality (for sites and habitats) or size (for sites, habitats or species' populations). The distinction between importance and value can be illustrated by the great crested newt, which, as well as being legally protected, is important at a national level because it is a species of principal importance for biodiversity (Ref. 20.16). However, depending on the local abundance of this species, a small affected population might be anywhere between low or high biodiversity value.

20.4.21 The findings of the valuation of important receptors, together with information about whether receptors are legally protected, are set out in Table 20N.1 in **Appendix 20N**. For those receptors that are assessed as being of insufficient value for impacts to be significant, this appendix provides a justification for this conclusion.

20.4.22 Important receptors that are of sufficient value that an impact upon them could be significant, together with all legally protected species, were then taken through to the next stage of the scoping assessment. This involved identifying, for each receptor, any environmental changes that are likely to be caused by the proposed development, which have the potential to lead to a significant impact. Then the area was determined within which the environmental change could cause a significant impact on the receptor; this area is referred to as an 'ecological zone of influence'. The area where the receptor occurs was then compared with the ecological zone of influence. If the receptor occurs or is likely to occur within the zone of influence it was 'scoped in' to further assessment (Table 20N.2 in **Appendix 20N**).

20.4.23 The ecological zone of influence that is the most straightforward to define is the area affected by land take and land cover changes associated with the development. This zone is the same for all affected receptors. By contrast, for each environmental change that can extend beyond the area affected by land take and land cover

[5] There was also the possibility that other receptors could be identified as potentially being affected, based on the study team's experience of the local area.

change (e.g. changes in noise), the zone of influence may vary between receptors, dependent upon the receptors' sensitivity to the change and the precise nature of the change.

20.4.24 For example, one bird species might be unaffected by noise unless the noise is generated very close to where the bird nests, whilst another bird species might be disturbed at much greater distances; other species (e.g. of invertebrate) may be unaffected by changes in noise. A further complication is that the response of a receptor to a change associated with one development may differ to the response of the same receptor to a similar change on another development. This can occur as a result of the wide range of variables that influences the precise nature of any change (e.g. for noise this can include differing baseline noise conditions, specific magnitude, timing or other characteristics of the noise, and the effects of screening and topography).

20.4.25 In view of these complexities, the definition of the zones of influence that extend beyond the land take area was based upon professional judgement, informed by discussions with the technical specialists who were working on other chapters of the ES. These specialists provided information about the environmental changes that they assessed in their ES chapters. This information was then combined with available ecological information about different receptors' sensitivity to different environmental changes in order to define the extent of each ecological zone of influence. The potential outcome of this was that a zone of influence could be so extensive that a larger than expected species population or area of habitat could be affected, which in turn could lead to the potential for an impact to be significant when it was previously assessed that this would be unlikely. As a consequence, receptors that were initially scoped-out could be scoped back into the assessment.

20.4.26 Each relevant receptor (i.e. that is of sufficient value or is legally protected, as described above), which was located wholly or partly within one or more zones of influence, was then subject to further scoping assessment in relation to the relevant environmental change(s). The spatial extent of this assessment reflected the area occupied by the receptor. Thus, if part of a designated nature conservation site was located within a zone of influence, an assessment was made of the impacts on the site as a whole. A similar approach was taken for areas of notable habitat. For species that occur within an ecological zone of influence, an assessment was carried out on the total area that is used by the affected individuals of the species (e.g. for foraging or as a breeding territory).[6]

20.4.27 This final stage of the scoping assessment involved drawing upon available information about the magnitude and other characteristics of the environmental changes and the sensitivity of each relevant receptor to these changes, to arrive at a conclusion about the potential for a significant impact to occur. Where there was the potential for a significant impact, or contravention of protected species legislation, the receptor was taken forward for further 'post-scoping' assessment (see sub-section (d) below) as identified in the final column of Table 20N.2 in **Appendix 20N**.

[6] The affected individuals may, for example, be a pair of birds, a badger clan associated with a main sett or the population of great crested newts in a pond. Where appropriate, the area for which data were required was extended (e.g. to include other pairs of birds in a discrete subpopulation, or a metapopulation of newts).

20.4.28 In undertaking the sequence of steps that are described above, it was recognised that if the environmental changes could significantly affect biodiversity resources further than 2km from the development site (or 10km for European designed sites), the data-collection area would need to be extended. Further data collation would also be required if there were insufficient biological data for any receptor that could be significantly affected by the proposed development. However, neither scenario arose.

e) Assessment Methodology

20.4.29 The assessment of potentially significant biodiversity impacts in this ES draws upon:

- the results of desk study and field survey work;
- relevant published information on potential biodiversity receptors' status, distribution, biology and sensitivity to environmental changes (referenced in the text where used); and
- professional knowledge of ecological processes and functions.

20.4.30 Throughout the assessment process, the findings of the assessment were used to inform the design of the proposed development and identify requirements for any additional baseline data. As a result of this iterative process, environmental measures to avoid, reduce or offset impacts on potential biodiversity receptors were incorporated into the scheme design or identified as mitigation.

20.4.31 The remainder of this section outlines the approach that has been adopted to assessing the significance of impacts, which draws upon information about biodiversity value and the magnitude of impacts. It should be noted that the assessment has been undertaken in relation to each biodiversity receptor that could be significantly affected and/or that is legally protected (as identified in the final column of Table 20N.2 in **Appendix 20N)**, considering that the impact on each receptor could be the result of more than one type of environmental change caused by the development. For example, a receptor might be affected by land take and construction noise.

i. Value of Receptor

20.4.32 Sites, species' populations and areas of habitats have been valued as shown in **Table 20.4.** It should be noted that, in respect of species, the approach taken is to determine the value of the development site for the species under consideration, rather than the biodiversity conservation importance of the species itself (as discussed above in relation to scoping).

Table 20.4: Definition of Terms Relating to Biodiversity Value

Value Level	Value Guidelines
High	International/National designations – SACs, SPAs, Ramsar sites and SSSIs. Cited features of internationally/nationally designated sites. Species populations or habitat areas that are of major importance because of the quality/size of the habitat or the size of the species population in relation to the wider habitat resource/population – species/habitats are most likely to be species/habitats of principal importance under Section 41 of the NERC Act (and UK BAP priority habitats/species), species/habitats that are nationally rare and/or species that are legally protected. The regular occurrence of internationally/nationally important numbers of waterfowl (i.e. 1% or more of the relevant international or national population respectively).
Medium	County Wildlife Sites (CWSs). Features for which CWSs have been designated. Species populations or habitat areas that are of moderate importance because of the quality/size of the habitat or the size of the species population in relation to the wider habitat resource/population – species/habitats are most likely to be species/habitats of principal importance under Section 41 of the NERC Act (and UK BAP priority habitats/species), priority species/habitats in the Local BAP, species/habitats that are rare at the regional/county level and/or species that are legally protected.
Low	Other designated sites of district or local importance including Local Nature Reserves (LNRs), except where these have a higher additional designation. Species populations or habitat areas that are of some biodiversity value because of the quality/size of the habitat or the size of the species population in relation to the wider habitat resource/population – species/habitats are most likely to be species/habitats of principal importance under Section 41 of the NERC Act (and UK BAP priority habitats/species), priority species/habitats in the Local BAP, species/habitats that are rare at the district/local level and/or species that are legally protected species.
Very Low	Species populations or habitat areas that are of very low biodiversity value, typically because they are common and/or are not species/habitats of principal importance under Section 41 of the NERC Act, UK BAP priority habitats/species, priority species/habitats in the Local BAP, species/habitats that are rare at the district/local level and/or legally protected species.

ii. Magnitude of Impact

20.4.33 Using information about the way in which sites/habitats/species are likely to be affected by the proposed development, each impact that is assessed has been assigned a level of ‘magnitude’, based on the definitions that are set out in **Table 20.5.**

Table 20.5: Guidelines for the Assessment of Impact Magnitude

Magnitude of Impact	Criteria
High	The change permanently (or over the long-term) adversely affects the conservation status of a habitat/species, reducing the ability to sustain the habitat or the population level of the species within a given geographic area. Relative to the wider habitat resource/species population, a large area of habitat or large proportion of the wider species population is affected. For designated sites, integrity is compromised. There may be a decrease in the level of biodiversity conservation value of the receptor.
Medium	The change permanently (or over the long-term) adversely affects the conservation status of a habitat/species reducing the ability to sustain the habitat or the population level of the species within a given geographic area. Relative to the wider habitat resource/species population, a small-medium area of habitat or small-medium proportion of the wider species population is affected. There may be a decrease in the level of biodiversity conservation value of the receptor.
Low	The quality or extent of designated sites or habitats or the size of species' populations, experience some small scale reduction. These impacts are likely to be within the range of natural variability and there is not expected to be any permanent change in the conservation status of the species/habitat or integrity of the designated site. The change is unlikely to modify the evaluation of the receptor in terms of its biodiversity conservation value.
Very Low	Although there may be some impacts on individuals or parts of a habitat area or designated site, the quality or extent of sites and habitats, or the size of species populations would experience little or no reduction. Any impacts are likely to be within the range of natural variability and there would be no short-term or long-term effects on the conservation status of habitat/species receptors or the integrity of designated sites.
Beneficial	Improvement in the quality or extent of habitats, the size of species populations or the integrity of a designated site. This improvement must be achieved without compromising the integrity of the proposed development site or conservation status of the habitat/species that is present prior to development. Criteria for assessing the magnitude of beneficial effects can be derived from the definitions of adverse impacts.

20.4.34 The criteria in **Table 20.5** refer to the terms 'integrity' and 'conservation status'. The 'integrity' of a site, as referred to in **Table 20.5**, is defined as:

> *"the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified." (Ref. 20.31).*

20.4.35 Conservation status is defined differently for habitats and species (Ref. 20.31), as:

> *"For habitats, conservation status is determined by the sum of the influences acting on the habitat and its typical species, that may affect its long term distribution, structure and functions, as well as the long-term survival of its typical species within a given geographical area.*
>
> *For species, conservation status is determined by the sum of influences acting on the species concerned that may affect the long term distribution and abundance of its populations within a given geographical area."*

iii. Significance of Impacts

20.4.36 The significance of an impact is established with reference to Table 7.4 in **Volume 1, Chapter 7** of this ES, which sets out how, subject to moderation informed by professional judgement, the level of significance is derived from information about the magnitude of the impact and the value of the receptor. The only exception to this is for legally protected species, for which any contravention of the law is assessed as an impact of major significance irrespective of the magnitude of the impact or the biodiversity conservation value of the population that is affected.

iv. Cumulative Impacts

20.4.37 **Volume 1 Chapter 7** of this ES refers to the methodology used to assess cumulative impacts. Additive and interactive effects between impacts generated within the development site boundary and study area are assessed within this chapter. Cumulative impacts that consider activities and impacts generated at distance from the development site and study area are considered in **Volume 11** of this ES; this assesses the project-wide cumulative impacts and in-combination impacts with other proposed, or reasonably foreseeable projects.

f) Limitations, Constraints and Assumptions

20.4.38 No limitations, constraints or assumptions have been identified that would have a bearing on the assessment of likely significant impacts on biodiversity.

20.5 Baseline Environmental Characteristics

a) Introduction

20.5.1 Sub-section b below describes the biodiversity baseline of the study area (**Figure 20.1**), which includes desk study information obtained for a 3km radius around the development site (10km for European designated nature conservation sites and bat records), and field survey results from within the development site and the immediate surrounding 100m. The detailed results of each survey are described in the Baseline Reports in **Appendices 20A to 20L and 20Q**. A list of records of notable species (as defined in **Appendix 20M**), which was provided by SERC, is contained within **Appendix 20O**.

20.5.2 Information about the biodiversity baseline at the highway improvement sites is outlined in sub-section c below (and detailed in **Appendix 20P**). Given the small size of the highway improvement sites, desk study data were collected for 500m around each site and field survey data from within each site.

b) HPC Study Area Description

i. Designated Sites

20.5.3 The development site is located adjacent to five statutory designated nature conservation sites (see **Table 20.6** and **Figure 20.2**). There is one additional European designated nature conservation site within 10km of the development site (**Figure 20.3**). The development site is partially located within Strategic Nature Area 1169, Maritime Cliff and Slope, which extends along much of the coastline between Minehead and Bridgwater.

Table 20.6: Designated Statutory Nature Conservation Sites within 3km of the Development site (within 10km for European designated sites)

Site	Type of Designation	Location in relation to the development site	Reason for Designation
Severn Estuary	SPA	Adjacent to the development site	This site has been designated for its wintering populations of Bewick's swan (*Cygnus columbianus*), white-fronted goose (*Anser albifrons*), shelduck (*Tadorna tadorna*), gadwall (*Anas strepera*), dunlin (*Calidris alpina*) and redshank (*Tringa totanus*), and its wintering waterfowl assemblage.
Severn Estuary	SAC	Adjacent to the development site	This site has been designated for the following habitats and species: • estuaries; • intertidal mudflats and sandflats; • Atlantic salt meadows; • sandbanks; • reefs; and • three species of migratory fish: sea lamprey (*Petromyzon marinus*); river lamprey (*Lampetra fluviatilis*); and twaite shad (*Alosa fallax*).
Severn Estuary	Ramsar site	Adjacent to the development site	This site has been designated for the following habitats and species: • all SAC features (see above); • unusual estuarine communities associated with reduced productivity and diversity; • migratory fish, including sea trout (*Salmo trutta*), salmon (*Salmo salar*), Allis shad (*Alosa alosa*) and eel (*Anguilla anguilla*) in addition to the cited SAC species; • migratory birds in spring and autumn; • wintering waterfowl assemblage; and • internationally important wintering numbers of Bewick's swan, white-fronted goose, gadwall, shelduck, dunlin and redshank.

Site	Type of Designation	Location in relation to the development site	Reason for Designation
Bridgwater Bay	SSSI	Adjacent to development site	The site has been designated for the following habitats and species: • mudflats; • saltmarsh; • shingle beach; • grazing marsh; • internationally and nationally important numbers of wintering and passage wildfowl including (in addition to species cited in other designations) black-tailed godwit (*Limosa limosa*), teal (*Anas crecca*) and grey plover (*Pluvialis squatarola*); • a diverse invertebrate fauna of ponds and ditches; and • the ecological link to the Somerset Levels and the position of the area in the context of the Severn Estuary.
Bridgwater Bay	NNR	Adjacent to the development site	The site has been designated for its diverse habitats and plant communities, which support important bird populations.
Exmoor and Quantocks Oakwoods	SAC	5.2km to the south-west	The site has been designated for the following habitats and species: • old sessile oak woods in conjunction with heath; • alluvial forests with alder (*Alnus glutinosa*) and ash (*Fraxinus excelsior*); • barbastelle bat; • Bechstein's bat (*Myotis bechsteinii*); and • otter.

20.5.4 In addition to the bird species for which the Severn Estuary Ramsar site has been designated (under Criterion 6 of the Ramsar Convention), as set out in **Table 20.6**, other bird species occur at nationally important levels during the breeding season, passage periods and over-winter. These are herring gull (*Larus argentatus*), little egret (*Egretta garzetta*), ruff (*Philomachus pugnax*), whimbrel (*Numenius phaeopus*), curlew (*Numenius arquata*), greenshank (*Tringa nebularia*), wigeon (*Anas penelope*), shoveler (*Anas clypeata*), pochard (*Aythya ferina*), water rail (*Rallus aquaticus*) and spotted redshank (*Tringa erythropus*). Species identified on the Ramsar Information Sheet for possible future consideration under Criterion 6 are lesser black-backed gull (*Larus fuscus*), ringed plover (*Charadrius hiaticula*), teal and pintail (*Anas acuta*).

20.5.5 In relation to the SPA, the list in **Table 20.6** reflects the Natura 2000 Standard Data Form. Changes that have been suggested by the document, The UK SPA network: its scope and content (the 'SPA review') (Ref. 20.62) are the removal of white-fronted goose and gadwall (which no longer meet qualifying levels), and the addition of passage ringed plover and wintering curlew and pintail. The SPA Review has yet to be formally adopted, although, in practice, recommended additions are treated as SPA species.

20.5.6 One non-statutory designated site (County Wildlife Site – CWS) lies partially within the development site and a further seven are located within 3km (see **Table 20.7** and **Figure 20.4**).

Table 20.7: Designated Non-Statutory Sites within 3km of the Development site

Site	CWS Reference Number	Location in relation to the development site	Reason for Designation
Hinkley CWS	ST24/043	Partly within the development site boundary.	The site supports species-rich scrub, coastal grassland and broad-leaved woodland with ponds and areas of improved grassland. Designated specifically for the presence of Somerset County Notable vascular plant species, including grass vetchling (*Lathyrus nissolia*), pyramidal orchid (*Anacamptis pyramidalis*), Dyer's greenweed (*Genista tinctonia*) and yellow-wort (*Blackstonia perfoliata*).
Blue Anchor to Lilstock Coast CWS	ST24/051	0.1km to the west	Coastal cliffs, with unimproved calcareous grassland and scrub habitats from Blue Anchor to Lilstock
Cole Pool Field CWS	ST14/103	0.7km to the south south-west.	Field with unimproved neutral and marshy grassland and semi-improved areas
Mud House Copse CWS	ST24/003	1.2km to the south-east	Ancient semi-natural broad-leaved woodland
Honibere Wood CWS	ST14/046	1.3km to the west	A large tract of hedged, embanked and ditched ancient semi-natural woodland occupying very wet-lying ground on coastal strip of county (north of Stringson)
Wick Park Covert CWS	ST24/002	1.4km to the south-east	Ancient semi-natural broad-leaved woodland bisected by road
Martin's Wood CWS	ST14/070	1.4km to the south-west	A more or less square tract of ancient semi-natural woodland, with a hedge, ditch and embankment around its perimeter and with a small stream flowing eastwards along its southern edge
Monk Wood CWS	ST24/001	1.5km to the south-east	Broad-leaved ancient woodland
Fairfield House Park CWS	ST14/099	1.5km to the south-west	Parkland site marked on the 1st edition Ordnance Survey map, with an important assemblage of veteran trees
Cross Elms CWS	ST14/027	1.9km to the west	Small field of unimproved grassland and adjacent semi-natural broad-leaved woodland
Pophams Park CWS	ST14/045	2.1km to the south-west	Small area of deciduous woodland situated on flat ground
Fairfield Wood CWS	ST14/047	2.6km to the south-west	A large tract of high-forest, partly ancient woodland, straddling a stream which marks

Site	CWS Reference Number	Location in relation to the development site	Reason for Designation
			the boundary between Nether Stowey and Stringston parishes on essentially level and rather low-lying ground amidst arable and grassland
Quarry Copse CWS	ST14/054	2.8km to the south-west	A small copse of ancient woodland (tithe map) origin on relatively high ground north of Stringston
Claylands Corner Verge CWS	ST24/004	2.9km to the south-east	Roadside verge with species-rich unimproved neutral grassland supporting diverse invertebrate fauna, flanked by tall hedge/tree-belt and with advancing scrub
New Barn Wood CWS	ST24/017	2.9km to the south-east	Ancient semi-natural broad-leaved woodland with broad-leaved plantation

ii. Habitats

20.5.7 The results of the Phase 1 Habitat Survey are presented in **Figure 20.5** and summarised below. The habitats are described in detail in the Habitat Report in **Appendix 20A**.

Overview

20.5.8 The development site comprises open, gently rolling, mixed lowland farmland with hedgerows of variable quality, small scrubby woodlands and occasional standard trees. Although, much of the area is intensively managed, small areas of species-rich calcareous grassland occur along the cliff edge and the immediate vicinity of the existing Hinkley Point Power Station Complex. The latter form part of the Hinkley CWS, which also includes areas of woodland, scrub and other habitats. There is a lane with tall, species-rich hedgerows along much of its length aligned east-west along the low ridge across the approximate centre of the development site, this being referred to hereafter as ‘Green Lane’.

20.5.9 There is one water body within the development site boundary and two streams – the Holford Stream and HPC Drainage Ditch. The former flows west-east across the development site and connects to the Bridgwater Bay SSSI, whilst the latter discharges to the inter-tidal area to the north, which is also part of this SSSI, as well as being part of the Severn Estuary SAC, SPA and Ramsar site. A further watercourse forms the southern boundary of the development site (Bum Brook).

20.5.10 The northern boundary of the development site lies adjacent to Bridgwater Bay, from which it is separated by a low cliff, between zero and ten metres in height, which forms an escarpment between the land and sea. At low tide, the shore adjacent to the development site comprises a relatively narrow expanse of rock (extending to approximately 200m from the cliff and running parallel to it), interspersed with and fringed by muddy sand. Inter-tidal areas to the west include more extensive areas of mobile sand, while to the east, adjacent to the existing Hinkley Point Power Station Complex, the inter-tidal rock platforms, mud and sand extend up to 500m from the upper shore at low water (see **Chapter 19**, **Volume 2** of this ES).

Grassland

20.5.11 Most of the grassland within the development site is agriculturally improved and species-poor pasture dominated by perennial rye-grass (*Lolium perenne*) with abundant white clover (*Trifolium repens*). In a small number of fields, the sward is more structurally diverse and supports a greater range of species including creeping cinquefoil (*Potentilla reptans*), bulbous buttercup (*Ranunculus bulbosus*) and meadow vetchling (*Lathyrus pratensis*) (**Figure 20.5**, Target Notes [TNs] 1 and 3). A further area of grassland (around TN 2) is being managed, through a Countryside Stewardship agreement with NE, to gradually create a neutral to calcareous grassland community.

20.5.12 The four areas of grassland surveyed using the NVC survey methodology support a variety of species and grassland types, as described below.

- Grassland along and adjacent to the coastal footpath between the fence and the soft cliff edge: this calcareous grassland is generally only a few metres wide and has been narrowed in places by scrub invasion. It is species-rich, with notable species including adder's tongue (*Ophioglossum vulgatum*), bee orchid (*Ophrys apifera*) and carline thistle (*Carlina vulgaris*) (all of which are listed within the Somerset Notable Species Dictionary as 'uncommon'). This grassland community has closest affinity to the NVC community MG5(b) crested dog's tail (*Cynosurus cristatus*) – black knapweed (*Centaurea nigra*) grassland, lady's bedstraw (*Galium verum*) sub-community.
- Grassland along the western edge of the existing power station complex: grasses dominate the short (15 – 20cm) species-rich sward, within which notable species include grass-vetchling and dyer's greenweed. This grassland is intermediate between MG5 crested dog's tail-black knapweed grassland and MG1(e) false oat grass (*Arrhenatherum elatius*) grassland, black knapweed sub-community.
- Grassland associated with the young broad-leaved plantation (Bishop's Wood): the area is currently a young plantation, and the central part and the various tracks that radiate from it have a community that is classified as conforming to a mixture of MG6a perennial rye grass-crested dog's tail grassland and MG1 false oat grass grassland. However, the sward is moderately species-rich and has occasional common centaury (*Centaurium erythraea*), yellow-wort and pyramidal orchid, which suggest a slight calcareous influence.
- Grassland adjacent to Holford Stream: this is classified as MG10a Yorkshire fog – soft rush (*Holcus lanatus*-*Juncus effusus*) rush-pasture. The vegetation is generally very species-poor, although the northern part of the field is slightly more species-rich. The only notable species that has been recorded is grass vetchling, which is scattered throughout.

Woodland

20.5.13 There are seven areas of mature, semi-natural broad-leaved woodland within the development site, all of which are small, ranging in size between 0.1ha and 0.9ha. They are well connected to each other by the network of hedgerows, but none are adjacent to extensive areas of semi-natural habitat.

20.5.14 Although the structure and characteristic dominant species in each woodland varies slightly, all the woods, apart from Woodlands C and F (**Appendix 20A**), correspond broadly to NVC community W8 ash-field maple-dog's mercury (*Fraxinus excelsior – Acer campestre – Mercurialis perennis*) . Based on the species-poor ground flora in Woodlands A (Newclose Covet), D (Whitewall Brake), E and G (Govett's Copse), these show affinity with the ivy (*Hedera helix*) sub-community of W8. Woodland B supports few ash or field maple trees as it is dominated by English elm (*Ulmus procera*). Due to this dominance of elm, Woodland B (Haysgrove Brake) corresponds closer to the herb-Robert (*Geranium robertianum*) sub-community of W8, in which elm frequently occurs in varying abundance.

20.5.15 Woodlands C (Seaberton Brake) and F support little ash and field maple, whilst scrub species such as hawthorn (*Crataegus monogyna*) and blackthorn (*Prunus spinosa*) are dominant. Therefore, these woodlands correspond better with NVC community W21 hawthorn-ivy (*Crataegus monogyna – Hedera helix*) scrub. Again, due to the dominance of ivy in the ground flora, the ivy-common nettle (*Hedera helix – Urtica dioica*) sub-community fits best with the species present in both woodlands.

20.5.16 None of the woodlands within the development site are assessed as being ancient (i.e. they were not present prior to 1600AD) and many have only developed over the last 100 years. The recent development of the woodlands is likely to contribute significantly to their species-poor and structurally similar character.

20.5.17 In the southern part of the development site there are two areas of plantation woodland. The larger of these, Bishop's Wood (TN9 on **Figure 20.5**), was planted with native broad-leaved trees and shrubs in winter 1998/1999. Its ground flora contains a variety of grassland species including cowslip (*Primula veris*) and is moderately species-rich. The smaller area of plantation woodland (TN10) has also been planted with native broad-leaved species. However, tall ruderal vegetation, such as nettle (*Urtica dioica*) and creeping thistle (*Cirsium arvense*), dominates the ground flora.

Hedgerows

20.5.18 Of the 58 hedgerows within or directly adjacent to the development site, the survey concluded that 37 meet the criteria for classification as being ecologically 'important' under Paragraph 7 of Schedule 1 of the Hedgerows Regulations 1997 (Ref. 20.15). Seventeen of these hedgerows support seven or more woody species within each 30m section surveyed (although 25 of the hedgerows support seven or more woody species within their entire length). The maximum number of woody species recorded growing in a hedgerow was 12, with five other hedgerows supporting ten or 11 species.

20.5.19 Hawthorn and blackthorn are the commonest hedgerow species within the development site. The ground flora associated with all the hedgerows is species-poor and generally contains few of the woodland flora species that are listed on Schedule 2 of the Hedgerows Regulations (Ref. 20.15). Many of the hedgerows within the development site are located on banks or adjacent to ditches or both, but few of the hedgerows contain standard trees. Most of the hedgerows have gaps constituting less then 10% of their length.

20.5.20 Green Lane, which is located in the centre of the development site, is bounded along its entire southern boundary by a mature hedgerow located on a steep bank and dominated by elm, but also supporting blackthorn, elder (*Sambucus nigra*) and wild privet (*Ligustrum vulgare*). Along part of the lane, a mature hedgerow is also present to the north, which is species-rich and supports species such as wild privet, wayfaring tree (*Viburnum lantana*) and field rose (*Rosa arvensis*).

Watercourses

20.5.21 The two minor watercourses within the development site are poorly connected, seasonal or ephemeral, are encroached in places by ruderal vegetation and show signs of having been affected by agricultural activity.

20.5.22 The HPC Drainage Ditch is approximately 1km in length and varies in width between 0.5m and 1m. It has a steady flow of water during the wetter, winter months with an estimated depth of 0.2-0.3m, but the section upstream of Woodland A is dry for much of the year. The watercourse passes through three culverts and has earth banks (some of which have been re-profiled) along its entire course. Approximately 70% of the stream bed has a muddy substrate. The north-eastern section of the watercourse has sparse bank-side and channel vegetation limited to fool's water cress (*Apium nodiflorum*), hemlock water-dropwort (*Oenanthe crocata*) and bramble (*Rubus fruticosus* agg.). Within Woodland D (Whitewall Brake), the banks support a range of ruderal and marginal species, and mature trees, including crack willow (*Salix fragilis*) and hawthorn.

20.5.23 Holford Stream is between 0.5 and 1m wide and varies in depth between 0.1 and 1m. The watercourse passes through five culverts and under one stone bridge. The western section of the watercourse is ephemeral, and supports well established grassland and ruderal vegetation. The central section, which dries out during summer, is extensively cattle-poached. Freshwater plants in the channel are limited to fool's-watercress and brooklime (*Veronica beccabunga*). The eastern part of the watercourse is less cattle-poached.

20.5.24 Bum Brook, which runs along the southern boundary of the development site, is less ephemeral than the other watercourses on the site. It varies in width and depth, but along most of the section adjacent to the development site it was (at the time of survey) approximately 1m wide and 0.3-0.5m deep. The watercourse is shaded along its western section due to extensive bank vegetation, which includes bramble, nettle, Himalayan balsam (*Impatiens glandulifera*) and great willowherb (*Epilobium hirsutum*), with overhanging semi-mature crack-willow trees. Further downstream the watercourse is unshaded, with species on the banks including cow parsley (*Anthriscus sylvestris*) and hemlock water-dropwort, with branched bur-reed (*Sparganium erectum*) and fools water-cress within the channel. Further downstream, a hedgerow is present on the southern side of the watercourse which again shades the channel.

Water bodies

20.5.25 The single still water body within the development site is located within a wide hedgerow boundary adjacent to an arable field in the north-western part of the site. The pond has a mixture of willow and hawthorn growing in the centre and is prone to drying out (e.g. in July 2009), although it can be over 20m long by 8m wide in wet conditions. The pond supports few aquatic or marginal plants and, although there are areas of open water, the pond is heavily shaded by surrounding scrub and hedgerows.

iii. Birds

20.5.26 The following sections summarise the desk study data relating to birds and the results of the bird survey work. More detailed information about the desk study and survey findings is set out in **Appendix 20B, Appendix 20C** and **Appendix 20Q**.

Breeding Birds: Desk Study Information

20.5.27 Notable breeding bird species that have been recorded on or in the vicinity of the development site include lesser whitethroat (*Sylvia curruca*), which in Somerset is close to the western limit of its breeding range in the UK (Ref. 20.39), and nightingale (*Luscinia megarhynchos*), which has a restricted national distribution and breeds in small numbers that are of county-importance within the scrub to the south of the existing Hinkley Point Power Station Complex. Black redstart (*Phoenicurus ochruros*), which is protected under Schedule 1 of the Wildlife and Countryside Act 1981 (WCA), bred within the Hinkley Point Power Station Complex in 1996. Barn owl, which is another Schedule 1 species, has also nested on the development site. Other notable species that have been recorded include a number of farmland birds that have been subject to rapid population decline over recent years and, as a consequence, are listed as Species of Principal Importance under the NERC Act 2006 (Ref. 20.16) and/or are included in the Birds of Conservation Concern red list (Ref. 20.63).

Breeding Birds: Survey Data

20.5.28 The 2007 breeding bird survey recorded 28 species of breeding bird on the development site (see **Table 20.8**). Ten other species were recorded within 250m of the development site (which, on a conservative basis is used in this chapter as the area within which disturbance impacts are likely to occur – Ref. 20.64). In addition, independently of the survey, Cetti's warbler (*Cettia cetti*) was recorded off-site, but within 250m of it.

Table 20.8: Numbers of Breeding Bird Territories recorded in and within 250m of the Development Site

Species	Number of Territories Recorded within the Development Site Boundary	Number of Territories Recorded within 250m Buffer	WCA Schedule 1	Species of Principal Importance (NERC Act 2006)	Birds of Conservation Concern Red List
Buzzard	0	1			
Pheasant	4	2			
Moorhen	0	1			
Woodpigeon	8	8			
Stock dove	0	2			

Species	Number of Territories Recorded within the Development Site Boundary	Number of Territories Recorded within 250m Buffer	WCA Schedule 1	Species of Principal Importance (NERC Act 2006)	Birds of Conservation Concern Red List
Cuckoo*	1	1		Y	Y
Great spotted woodpecker	0	1			
Skylark	23	13		Y	Y
Rock pipit	0	1			
Wren	22	36			
Dunnock	20	13		Y	
Robin	20	19			
Blackbird	13	9			
Song thrush	7	3		Y	Y
Sedge warbler	2	0			
Reed warbler	3	10			
Garden warbler	0	1			
Lesser whitethroat	3	0			
Whitethroat	34	15			
Blackcap	11	10			
Willow warbler	1	8			
Chiffchaff	19	15			
Goldcrest	1	2			
Blue tit	7	11			
Great tit	8	8			
Long-tailed tit	1	1			
Starling	1	0		Y	Y
Magpie	1	1			
Jackdaw	0	1			
Rook	0	109			
House sparrow	0	1		Y	Y
Chaffinch	20	27			
Greenfinch	7	15			
Goldfinch	5	5			
Bullfinch	0	2		Y	
Linnet	7	5		Y	Y
Yellowhammer	9	7		Y	Y
Reed bunting	3	0		Y	

***** *Cuckoo numbers are difficult to accurately census as they are highly mobile, vocal and have complex breeding ecology. Therefore, it is likely that the number of pairs of cuckoo has been overestimated.*

20.5.29 Cetti's warbler, which is also Schedule 1 listed, was recorded outside of the development site, to the south of the Hinkley Point Power Station Complex. No evidence was found that barn owl or nightingale breed on or within 250m of the development site and there is no further requirement to consider these species within this ES.

Inter-tidal Birds: Desk Study Information

20.5.30 The closest Wetland Bird Survey (WeBS) core count area (the areas counted at high tide annually as part of this national volunteer survey effort) is the large area of mud to the east of Hinkley Point (**Figure 3.1** in **Appendix 20C**); this area is known as Stert Flats and is referred to as 13411. This area regularly supports large aggregations of wading birds and wildfowl (referred to hereafter as waterbirds); peak counts of species that are interest features of the statutory nature conservation sites that adjoin the development site, are shown in **Table 20.9.**

Table 20.9: Selected WeBS High Tide Count Data 2003-2008

Species*	Peak Count (with month when peak count was recorded)					
	2003	2004	2005	2006	2007	2008
Black-tailed godwit	194 (November)	137 (October)	3 (September)	7 (November)	31 (November)	0
Curlew	1,330 (September)	1,380 (July)	1,550 (August)	1,480 (August)	1,450 (August)	425 (January)
Dunlin	8,900 (November)	8,300 (October)	9,300 (December)	11,000 (November)	5,500 (January)	3,500 (January)
Grey plover	170 (December)	190 (October)	146 (March and December)	520 (February)	138 (February)	190 (March)
Pintail	1 (September)	44 (September)	17 (November)	25 (October)	42 (November)	3 (March)
Redshank	583 (November)	950 (December)	380 (December)	580 (January)	469 (November)	680 (March)
Ringed plover	3 (September)	200 (August)	320 (August)	780 (August)	160 (August)	29 (March)
Shelduck	2,145 (September)	1,850 (October)	2,900 (August)	2,480 (September)	1,850 (August)	2,180 (June)
Shoveler	9 (December)	9 (January)	2 (January)	21 (March)	20 (November)	6 (January)
Teal	350 (December	1,800 (October)	720 (November)	1,350 (January)	820 (December)	1,350 (January)
Wigeon	240 (December	500 (November)	940 (November)	950 (January)	820 (January)	940 (January)

* *Bewick's swan, white-fronted goose and gadwall were not recorded during any of the WeBS High Tide surveys.*

20.5.31 The WeBS low tide count sectors BV695, BV696 and BV697 (**Figure 3.1** in **Appendix 20B**) cover all the count sectors included in the inter-tidal bird surveys. During low tide counts in winter 2002/03, the WeBS surveys recorded 13 species; these species and the peak counts recorded are shown in **Table 20.10.**

Table 20.10: WeBS Low Tide Count Data 2002/03

Species	BV695	BV696	BV697
Curlew	0	16	15
Dark-bellied Brent goose	0	0	11
Dunlin	0	10	0
Grey heron	0	3	2
Lapwing	90	4	0
Mallard	0	8	0
Oystercatcher	0	43	24
Pintail	0	30	0
Redshank	0	40	1
Shelduck	0	70	8
Teal	0	6	0
Turnstone	0	5	2
Wigeon	0	90	10

20.5.32 In general the peak numbers recorded were in BV696 which is to the east of the proposed development (approximately 950m away); BV697 that covers the frontage of the proposed development was shown to support relatively low numbers of waterbirds; this difference is expected given the distribution of intertidal habitats in the area.

20.5.33 Other inter-tidal survey data were collected from 2003-2006 in connection with the West Hinkley Wind Farm application (Ref. 20.38). The survey area comprised the inter-tidal area adjacent to the development site, extending to both the east and the west. The surveys found that the only wildfowl species that made regular use of the survey area were shelduck and wigeon and that these species were concentrated in inter-tidal habitat to the east of the existing Hinkley Point Power Station Complex. Amongst the waders that were recorded, curlew was found regularly during the surveys, with a peak count of 70. They ranged across the entire area surveyed, but favoured the inter-tidal mud to the east of the existing Hinkley Point Power Station Complex. Other cited species that were recorded in lower numbers were ringed plover, black-tailed godwit, grey plover and redshank. Non-cited wader species that were recorded included oystercatcher, purple sandpiper (*Calidris maritima*) and turnstone (*Arenaria interpres*).

Inter-tidal Birds: Survey Data

20.5.34 In total, each of five survey locations (see **Figure 2.4** of **Appendix 20C**) were visited on 182 occasions between April 2007 and March 2009. During the survey, 43 species of waders, waterfowl, gulls, terns and other seabirds were recorded. The majority of these species occurred in small numbers and/or sporadically. Fourteen species were recorded that are interest features of the Severn Estuary SPA and Ramsar site, or the Bridgwater Bay SSSI. **Table 20.11** shows summary data of peak counts and frequency of occurrence. **Figures 20.7-20.10** show a graphical representation of the data collected for species that occurred frequently.

Table 20.11: Summary Data from the Intertidal Bird Surveys

Area[1]	Species	No. of Survey Dates when Species was Recorded (and No. as a percentage of 182 survey dates)	SPA/SSSI Population[2]	Summed Peak Count[3]	% of SPA/SSSI Population	% Survey Dates >1%[4]
CS 1-3	Black-tailed godwit	0 (0%)	172	0	0%	0%
CS1-3	Curlew	141 (77%)	3903	25	0.6%	0%
CS1-3	Dunlin	11 (6%)	44624	13	0%	0%
CS1-3	Grey plover	2 (1%)	416	3	0.7%	0%
CS1-3	Lapwing	2 (1%)	12056	35	0.3%	0%
CS1-3	Mallard	44 (24%)	3335	4	0.1%	0%
CS1-3	Pintail	6 (3%)	599	60	10%	1%
CS1-3	Redshank	8 (4%)	2330	1	0%	0%
CS1-3	Ringed plover	44 (24%)	655	33	5%	3%
CS1-3	Shelduck	117 (64%)	3330	500	15%	7%
CS1-3	Shoveler	1 (1%)	561	4	0.7%	0%
CS1-3	Teal	1 (1%)	4709	1	0%	0%
CS1-3	Whimbrel	12 (7%)	171	5	2.9%	3%
CS1-3	Wigeon	40 (22%)	8466	67	0.8%	0%
CS4	Black-tailed godwit	0 (0%)	172	0	0%	0%
CS4	Curlew	121 (66%)	3903	41	1.1%	0.5%
CS4	Dunlin	0 (0%)	44624	0	0%	0%
CS4	Grey plover	0 (0%)	416	0	0%	0%
CS4	Lapwing	4 (2%)	12056	3	0%	0%
CS4	Mallard	21 (12%)	3335	32	1%	0%
CS4	Pintail	18 (10%)	599	20	3.3%	4.4%
CS4	Redshank	7 (4%)	2330	1	0%	0%
CS4	Ringed plover	13 (7%)	655	10	1.5%	0.5%
CS4	Shelduck	81 (45%)	3330	71	2.1%	3.3%
CS4	Shoveler	0 (0%)	561	0	0%	0%
CS4	Teal	2 (1%)	4709	25	0.5%	0%

Area[1]	Species	No. of Survey Dates when Species was Recorded (and No. as a percentage of 182 survey dates)	SPA/SSSI Population[2]	Summed Peak Count[3]	% of SPA/SSSI Population	% Survey Dates >1%[4]
CS4	Whimbrel	14 (8%)	171	4	2.3%	3.8%
CS4	Wigeon	66 (36%)	8466	220	2.6%	8.8%
CS5	Black-tailed godwit	2 (1%)	172	100	58.1%	1.1%
CS5	Curlew	117 (64%)	3903	63	1.6%	0.5%
CS5	Dunlin	1 (1%)	44624	9	0%	0%
CS5	Grey plover	0 (0%)	416	0	0%	0%
CS5	Lapwing	13 (7%)	12056	102	0.8%	0%
CS5	Mallard	32 (18%)	3335	51	1.5%	0.5%
CS5	Pintail	30 (16%)	599	48	8%	12.1%
CS5	Redshank	5 (3%)	2330	22	0%	0%
CS5	Ringed plover	1 (1%)	655	4	0%	0%
CS5	Shelduck	152 (84%)	3330	700	21%	55.5%
CS5	Shoveler	3 (2%)	561	4	0%	0%
CS5	Teal	3 (2%)	4709	14	0%	0%
CS5	Whimbrel	15 (8%)	171	8	4.7%	4.9%
CS5	Wigeon	82 (45%)	8466	204	2.4%	6.6%

[1] The area has been separated into Count Sectors 1-3, 4 and 5 to coincide with the assessment of effects.

[2] Use has been made of the Severn Estuary SPA population of each species, this being the qualifying population (in the Natura 2000 Data Form or SPA Review) or, for assemblage species, the 5 year peak mean count for 2004/05 to 2008/09 inclusive, as shown in the 2008/09 annual WeBS report (Ref. 20.65). It should be noted that little egret, herring gull and black-tailed godwit are not designated features of the Severn Estuary SPA either as individual or assemblage species. This is evidenced by there being no mention of them within the Natura 2000 data form, SPA review or description of features by NE and the Countryside Council for Wales in the Severn Estuary European Marine Site Regulation 33 report (Ref. 20.66). Little egret and herring gull are described as species occurring in nationally important numbers on the Ramsar designation (but not as a qualifying features under any criterion), whilst black-tailed godwit appears as a cited feature for the Bridgwater Bay SSSI; the SSSI population has been taken to be the peak monthly count for the Parrett Estuary in 2009 (Ref. 20.44).

[3] The peak intertidal survey counts have been derived from the largest count of each species on any survey date in each area (for example, 25 curlew were counted in total across Count Sectors 1, 2, 3 on 14 September 2007).

[4] This figure shows the percentage of survey dates when the species count in the area concerned exceeded 1% of the SPA population. Intertidal surveys were undertaken on a total of 182 dates between April 2007 and March 2009 inclusive.

20.5.35 Other notable species recorded regularly were little egret, oystercatcher and herring gull. Little egret was recorded on 145 of 182 survey visits in numbers which peaked at six individuals but were usually between one and three birds. The majority of the activity was within Count Sectors 4 and 5, although little egret was recorded regularly in all 5 count sectors.

20.5.36 Oystercatcher was recorded on all 182 survey dates, with birds observed foraging, loafing and roosting within all five count sectors; the peak count was of 100 birds. The greatest level of roosting activity took place on the rocky platforms within Count Sectors 3 and 4; foraging birds were regularly recorded throughout the survey area.

20.5.37 Herring gull was noted on all survey dates and across all count sectors. A peak count of 350 birds was recorded. However, numbers fluctuated markedly between visits, as would be expected from this species, which ranges widely on a daily basis.

20.5.38 Data from the surveys undertaken within Stolford Bay and across Stert Flats (to the east of Hinkley Point) between April 2010 and January 2011 show that the number and frequency of occurrence of waterbirds across the mud flats to the east of Hinkley Point is greatly in excess of what was recorded in front of the existing HPB infrastructure and the development site. This is expected given the much greater foraging resource available in this area provided by the extensive mudflats.

20.5.39 Sixteen species of wildfowl, 19 species of wader and six additional species of seabird were recorded during the survey period. Twenty of these species occurred frequently and/or in high peak numbers (see **Table 20.12**).

Table 20.12: Peak Counts Recorded from Single Vantage Points on Stert Flats between April 2010 and January 2011

Species	No. of Survey Dates when Species was Recorded (from 123 Survey Dates)	SPA/SSSI Population or Severn Estuary/Somerset population[1]	Peak Count[2]	% of SPA/SSSI Population or Severn Estuary/Somerset population
Black-tailed godwit	27	172	160	93%
Curlew	122	3903	739	19%
Dunlin	99	44624	12590	28%
Grey plover	71	416	975	234%
Golden plover	10	17010	500	2.9%
Knot	51	3591	3575	100%
Lapwing	24	12056	412	3.4%
Mallard	84	3335	87	2.6%
Oystercatcher	117	803	504	63%
Pintail	67	599	158	26%
Redshank	56	2330	355	15%
Ringed plover	64	655	702	107%
Shelduck	123	3330	2049	66%
Shoveler	10	561	90	16%

Species	No. of Survey Dates when Species was Recorded (from 123 Survey Dates)	SPA/SSSI Population or Severn Estuary/Somerset population[1]	Peak Count[2]	% of SPA/SSSI Population or Severn Estuary/Somerset population
Teal	7	4709	27	0.6%
Turnstone	67	409	90	22%
Whimbrel	37	171	134	78%
Wigeon	37	8466	312	3.7%

[1] SPA/SSSI population figures are used for species that are interest features of the SPA/SSSI. For other species, Severn Estuary population levels were used (Ref. 20.62); if these were not available Somerset peak counts were used.

[2] Peak count numbers are from a single vantage point on a single date and are not summed across count sectors or dates.

20.5.40 **Table 20.12** shows that the peak numbers recorded from single vantage points during 2010/11 sometimes exceeded the population sizes of the Severn Estuary SPA; this reflects the highly mobile nature of wildfowl and waders in UK estuaries, which can be influenced by, for example, migratory and cold weather movements. The majority of records were of birds foraging and loafing on the mudflats – only a low level of roosting was recorded. Greatest levels of activity were noted on the mid- and high shore, which is likely to be due to the substrates in these areas being exposed for a longer period than on the lower shore.

20.5.41 Surveys of rafting shelduck in July and August 2011 recorded the majority of this species' activity at a considerable distance offshore (**Appendix 20Q**). Flocks were often diffuse and numbers regularly changed with individuals flying to/from flocks (demonstrating that not all birds that were present were in moult). A peak count of 1,100-1,300 birds was recorded, and the peak flock count that was recorded was of 450 birds, although the majority of flock counts numbered less than 100 individuals. Rafting birds spent most time drifting in the same direction as the tidal current but were seen to be able to swim against the tide, sometimes moving 100s of metres.

Birds using Agricultural Land: Desk Study Information

20.5.42 Data on birds recorded using fields within the development site were obtained from surveys that were undertaken to inform the West Hinkley Wind Farm application (Ref. 20.38). Records include small numbers of shelduck, teal and shoveler.

Birds using Agricultural Land: Diurnal Survey Data

20.5.43 The survey findings for species that are interest features of the statutory designated sites in the vicinity of the development site are set out in **Appendix 20B**. The maximum counts for these species within the development site boundary or within 250m of it were:

- shelduck – 20;
- mallard – 2;
- teal – 2;

- curlew – 20;
- redshank – 1;
- whimbrel – 3;
- little egret – 1;
- water rail – 1; and
- lapwing – 70.

20.5.44 Other species that were recorded in small numbers or infrequently included: golden plover (*Pluvialis apricaria*); snipe (*Gallinago gallinago*); peregrine (*Falco peregrinus*); merlin (*Falco columbarius*); and kingfisher (*Alcedo atthis*). Large flocks of some other non-cited species were recorded in some winter months. These species included skylark (*Alauda arvensis*), meadow pipit (*Anthus pratensis*), redwing (*Turdus iliacus*), fieldfare (*Turdus pilaris*) and linnet (*Carduelis cannabina*).

Wintering Birds on Agricultural Land: Nocturnal Survey Data

20.5.45 These surveys (see **Appendix 20B**) found that the fields within the development site that were surveyed and adjacent upper inter-tidal habitat were not being regularly used by large numbers of roosting or foraging birds, although there was consistent use of the coastal fields by small numbers of golden plover, a concentration of foraging snipe in Field 66 on one occasion and regular use of Count Sector 1 by moderate numbers of roosting oystercatcher (peak of 100 birds).

iv. Badger

Desk Study Information

20.5.46 Records held by SERC suggest that badgers occur throughout the survey area and that they are numerous in the district of West Somerset.

Survey Data

20.5.47 The bait marking study in 2010 identified 54 setts within the survey area including seven main setts (i.e. seven social groups), six annexe setts and 41 outlying setts. Of these, 30 were located within the development site boundary. These included five main setts, four annexe setts and 21 outlying setts. Since this survey, a further 23 outlying setts have been constructed within the development site boundary.

20.5.48 Disclosure of information about badgers (such as sett locations) cannot be included in public documents such as this ES. A confidential report (**Appendix 20D**) that sets out the survey findings has been provided to NE and will also be made available to the IPC and relevant consultees.

v. Bats

Desk Study Information

20.5.49 There are records of the following species from within the 3km study area:

- common pipistrelle (*Pipistrellus pipistrellus*);
- soprano pipistrelle (*Pipistrellus pygmaeus*);
- noctule (*Nyctalus noctula*);
- serotine (*Eptesicus serotinus*)
- *Myotis* sp.;
- long-eared bat (*Plecotus* sp.); and
- lesser horseshoe (*Rhinolophus hipposideros*).

20.5.50 Bat surveys completed to support previous development proposals (such as West Hinkley Wind Farm [Ref. 20.38]) found evidence that the barns in the western part of the development site were likely to be used by roosting bats. In the wider study area (which is 10km for bat records), there are also records of lesser and greater horseshoe (*Rhinolophus ferrumequinum*) bat maternity and hibernation roosts and brown long-eared (*Plecotus auritus*) bat roosts.

20.5.51 During 2010, a range of bat surveys was completed by Halcrow in support of the EA's Steart Realignment Project (Ref. 20.67), the location of which is approximately 2km to the east of the development site. The surveys were predominantly walked transects, with Anabats left out for single nights during the dusk and/or dawn surveys. At least nine species of bat were recorded during these surveys including common and soprano pipistrelle, noctule, serotine, long-eared, *Myotis* sp., lesser and greater horseshoe, and barbastelle. Barbastelle was only recorded from the Anabats (on seven of the 18 Anabat survey occasions (39% of the survey nights)), with the greatest number of passes recorded being on the 9 and 10 August 2010. During these peaks of activity, the passes were spread fairly evenly through the night, with short peaks of activity comprising a small number of calls close together, which were likely to be foraging bouts. Most of the activity was recorded in the western part of the Steart survey area (which is the closest part to the development site), with small numbers of passes along the River Parrett.

Survey Data

20.5.52 The surveys completed within the development site boundary between 2007 and 2009 recorded at least nine species of bat using the site (see **Appendix 20E**), namely:

- common pipistrelle;
- soprano pipistrelle;
- noctule;

- serotine;
- long-eared (likely to be brown long-eared);
- *Myotis* sp. (likely to be at least Natterer's (*Myotis nattereri*) and Daubenton's (*Myotis daubentoni*) based on call characteristics and habitats present);
- barbastelle;
- lesser horseshoe; and
- greater horseshoe.

20.5.53 The majority of the bat activity was recorded along the woodland edges and hedgerows, particularly along the well-hedged Green Lane. Both commuting and foraging behaviour were recorded.

20.5.54 The number of registrations and the location of these throughout the survey area indicate that all of the species recorded, apart from the horseshoe and long-eared bats, occur frequently throughout the development site. However, it is likely that the long-eared bats have been under-recorded (due to their quiet call). The occurrence of the lesser and greater horseshoe is no more than occasional and appears to be largely restricted to Green Lane.

20.5.55 The number of barbastelle records within the development site was much greater in 2009 than in previous survey years. The survey findings show that within the development site:

- there is regular usage of the woodlands and taller hedgerows in the northern part of the site – it is likely that barbastelle bats commute along a short stretch of the HPC Drainage Ditch in the northern part of the site (which provides no tree or hedge cover) to reach the northern woodland blocks;
- Green Lane is regularly used as a commuting (and possibly foraging) route for this species; and
- Benhole Lane is also regularly used by barbastelle.

20.5.56 The main findings of the, primarily off-site, bat survey work in 2010 in relation to barbastelle are summarised below (further detail is contained in **Appendix 20F**).

- During the off-site transect and emergence/re-entry surveys, barbastelle was recorded on four of the 15 survey nights (27% of the survey nights). To the east of the development site, a probable pass was recorded at Stolford and a definite pass was recorded at Wick Park Covert whilst, to the west of the development site, two passes were recorded at each of two sites to the north-west of Stringston (near Honibere Farm and at Great Plantation). The earliest pass was 26 minutes after sunset at Wick Park Covert in June, which is such a short period after the bat is likely to have left its roost that it may indicate that it was roosting in this woodland. The other records are likely to be indicative of commuting or brief foraging activity.

- The automated static Anabat surveys recorded barbastelle on 95 (27%) of the survey nights and at all but two of the survey locations. Based on available evidence, these records are most likely to be associated with commuting (i.e. a single pass in one night) than foraging behaviour (i.e. more than one pass over a period of time in one night).
- The highest levels of barbastelle activity were recorded where hedgerows are associated with watercourses or ponds. Barbastelle was also recorded occasionally in low numbers in very exposed locations along the coast.
- Whilst the Anabat surveys indicate regular usage of the landscape surrounding the development site by barbastelle, the level of activity recorded at each survey location and during each survey month varied greatly from a minimum of two passes up to a maximum of 305 passes per survey period. These results suggest that the land within the area surveyed is likely to be seasonally used by barbastelle, possibly in response to food availability. This is evidenced by the results at a survey location to the east of the development site, which is associated with a pond (East 2 – see **Appendix 20F**) where a high level of activity was recorded over a short period in May and very low or no activity was recorded in later survey months.
- The majority of the passes were recorded at least 60 minutes after sunset or before sunrise, suggesting that primary roosting sites (such as maternity roosts) are not in close proximity to the survey locations and that bats are travelling from a roost site to the survey area. However, the data provide no indication of the likely direction from which barbastelle bats were travelling to access the survey area.

20.5.57 All four of the derelict buildings within the development site support very small pipistrelle roosts (likely to comprise one or two bats only). Based on the activity survey results and the roosting opportunities offered by the buildings, there is also the potential for *Myotis* sp. and long-eared bats to use them. The buildings also provide conditions that could be suitable for hibernating bats. However, given the structural features present within the buildings it is likely that only small numbers of pipistrelles, *Myotis* sp. and long-eared bats would roost in the buildings during the winter.

20.5.58 One of the trees on the development site (a field maple at the eastern edge of Woodland F) has a 25cm deep cavity approximately 7m above the ground, within which a small number of bat droppings were found in 2009. Due to their location, these could not be collected for examination; they were therefore examined *in situ* using an endoscope. This confirmed that they were likely to be *Myotis* sp. droppings, although they could have been from barbastelle. Due to the speed with which bat droppings can decompose in the damp conditions within crevices, it is likely that this feature had been used during 2009. However, when the feature was inspected again in March 2010 and August 2010, no evidence of use by roosting bats was found, indicating that the feature is a very infrequently used roost.

20.5.59 Full details of the survey results are provided in **Appendix 20E and Appendix 20F**.

vi. Dormouse

Desk Study Information

20.5.60 There are no records of dormouse from within the study area. The nearest dormouse record is from approximately 6.5km to the south-west at Holford on the edge of the Quantock Hills (1994). There are three other dormouse records from the Quantock Hills, with further records on Exmoor to the west and Taunton to the south (from the NBN website [Ref. 20.68]).

Survey Data

20.5.61 No evidence of dormouse was found during the surveys that were undertaken to inform this ES (see **Appendix 20G** for more information about the survey findings). The survey effort score achieved equals 20 points and as such, in line with NE guidance (Ref. 20.55), it is reasonable to conclude that dormice are not present at this development site.

vii. Otter

Desk Study Information

20.5.62 There are no records of otter using the watercourses within or adjacent to the development site boundary. However, signs of otter are frequently found by EDF Energy's conservation warden at Hinkley Point on the watercourses to the east of the development site and an otter was seen on the 4 June 2011 at a large pond approximately 0.8km to the east of the site.

20.5.63 Otter survey work in the vicinity of the development site was undertaken on behalf of the Somerset Otter Group between 30 November 2010 and 22 January 2011, with four locations surveyed; three were along the coast north of Stolford (~1.8km east of the development site) and one was on Wick Moor Drove adjacent to the site. All of these locations showed evidence of use by otter, with recent evidence of activity recorded on between 22% and 50% of the survey visits.

20.5.64 In the wider area, otters occur on all the major watercourses including the River Parrett and its catchments to the east of the development site, and on smaller watercourses to the west such as those that discharge at Kilve and Williton (Somerset Otter Group, pers. comm.).

Survey Data

20.5.65 On the development site, the only evidence of otter presence was from three locations along the Bum Brook. In the wider area, evidence of otter was recorded in the following locations:

- a minor watercourse on Wick Moor (east of the development site);
- Great Arch, Stolford (east of the development site);
- Bum Brook (west of the development site); and
- Stogursey Brook (south of the development site).

20.5.66 With the exception of Bum Brook, the survey work found that water features within the development site offer limited commuting, foraging or resting/breeding opportunities for otter due to their lack of connectivity and ephemeral nature.

20.5.67 Full details of the otter survey results are provided in **Appendix 20H**.

viii. Water Vole

Desk Study Information

20.5.68 There are no records of water vole using the watercourses within or adjacent to the development site boundary. However, water vole has been sporadically recorded using ponds and watercourses to the east of the development site.

Survey Data

20.5.69 No water voles were recorded on watercourses within or adjacent to the development site during the surveys that were undertaken to inform this ES and, due to the poor habitat provided by the HPC Drainage Ditch and the Holford Stream, they are unlikely to occur in the future. The water vole survey results are provided in **Appendix 20H**.

ix. Great Crested Newt

Desk Study Information

20.5.70 There are no records of great crested newt from within the development site. Within the study area, there are records of this species from Pixies' Pond and another pond within Hinkley CWS to the east of the development site, which no longer exists. Populations of great crested newt are also known to occur approximately 1.5km to the east of the Hinkley Point Power Station Complex, in the Stolford area (all records provided by SERC).

Survey Data

20.5.71 One pond is located within the development site, with a further nine ponds identified within 500m of the development site boundary (with 500m being the maximum distance that great crested newts are generally considered likely to travel from their breeding ponds to utilise terrestrial habitats (Ref. 20.32)). Three of the ten ponds were screened out of further assessment on the basis that they were not suitable for breeding great crested newts or, if they were suitable, it was unlikely that any newts from these ponds would be able to access the development site.

20.5.72 A fourth pond, located off-site at Knighton Farm could not be accessed safely and, was therefore not included in the presence/absence surveys. However, as it is 335m from the development site and surrounded by good terrestrial habitat, it is unlikely that any great crested newts that occur in the pond would access the development site. Consequently this pond was also screened out of the need for further survey work.

20.5.73 The remaining six ponds were subject to presence/absence surveys that found no evidence of great crested newts (see **Appendix 20I** for more information about the survey findings).

x. Reptiles

Desk Study Information

20.5.74 The desk study did not locate any records of reptiles from within the development site. Grass snake (*Natrix natrix*) and slow-worm (*Anguis fragilis*) have been recorded from the eastern part of the Hinkley CWS and also from the nearby villages of Shurton and Stolford (records from SERC).

Survey Data

20.5.75 The surveys found small numbers of slow-worm using rough grassland located to the south of the woodland belt along Green Lane, with the maximum count being three adults. Based on guidelines in Froglife's Reptile Survey Advice Sheet (Ref. 20.59), this corresponds to the development site supporting a 'low' population of slow-worm. Both slow-worm and grass snake were recorded within the area of Hinkley CWS to the south of the existing Hinkley Point Power Station Complex, with maximum adult counts during one survey event of nine slow-worms and four grass snakes (see **Appendix 20J** for more information about the survey findings).

xi. Invertebrates

Desk Study Information

20.5.76 Invertebrates that have been recorded during the selective annual invertebrate monitoring that has been undertaken by EDF Energy (and previously British Energy) within Hinkley CWS since 1996 (focused primarily on butterflies and moths) include:

- chalkhill blue (*Polyommatus coridon*) recorded in 1999, but does not occur annually;
- populations of marbled white (*Melanargia galathea*) are a feature of the semi-natural grassland habitats;
- five UK Biodiversity Action Plan (BAP) priority butterfly species (which are also species of principal importance under the NERC Act) have been recorded – small heath (*Coenonympha pamphilus*), wall brown (*Lasiommata megera*), grayling (*Hipparchia semele*), dingy skipper (*Erynnis tages*) and grizzled skipper (*Pyrgus malvae*) (wall brown, dingy skipper and grizzled skipper are also Local BAP priority species);
- the moss carder bee (*Bombus muscorum*) has been recorded from the mosaic of habitat with the Hinkley CWS to the east of the development site; and
- the Nationally Scarce[7] beetle *Platyrhinus resinus* has been recorded adjacent to the development site within Branland Copse.

[7] Nationally Scarce species are defined as being recorded from 16-100 10x10km squares of the national grid.

20.5.77 In addition, SERC data list ten UK BAP priority moth species (which are also species of principal importance under the NERC Act) recorded from Hinkley/Hinkley Point. Another five UK BAP priority moth species (and species of principal importance) are listed within the Land Management Review Annual Reports (Ref. 20.37). In addition, Red Data Book (RDB) and Nationally Scarce water beetle species have been recorded from the ditches on Wick Moor (part of Bridgwater Bay SSSI) to the east of the development site.

20.5.78 The exact locations of the species seen during the historical surveys of Hinkley CWS are not provided in the Land Management Review Annual Reports (Ref. 20.37). However, based on their habitat preferences, all of the butterflies listed above are likely to occur within the development site, particularly along the coastal strip and within areas of calcareous grassland. Equally, the predominantly woodland or wetland habitat preferences of the moth species that have been recorded, mean that they are also likely to occur within the development site.

Survey Data

20.5.79 The aquatic invertebrate surveys within the development site boundary recorded common and widespread species of English watercourses with no nationally rare species identified. The only notable species recorded was the water beetle *Agabus congener*, which was found in the HPC Drainage Ditch. Holford Stream is generally more species-rich than the other watercourses sampled, being more faunistically similar to the watercourses on Wick Moor, although no notable species were recorded from it. The off-site sampling locations recorded three Nationally Scarce species, namely the hairy dragonfly (*Brachytron pratense*), the reed beetle *Donacia clavipes* and the anthomyzid fly *Anagnota bicolor*.

20.5.80 The terrestrial invertebrate surveys within the development site concluded that Whitewall Brake may be of value for invertebrates due to its semi-natural characteristics, structure and the maturity of some of the oaks. Two Nationally Scarce species were recorded here; the cranefly *Atypophthalmus inusta* and the snail-killing fly *Tetanocera punctifrons*.

20.5.81 The Nationally Scarce bombardier beetle, *Brachinus crepitans,* was found in the grassland on the coastal strip during the 2009 terrestrial invertebrate survey; another three Nationally Scarce species were then recorded in the 2010 survey of the cliff-top and foreshore habitats: the grey green bush cricket (*Platycleis albopunctata*), the scavenger beetle *Cercyon depressus* and the rove beetle *Heterota plumbea*. However, the habitat assessment of the cliff-top and foreshore habitats concluded that this area was unlikely to support important populations of invertebrates.

20.5.82 Full details of the invertebrate survey results are provided in **Appendix 20K** and **Appendix 20L.**

xii. Other Notable Species

20.5.83 SERC provided no other records of legally protected species from within the development site. In the wider area study area there are records of common toad (*Bufo bufo*), but there are no known active toad crossings within 2km of the site, with the nearest being 8.7km to the south. Records of hedgehog (*Erinaceus europaea*), 13 moth species and shepherd's needle (*Scandix pectens-veneris*), all of which are UK BAP priority species and species of principal importance under the NERC Act have also been recorded in the wider study area. Shepherd's needle is also an LBAP priority plant species; four other Local BAP (LBAP) priority plant species have also been recorded.

c) Highway Improvement Study Area Description

20.5.84 The results of the desk study and Extended Phase 1 Habitat Survey of the highway improvement sites are provided in **Appendix 20P**.

i. Designated Sites

20.5.85 Within 500m of the highway improvement sites, the only designated sites are 12 CWSs (**Table 20.13**).

Table 20.13: Designated Non-Statutory Sites within 500m of the Highway Improvement Sites

Site	CWS Reference Number	Location in Relation to the Site	Reason for Designation
C182 Farringdon Hill Lane Horse Crossing			
Mud House Copse CWS	ST24/003	Adjacent	Ancient semi-natural broad-leaved woodland
Wick Park Covert CWS	ST24/002	180m to the south-east	Ancient semi-natural broad-leaved woodland bisected by road
Junction Improvements at Claylands Corner			
Claylands Corner Verge CWS	ST24/004	Within site boundary	Roadside verge with species-rich, unimproved neutral grassland supporting a diverse invertebrate fauna, flanked by a tall hedge/tree-belt and with advancing scrub
Stockland Moor Wood CWS	ST24/016	140m to the south-east	Ancient semi-natural broad-leaved woodland with an area of swamp and invading carr woodland
New Barn Wood CWS	ST24/017	420m to the north-east	Ancient semi-natural broad-leaved woodland with broad-leaved plantation
A38 Taunton Road/Broadway			
Brownes Pond CWS	ST23/102	300m to the south-west	Pond supporting legally protected species
M5 Junction 23 (inc. Dunball Roundabout)			
South Hills Wood CWS	ST34/019	300m to the south-east	Ancient semi-natural broad-leaved woodland with species-rich grassland
Washford Cross Roundabout			
Furzy Ground Plantation CWS	ST04/027	500m to the north	Semi-natural broad-leaved woodland on tithe-map woodland site
Puthills Copse CWS	ST04/026	500m to the west	Ancient semi-natural broad-leaved woodland

Site	CWS Reference Number	Location in Relation to the Site	Reason for Designation
Cannington High Street			
Cannington Brook CWS	ST23/090	260m to the south	Site with legally protected species (designated for the presence of otter)
Huntworth Roundabout			
Junction 24 Embankment CWS	ST33/050	Within site boundary	Roadside verge/embankment which support Roesel's bush cricket (*Metrioptera roeselii*).
Stockmoor CWS	ST23/105	370m to the west	Interconnecting rhyne network containing legally protected species and nationally rare and nationally scarce invertebrates. Ponds support legally protected species.

ii. Desk Study Information

20.5.86 SERC held no records of legally protected or notable species from within the highway improvement sites. However, there are records of kingfisher adjacent to the A38 Bristol Road/The Drove site and of common pipistrelle adjacent to the Cannington High Street site. More distant records are of kingfisher from within 500m of two sites, brown hare within 500m of the A39 Sandford Corner site and the C182 Farringdon Hill Lane site, and otter recorded at the latter and within Cannington Village. Grass snake and slow-worm have also been recorded within 500m of the Cannington High Street site.

20.5.87 A cluster of existing species records (from SERC) is located approximately 400m to the west of the Huntworth Roundabout site. It appears that these records all relate to Stockmoor CWS but, based on the species they are unlikely to have all been recorded in this location. The records include various bat species, water vole, otter and great silver water beetle (*Hydrophilus piceus*). SERC also provided three records of barn owl within 500m of the site.

20.5.88 SERC also provided five records of Somerset Notable plant species within the study area.

iii. Extended Phase 1 Habitat Survey

Habitats

20.5.89 The majority of the highway improvement sites are dominated by hardstanding (roads and pavements) with adjacent areas of amenity grassland (e.g. gardens) and/or species-poor grassland, supporting species such as perennial rye grass, cock's-foot and white clover. At two of the sites (A39 Sandford Corner and Junction Improvements at Claylands Corner), there are small areas of more species-rich grassland with species present including agrimony, tufted vetch and bird's-foot trefoil.

20.5.90 Trees, scrub and hedgerows occur frequently within the highway improvement sites, with those sites located in urban areas (e.g. the centre of Bridgwater) tending to support ornamental non-native shrub species and planted native broad-leaved trees such as ash and lime, although scatted semi-mature field maple and sycamore trees also occur within a number of the site boundaries. Where scrub is present at any of the sites, it is species-poor and predominantly comprises bramble.

20.5.91 Hedgerows occur within four of the sites, with the majority supporting a limited range of woody species, restricted primarily to hawthorn, elder and hazel. None of the hedgerows are assessed as being ecologically 'important' under Paragraph 7 of Schedule 1 of the Hedgerows Regulations 1997 (Ref. 20.15).

20.5.92 One site (Wylds Road/The Drove) also supports a small area of ephemeral/short perennial vegetation growing on gravel, comprising buddleia (*Buddleja davidii*), scentless mayweed (*Tripleurospernum inordorum*) and perennial sow-thistle (*Sonchus arvensis*). The Perrymoor Brook flows through the A39 Sandford Corner site, although it is culverted underneath the A39 and a minor road, and is heavily shaded by scrub within the site.

Fauna

20.5.93 No evidence of legally protected or other notable fauna was found during the extended Phase 1 habitat surveys. However, some of the habitats that are present have the potential to support legally protected species, including breeding birds, which are likely to nest in the scrub, trees and hedgerows that occur on the majority of the sites. None of the trees within the highway improvement sites support features that are suitable for roosting bats, although the small extent of linear features within the sites (mainly hedgerows) could be used by commuting bats.

20.5.94 The rough grassland and scrub habitat at four of the sites has low potential to support small numbers of reptiles and/or great crested newts (the newts could be present as there are water bodies within 500m of these sites).

20.6 Assessment of Impacts

a) Introduction

20.6.1 The starting point in this section is to define those biodiversity receptors that could be significantly affected by the proposed development and/or are legally protected (as concluded in Table 14C.2 in **Appendix 14C**). In subsequent sections, these receptors are taken forward for assessment in relation to the construction and operational phases of the proposed development. The assessment reflects the following aspects of the proposed development that were incorporated as part of the iterative design process and that are relevant to the ecological impact assessment[8].

- The majority of the hedgerow that runs east-west across the centre of the development site (largely along Green Lane) and two strips of land to the north and south of the Green Lane would be retained throughout the development. The hedgerows associated with the Green Lane would be managed to increase their biodiversity value through a programme of removing of dead elm and replanting

[8] Some of these measures avoid or reduce impacts, but, as they form an integral part of the scheme, are not considered to be mitigation.

the resultant gaps with a species-rich mix of hedgerow shrubs and standard trees (**Chapter 22, Volume 2** of the ES).

- The north-south hedgerow along the development site's western boundary (eastern side of Benhole Lane) would also be retained and buffered from the construction activities by an approximately 30m wide strip of land between Benhole Lane and the security fence. This area (totally approximately 2.6ha) would be managed as a woodland/grassland habitat mosaic and would be partly planted with native broad-leaved trees.

- During 2009 and 2010, grass and wildflower seed was collected from areas of calcareous grassland located within that part of the Hinkley CWS that is within the boundary of the development site. This seed has been stored under controlled conditions in order to maintain its viability and would be used in combination with a locally sourced calcareous seed mix during the restoration of the construction area.

- Approximately 2.2ha of broad-leaved woodland planting, using a species-rich mixture of native whips and mature specimens, was planted in the south-west corner of the development site (broadly along the western part of Bum Brook) at the beginning of 2011.

- Approximately 1.4ha of broad-leaved woodland/scrub would be planted on a created bund along the north-western boundary of the development site at an early stage of the construction phase. This would be connected to Green Lane and Benhole Lane by a retained species-rich hedgerow.

- A woodland/grassland/wetland habitat mosaic would be created in the southern part of the development site during the beginning of the construction phase (see **Chapter 22**, **Volume** 2 of the ES). A mix of broad-leaved native tree species would be permanently planted in the southern part of this area using a mixture of whips and mature trees (a total of approximately 8.7ha). The northern part of the area would be seeded with a temporary native wildflower meadow mix (approximately 6.4ha), which would be lost during the restoration of the development site post-construction, but subsequently planted with trees as part of the restoration of the development site. A wetland area comprising ponds and reedbeds would be created adjacent to Bum Brook (approximately 0.2ha).

- A total of 15 buildings would be constructed with stonecrop (*Sedum* spp.) green roofs.

- A total of 25ha of arable land and/or improved pasture off-site would be seeded with a native wildflower mix.

- The management of the retained and created habitat features during construction and operation would be delivered through an Integrated Land Management Plan (ILMP) for the development site. This would detail the management objectives, and the prescriptions required to achieve these in relation to biodiversity and other topics (e.g. cultural heritage). The ILMP would also contain a management and monitoring programme.

- Appropriate fencing would be installed around all the created and retained habitat features within the construction area to protect them from direct impacts during development (see **Chapter 22** of this volume of the ES).

- A bat barn has been constructed along the development site's south-western boundary, adjacent to Benhole Lane) to provide alternative and enhanced roosting habitat for bats, to compensate for the barns removed as a result of the development. Bat boxes have been erected on trees within and adjacent to the development site, to compensate for the loss of the trees supporting features that are of medium and high potential value for roosting bats.

- The existing small, single storey barn located adjacent to the western boundary of the development site (see **Appendix 20E**) would be retained throughout the development.

- Green Lane would be crossed in two places by construction haul roads. The width of these crossing points would be minimised by a number of measures. Firstly, the vegetation clearance to allow construction of the haul road would be minimised. The areas where vegetation clearance is unavoidable to allow construction would then be replanted with tree stock 3-6m tall between the remaining Green Lane vegetation and the edge of the haul roads. Due to the residual width of the eastern haul road, a gantry-type structure would be installed above the haul road to provide a linear feature for commuting bats to follow (and also to provide them with some cover from predators).

- Prior to the completion of the permanent measures as described in the preceding bullet point, temporary structures would be put in place to provide connectivity across the gaps. This would be achieved using cut trees placed in barrels of sand and tied with mesh ribbon, to mimic leaves, as described in the Design Manual for Roads and Bridges (DMRB – Ref. 20.69). These barrels would be moved into position, approximately 2-3m apart, at the end of each working day for the period that they are required temporarily to bridge a gap in vegetation. These measures are unlikely to be required during the bat hibernation period between November and February.

- Once construction of the development is completed, the undeveloped construction areas would be restored. As described on the restoration plan **Chapter 22**, **Volume 2** of the ES) this would create an area of approximately 94ha[9] of semi-natural habitat, which together with Bridgwater Bay SSSI and the unaffected part of the Hinkley CWS would create a large area of semi-natural habitat around Hinkley Point.

- Vegetation clearance and habitat management would take place between September and March to avoid the breeding bird season. Where this is not possible, clearance would only be undertaken once surveys have shown that any breeding birds have fledged from the areas to be cleared.

- The EA's Pollution Prevention Guidelines (PPGs) would be adhered to and discharges into the Holford Stream and the Bum Brook would be managed to ensure compliance with greenfield run-off rates (see **Chapter 16** of this volume of the ES).

- The lighting strategy for the development site has been designed with reference to the Bat Conservation Trust's (BCT) Bats and Lighting publication (Ref. 20.70). It involves lighting being directional, with minimal upwards or backwards light spill

[9] See **Appendix 20R** – this figure includes an area for hedgerows, which are assumed to be 3m wide

and minimising light spill onto retained and created habitat features used by bats (such as tree lines).

- Measures have been incorporated into the scheme that are designed to avoid contravention of the legislation relating to legally protected species. These measures are outlined in Sections 20.6d and e of this chapter.
- Good practice measures would be implemented to minimise dust generation and road traffic emissions (see **Chapter 12** of this volume of the ES), polluted surface water run-off (see **Chapter 16** of this volume of the ES), changes in groundwater (**Chapter 15** of this volume of the ES) and noise (see **Chapter 11** of this volume of the ES).

b) Identification of Receptors that could be significantly affected

20.6.2 The method described in Section 20.4(d) of this chapter has been used to determine whether any of the designated nature conservation sites, habitat areas or species' populations that have been recorded within the study area could be significantly affected by the proposed development and therefore need to be subject to further assessment. The environmental changes that are likely to be caused by the proposed development, which have the potential to cause significant impacts are:

- land take/land cover change;
- noise and visual disturbance;
- lighting disturbance;
- hydrological changes (surface and groundwater);
- air quality changes; and
- thermal and chemical changes.

20.6.3 It should be noted that the latter five changes only apply outside the land take/land cover change zone. Within this zone, it is only necessary to assess impacts caused by land take/land cover change. This is because, although there would be other environmental changes within this zone, land take and land cover change are the dominant factors influencing biodiversity receptors.

20.6.4 For receptors of sufficient value and/or that are legally protected, **Appendix 20N** sets out the ecological zones of influence relating to these six changes. Based on these zones of influence, the following biodiversity receptors require further assessment because there is a mechanism by which they could be significantly affected by the proposed development and/or they are legally protected.

Habitats

- off-site ditches and grazing marsh (part of Bridgwater Bay SSSI);
- off-site wetland areas (part of Hinkley CWS);
- lowland calcareous grassland (within Hinkley CWS, along the coastal strip and within Bishop's Wood);

- woodland;
- hedgerows;
- watercourses;
- habitat networks;

Fauna

- breeding birds (in relation to legal protection only);
- declining farmland birds (on and up to 250m from the development site);
- lesser whitethroat;
- Cetti's warbler;
- inter-tidal wintering waterbirds that are SPA/Ramsar/SSSI qualifying features;
- inter-tidal passage waterbirds that are SPA/Ramsar/SSSI qualifying features;
- terrestrial wintering and passage birds (other than waterbirds);
- badger (in relation to legal protection only);
- barbastelle bat;
- greater horseshoe bat;
- lesser horseshoe bat;
- bat assemblage;
- otter;
- reptiles (in relation to legal protection only);
- great crested newts (in relation to legal protection);
- invertebrate assemblage;
- Somerset Notable plant species (on-site);

Designated sites

- Bridgwater Bay SSSI; and
- Hinkley CWS.

20.6.5 All the above receptors are relevant to the development site, other than great crested newt, which is only relevant to the highway improvement sites. Hedgerows, breeding birds, reptiles and great crested newts are also relevant to the highway improvement schemes.

20.6.6 Four of the above receptors require further assessment only because they are legally protected. They do not require further assessment in relation to biodiversity conservation value; because they are of insufficient value for impacts to be significant (see **Appendix 20O)**.

20.6.7 Exmoor and Quantocks SAC was identified in **Appendix 20N** as having the potential to be significantly affected by the proposed development but is not included in the above list as impacts upon it are assessed in the **Habitats Regulations Assessment**.

c) Valuation of Receptors

20.6.8 In order to inform the assessment of impacts, the biodiversity receptors that have been identified as requiring further assessment, excluding those identified as requiring assessment only in relation to legal protection, have been valued on the scale high, medium, low and very low according to the criteria that are set out in **Table 20.4**. The conclusions of this valuation are set out in **Table 20.14**.

Table 20.14: Summary Evaluation of Biodiversity Receptors

Receptor	Applicable Legislation	Policy Implications	Value	Rationale
Habitats				
Off-site ditches and grazing marsh (part of Bridgwater Bay SSSI)	WCA	N/A	High	SSSIs are by definition of national value. Whilst each of the qualifying features may not be of high value individually, in this instance, the ditches and grazing marsh within the SSSI are assessed as being of high value due to the invertebrate populations they support and the contribution this habitat type makes to the integrity of the SSSI.
Off-site wetland areas (part of Hinkley CWS)	Not applicable (N/A)	PPS 9 West Somerset Local Plan	Medium	The wetland areas within the CWS, comprising two ponds and associated reedbeds, form part of the CWS designation and contribute to the integrity of the CWS.
Lowland calcareous grassland	N/A	UK BAP Priority Habitat Habitat of Principal Importance for Biodiversity	Medium /Low	Calcareous grassland is scarce at the county level. The small areas within the development site that are located within Hinkley CWS and along the coastal strip contain a variety of species that are rare or uncommon at the county level. These areas are therefore of medium biodiversity value. Another area of calcareous grassland on-site has grown up in Bishop's Wood and a field adjoining Holford Stream. With management, this area could develop into a more species-rich and diverse calcareous sward. However, the area is being managed as developing woodland rather than grassland and, although a few scarce species are present, it currently represents calcareous grassland of low value.

Receptor	Applicable Legislation	Policy Implications	Value	Rationale
Woodland	N/A	N/A Habitat of Principal Importance for Biodiversity	Low	Parts of the woodland within the development site form part of the Hinkley CWS. Whilst the CWS as a whole is considered to be of medium importance, the woodland blocks within the CWS (and within the development site) are of relatively recent plantation origin and, due to their lack of established woodland ground flora and poor structural diversity, they are considered to be of low value.
Hedgerows	Hedgerows Regulations 1997	UK BAP Priority Habitat	Low	The majority of hedgerows within the development site are intact, but associated field margin communities, where present, lack diversity (due to agricultural improvement). 17 of the hedges within the area surveyed support seven or more woody species within each 30m section surveyed and therefore meet the criteria for classification as being important under the Hedgerows Regulations. A further 20 were found to meet one or more of the other criteria for classification as being important under the Hedgerows Regulations. Hedgerows are typical boundary features in West Somerset and, although species-rich, the hedgerows within the development site lack associated ground flora diversity. Despite this, based on the large amount of this resource within the development site, it has been concluded that hedgerows within the site are of value within the district. (See also habitat networks below).
Watercourses	N/A	N/A	Low	Watercourses within the development site are partially seasonal, show signs of agricultural improvement and support no protected species. The watercourse adjacent to the development site (Bum Brook) is only of marginally greater botanical interest.

Receptor	Applicable Legislation	Policy Implications	Value	Rationale
Habitat networks	N/A	PPS9	Low	The mainly intact hedgerows that are present throughout the development site provide good linkages to on- and off-site woodland and to the coast. The approach road to the Hinkley Point Power Station Complex presents a barrier to movement between the development site and the mosaic of habitats to the south of the, complex but this impact is likely to be relatively limited for most species. The level of use by bats (including nationally scarce species) and the indicative age of some of the hedgerows suggest that they are an important connective feature for protected species dispersal. The watercourses are of less value as habitat corridors than the hedges, and are only likely to complement the hedgerows to a minor degree. Their effectiveness as corridors is limited by their seasonality and lack of connectivity. There is little evidence of use of the watercourses by protected species.
Fauna				
Declining farmland birds (on and up to 250m from the development site)	WCA	Some species are: UK BAP[1] Species of Principal Importance for Biodiversity	Low	The farmland bird community (both breeding and non-breeding birds) is typical of the habitats present in the local area. Although many of the species that are present are declining across the UK, they still remain common and widespread on a county, regional and national level and, as such, the small number of pairs that occur on the development site are important at the district level and hence of low biodiversity value.
Lesser whitethroat	WCA	N/A	Low	Lesser whitethroat breeds on-site. It is notable because the three territories recorded within the development site boundary represent 4.6% of the Somerset population based on figures from the 2008 Somerset Bird Report (Ref. 20.43). However, within the wider breeding bird survey area, seven territories were identified suggesting that the Somerset Bird Report under-estimates the current County population size. As such, and given the extent of suitable habitat in the local area, the population of this species on the development site is assessed to be of low biodiversity value.

Receptor	Applicable Legislation	Policy Implications	Value	Rationale
Cetti's warbler	Schedule 1 WCA	N/A	Medium	Cetti's warbler breeds within 250m of the development site, but not on the site itself. No comprehensive survey of this species has been carried out in Somerset but records suggest there are less than 100 breeding pairs in the county (based on figures from 2008 Somerset Bird Report – Ref. 20.43) and the UK population is approximately 645 pairs (based on counts of singing males). Therefore, the population that breeds close to the development site is of medium biodiversity value.
Wintering waterbirds (including SPA/Ramsar/ SSSI qualifying features)	EU Birds Directive	Some species are: UK BAP Species of Principal Importance for Biodiversity	High	A number of wintering species forming the cited interest of the Severn Estuary SPA and Ramsar Site, and Bridgwater Bay SSSI regularly occur within 1km of the development site.
Passage waterbirds (including SPA/Ramsar/ SSSI qualifying features)	EU Birds Directive	Some species are: UK BAP Species of Principal Importance for Biodiversity	High	A number of passage species forming the cited interest of the Severn Estuary SPA and Ramsar Site, and Bridgwater Bay SSSI regularly occur within 1km of the development site.
Wintering and passage birds (other than waterbirds)	EU Birds Directive	Some species are: UK BAP Species of Principal Importance for Biodiversity	Low	Very low levels of use of terrestrial habitats (both diurnally and nocturnally) were noted by wintering and passage birds (e.g. flocks of wintering thrushes).

Receptor	Applicable Legislation	Policy Implications	Value	Rationale
Barbastelle bat	WCA Habitats and Species Regs. 2010	UK BAP Species of Principal Importance for Biodiversity Somerset Priority Species	High	Regular use of the development site by barbastelle was noted in July and August 2009, mainly from Anabats, with more sporadic records outside this period. The survey data indicates mostly commuting behaviour with occasional instances of foraging recorded within the development site and no confirmed roosts are present. Greater levels of barbastelle activity were recorded off-site in 2010, indicating the surrounding area is regularly used, although usage may be in response to seasonal food availability. Despite the lower amount of barbastelle activity on-site compared to the surrounding area, the development site is assessed as being of high biodiversity value for this species.
Greater horseshoe bat	WCA Habitats and Species Regs. 2010	UK BAP Species of Principal Importance for Biodiversity Somerset Priority Species	Medium	Greater horseshoe bats were recorded commuting infrequently both on and off-site during the bat surveys that were undertaken to inform this ES, indicating that the development site and surrounding area is unlikely to form part of a core territory for this species.
Lesser horseshoe bat	WCA Habitats and Species Regs. 2010	UK BAP Species of Principal Importance for Biodiversity Somerset Priority Species	Medium	Lesser horseshoe bats were recorded commuting infrequently both on and off-site during the bat surveys that were undertaken to inform this ES, indicating that the development site and surrounding area is unlikely to form part of a core territory for this species.

Receptor	Applicable Legislation	Policy Implications	Value	Rationale
Bat assemblage	WCA Habitats and Species Regs. 2010	Some species of bats are Species of Principal Importance for Biodiversity UK BAP and West Somerset BAP priority species	Medium	The development site supports four confirmed ephemeral common pipistrelle summer roosts. These buildings also have the potential to support winter roosts and could be used by brown long-eared and *Myotis* sp. bats. There is regular use of parts of the development site by two pipistrelle species, (brown) long-eared bat, serotine, noctule and barbastelle. This level of use, combined with less regular commuting through the development site by *Myotis* species and lesser horseshoe bat (and occasional use by greater horseshoe bat) indicates that the area is of some importance for bats. However, the development site does not support typically good bat habitat and there are no known important roosts in close proximity to the site. Much of the behaviour, particularly of the rarer species, indicates commuting rather then feeding (few feeding buzzes were recorded). The level and nature of use of the development site by bats is likely to be typical of Somerset and reflects the high level of survey effort available for the locality. Nonetheless, on the basis of all the available evidence, and in particular the number of species present including those identified above as being of medium value, it is assessed that the development site is of medium biodiversity value for its bat assemblage.
Otter	WCA Habitats and Species Regs 2010	UK BAP Priority Species Species of Principal Importance for Biodiversity Somerset Priority Species	Low	The survey results indicate that the watercourses connected into the wider freshwater systems (e.g. the Bum Brook) are likely to be used fairly regularly for commuting. However, the watercourses within the development site (which are poorly connected) do not support habitat likely to support otter for a sustained period.

Receptor	Applicable Legislation	Policy Implications	Value	Rationale
Invertebrate assemblage	N/A	UK BAP Priority Species Somerset Priority Species Species of Principal Importance for Biodiversity Nationally Scarce	Medium	The vast majority of the development site comprises habitats that are unlikely to support important invertebrate assemblages. However, a small number of Nationally Scarce species have been recorded from the more diverse habitats within the development site (e.g. Whitewall Brake and the coastal strip).
Somerset Notable plant species (on-site)	N/A	Somerset Notable	Low	Whilst all the notable species present within the development site are classified as 'uncommon' in Somerset (Ref. 20.71), these species have also been recorded in the wider area (as part of the survey work to support the proposed development) and most are widespread Nationally.
Designated Sites				
Bridgwater Bay SSSI	WCA	N/A	High	The SSSI has been designated at the National level on the basis of the valuable interest features.
Hinkley County Wildlife Site (CWS)	N/A	PPS 9 West Somerset Local Plan	Medium	CWSs are identified by local authorities as being of county importance for biodiversity conservation.

[1] Skylark is also listed on the West Somerset LBAP.

20.6.9 For each receptor, the impacts that are assessed arise as a result of a combination of the environmental changes (e.g. changes in noise, lighting etc.) that could contribute to a significant impact. In this sense, the impacts are already 'cumulative' and consequently, no further cumulative assessment is required in this section (recognising that wider cumulative impacts are assessed in **Volume 11** of this ES).

d) Other Constraints

20.6.10 In addition to the potential biodiversity receptors listed in **Table 20.14**, the development site also supports Himalayan balsam, which is listed on Schedule 9 of the WCA (Ref. 20.8). The Act makes it an offence to plant or otherwise cause to grow in the wild any plant listed on Schedule 9.

20.6.11 As a result, any works in areas to Bum Brook, which is the only part of the development site that supports Himalayan balsam, would need to include measures to prevent the spread of this species.

e) Assessment of Impacts

20.6.12 This section sets out the findings of the assessment of the impacts of the proposed development on the ecological receptors that are listed in Section 20.6 (b). For each receptor, the assessment addresses both the construction and the operational impacts of the development.

20.6.13 In summary, drawing on the findings that are set out in the remainder of this section, the environmental changes that are set out in Section 20.6 (b) would result in a combination of permanent and temporary adverse impacts on biodiversity. These have all been assessed as being minor or negligible adverse impacts, except in relation to the permanent loss of calcareous grassland within Hinkley CWS and the permanent loss of part of the same CWS (which are assessed as moderate and major adverse impacts respectively). Once the undeveloped part of the development site is restored, which would involve an extensive programme of habitat creation work, its biodiversity value would progressively increase as the created habitats mature. All the new habitats are likely to attract a wide range of species within about ten years of being established. However, particularly for woodlands, it would take many more years before the newly created habitats would support a flora and fauna that is characteristic of good examples of their type.

i. Off-Site Ditches and Associated Grazing Marsh

20.6.14 Off-site ditches and associated grazing marsh on Wick Moor, which forms part of Bridgwater Bay SSSI and the Severn Estuary SPA, could be affected by changes in:

- the quality and volume of flows into the ditches;
- groundwater levels; and
- air quality.

The likely ecological impacts of these changes are described below.

20.6.15 Holford Stream, which passes through the development site, discharges to ditches on Wick Moor, which forms part of Bridgwater Bay SSSI and the Severn Estuary SPA. Bum Brook, which runs along the southern boundary of the development site, also discharges into the SSSI (via West and East Brook). Water from these streams contributes to supporting water levels within the ditches on Wick Moor which, in addition to being important as habitat for invertebrates and flora that are cited as interest features of the SSSI, play a role in supporting the nature conservation interest of the grazing marsh.

20.6.16 Within the development site, Holford Stream would be culverted (on a different alignment to the existing stream), with the result that it would continue to drain into the SSSI/SPA. The culvert would remain in place throughout the construction and operational phases. Instead of being fed from the existing agricultural landscape, flows within the stream would be derived from drainage off the development site (e.g. from stock-piled materials' storage areas, construction platforms etc. during construction and from the surrounding landscape during operation), which would be channelled to Water Management Zones (WMZs) and/or ponds (the latter during operation), from which the water would be released into the culverted stream. There is not likely to be any change in the flows through the culvert during the construction and operational phases of the development.

20.6.17 Bum Brook would continue to receive surface water runoff from the development site, during both the construction and operational phases. During construction this would also be channelled via WMZs to remove sedimentation.

20.6.18 Implementation of the good practice design measures described in Section 20.6.1, and **Chapters 6** and **12** of this volume of the ES, would maintain the existing greenfield runoff rates in the culverted Holford Stream, and avoid or minimise increased sediment loading, nutrient enrichment and accidental pollution incidents during both the construction and operational phases. This would prevent adverse impacts on the cited freshwater invertebrate and plant features of the SSSI. Construction of the Holford Stream culvert ‘off-line’, so that grouting compounds can cure before the culvert becomes operational, would also avoid chemical pollution associated with the grouting materials (see **Chapter 6** and **Chapter 12** of this volume of the ES).

20.6.19 Based on the differences in geology underlying the development site and Wick Moor, there is unlikely to be groundwater permeability between the two areas (see **Chapter 15** of this volume of the ES). It is therefore unlikely that wetland areas on Wick Moor would be adversely affected by activities such as dewatering during the construction phase.

20.6.20 The various activities that make up the construction phase also have the potential to cause changes in air quality, notably through the generation of sulphurous and nitrous oxides, dust and PM_{10s} from exhaust emissions from on-site plant and machinery (see **Chapter 12** of this volume of the ES). These air quality changes could adversely affect the flora of the ditches and grazing marsh of Wick Moor (Bridgwater Bay SSSI) due to its proximity to the development site boundary and the likely sensitivity of the SSSI to NO_x and nitrogen deposition.

20.6.21 The air quality chapter of this ES (**Chapter 12** of this volume of the ES) concludes that, during the construction phase and without best practice control measures, conditions that could cause fugitive dust/PM_{10s} to travel towards Wick Moor would occur less than 28% of the time and that any impact resulting from this is likely to be limited to within 50m of the source (taken to be the development site boundary). With best practice control measures, the area affected would be even less, with the result that very little if any of the SSSI would be affected. Furthermore, it is unlikely that the activities that generate the most dust/PM_{10} would always coincide with the meteorological conditions most conducive to the transport of airborne dust.

20.6.22 In relation to potential adverse impacts arising from on-site exhaust emissions and air pollutant deposition, **Chapter 12** (of this volume of the ES) concludes that any changes in emissions and deposition during the construction phase would be negligible and therefore adverse impacts on Wick Moor are unlikely to occur. Increases in annual NO_x levels resulting from off-site exhaust emissions during construction have been identified as occurring along Wick Moor Drove, adjacent to Wick Moor. The highest increases in NO_x levels in this location occur on the western boundary of the SSSI at the start of the construction phase (2013) and extend approximately 10m east into the SSSI. Beyond this distance, significant changes in

NO_x levels are unlikely to occur (see **Chapter 12** of this volume of the ES). Therefore, the vast majority of the Wick Moor would remain unaffected by the increases in NO_x concentrations.

20.6.23 The various activities that make up the operational phase also have the potential to cause changes in air quality, notably through nitrogen deposition and the generation of sulphurous and nitrous oxides (see **Chapter 12** of this volume of the ES). These air quality changes could adversely affect the flora of the ditches and grazing marsh of Wick Moor due to its proximity to the development site boundary and the likely sensitivity of the SSSI to NO_x and nitrogen deposition.

20.6.24 In relation to nitrogen, the maximum deposition rates of 1.05kg N ha^{-1} yr^{-1} and 3.99kg N ha^{-1} yr^{-1} (see **Chapter 12**) that are predicted within the SSSI would occur during the start of operation and during routine testing from the EPR units respectively. When these values are added to the existing average local deposition rate, no exceedance of the critical load range for grazing marsh habitat is likely to occur as a result of these activities (based on data from APIS Ref. 20.72).

20.6.25 Changes in annual NO_x, SO_2 and NH3 concentrations would also occur as a result of the routine EPR unit testing during the operational phase (**Chapter 12** of this volume of the ES). However, these changes would be below the Air Quality Standard (AQS) critical concentration levels (as provided by APIS [Ref. 20.72]) for these pollutants by 56%, 90% and 39% respectively.

20.6.26 In conclusion, with the tried and tested measures that form part of the proposed development (as set out in Section 20.6.1 and **Chapters 12, 15 and 16** of this volume of the ES), it is likely that the impacts on the high value off-site ditches and associated grazing marsh on Wick Moor would be, at worst, of very low magnitude, resulting in a **minor adverse** impact.

ii. Other Off-Site Wetland Areas

20.6.27 Dewatering during the construction phase could affect wetlands not only on Wick Moor, but also within Hinkley CWS. .However, based on the differences in geology underlying the development site and Hinkley CWS, there is unlikely to be groundwater permeability between the HPC site and the CWS (see **Chapter 15** of this volume of the ES). It is not therefore likely that the wetland areas within Hinkley CWS would be adversely affected by activities such as dewatering during the construction phase. No impacts are predicted during the operational phase. Therefore, a very low magnitude, temporary impact is predicted, resulting in a **minor adverse** impact on the medium value wetland features of the Hinkley CWS.

iii. Lowland Calcareous Grassland

20.6.28 Approximately 1.2ha of calcareous grassland would be lost within Hinkley CWS and along the coastal strip during the construction phase. This equates to approximately 1% of the West Somerset calcareous grassland resource and less than 0.01% of the County resource (Ref. 20.73). This is assessed as a medium magnitude impact, due to the extent of the permanent loss of this habitat type, on a receptor of medium value (due its location within the Hinkley CWS – see **Table 20.14**), leading to a **moderate adverse** impact.

20.6.29 The only calcareous grassland outside of Hinkley CWS that would be lost as a result of the construction of the proposed development is within Bishop's Wood, an area of 2.3ha that was planted with trees in 1998/1999 but still supports species-rich grassland, although it is assessed as being of low biodiversity value. The loss of this grassland is also assessed as being of medium magnitude, resulting in a minor adverse impact.

20.6.30 The air quality chapter of this ES (**Chapter 12** of this volume of the ES) concludes that, during the construction phase and without best practice control measures, conditions that could cause fugitive dust/PM_{10s} to travel towards the calcareous grassland within the CWS outside of the site boundary would occur less than 28% of the time and that any impact resulting from this is likely to be limited to within 50m of the source (taken to be the development site boundary). With best practice control measures, the area affected would be even less, with the result that very little if any of the calcareous grassland within Hinkley CWS would be affected. Furthermore, it is unlikely that the activities that generate the most dust/PM_{10} would always coincide with the meteorological conditions most conducive to the transport of airborne dust.

20.6.31 In relation to potential adverse impacts arising from on-site exhaust emissions and air pollutant deposition, **Chapter 12** (of this volume of the ES) concludes that any changes in emissions and deposition during the construction phase would be negligible and therefore adverse impacts on off-site calcareous grassland are unlikely to occur. Increases in annual NO_x levels resulting from off-site exhaust emissions during construction have been identified as occurring along Wick Moor Drove, to the south-west of Hinkley CWS. The highest increases in NO_x levels in this location occur approximately 380m to the south-west of the CWS boundary at the start of the construction phase (2013). As the increase in NO_x concentration progressively reduces to a low level within a short distance of the source, it is unlikely that significant changes in NO_x levels would occur. Impacts on the calcareous grassland within the CWS are therefore unlikely to occur (**Chapter 12** of this volume of the ES).

20.6.32 Operation of the development would not have any direct impacts on the calcareous grassland habitats adjacent to the site or on those created during the latter stages of the construction phase. Indirect impacts could occur on these habitats through the generation of sulphurous and nitrous oxides, dust and PM_{10s} from exhaust emissions from on-site plant and machinery and the operation of HPC itself. However, as concluded in **Chapter 12** of Volume 2 of the ES, any changes in emissions during the operational phase would be negligible. In addition, the nitrogen deposition plume from the EPR units could result in degradation of created calcareous grassland. However, the plume is most likely to be focused to the east of the restored construction site (see **Chapter 12** of this volume of the ES) thereby minimising impacts on the restored site. In addition, the predicted maximum deposition rates for nitrogen that are predicted within the CWS during the start of operation and during routine testing from the EPR units (1.05kg N ha^{-1} yr^{-1} and 2.49kg N ha^{-1} yr^{-1} respectively – see **Chapter 19**), will not increase the existing average local deposition rate (as provided by APIS Ref. 20.72) beyond the critical load exceedance range for calcareous grassland.

20.6.33 Changes in annual NO_x, SO_2 and NH3 concentrations would also occur as a result of the routine EPR unit testing during the operational phase (see **Chapter 12** of this volume of the ES). However, these changes would be below the Air Quality

Standard (AQS) critical concentration levels (as provided by APIS Ref. 20.72) for these pollutants in relation to calcareous grassland by 6%, 89% and 45% respectively. As the potential impact due to changes in air quality is likely to be of very low magnitude on a medium value resource, this would result in a **negligible adverse** impact.

20.6.34 At the end of the construction phase, the restoration of the construction areas would commence. As part of this, 17.7ha of calcareous grassland (**Appendix 20R**) would be created on suitable soil using a combination of seed collected on the development site during 2009 and 2010 and an ‘off the shelf’ seed mix of British provenance. This would create an area of calcareous grassland almost 15 times the size of the area lost during the construction phase. The calcareous grassland would be created on the south-facing slopes south of Green Lane and would provide habitat connectivity for fauna between retained areas of calcareous grassland within Hinkley CWS and along the coastal grassland to the west of the development site (along the cliff edge).

20.6.35 The new areas of calcareous grassland would be managed for the benefit of biodiversity. The detailed objectives, prescriptions and programme of management and monitoring would be provided in an Integrated Land Management Plan (ILMP); this would be produced once the development site had been restored as it would need to respond to the specific site conditions at that time. In addition to specifying the grassland management regime, the ILMP is likely to include proposals for regular surveys to be used in monitoring the development of the grassland and informing management decisions.

20.6.36 With this management regime, it is likely that, after a period of about five to ten years, the newly created grassland would be a valuable biodiversity resource, supporting many of the species that are currently present on the calcareous grassland within the development site. At this stage, it is likely to be of low biodiversity value but, with the ongoing programme of high quality management, the objective would be for it to achieve medium biodiversity value by year 30 after the completion of the construction phase. As the area of habitat creation would be almost 15 times the size of that lost, the long term outcome would be of a medium magnitude, resulting in a **moderate beneficial** impact.

iv. Woodlands

20.6.37 With the exception of the small part of Branland Copse that is located within the development site (0.2ha), the construction of the proposed development would result in the clearance of all the woodland within the site. This totals 6.8ha (**Appendix 20R**), which is less than 0.01% of the West Somerset broad-leaved woodland resource (Ref. 20.73). The woodlands that would be lost are of low value and their total loss would be a medium magnitude impact, reflecting the permanent loss of a small area of habitat. On this basis, their loss would be a **minor adverse** impact.

20.6.38 To compensate for this loss, new areas of woodland would be created. These include 2.2ha of additional permanent woodland, using a species-rich mixture of native tree and shrub species (comprising whips and mature specimens), which was planted in the south-west corner of the development site (broadly along the western part of Bum Brook) at the beginning of 2011. Further permanent native, broad-leaved woodland (approximately 8.7ha) would be planted during the early stages of the construction phase on the land between the construction site boundary and the Bum Brook. In addition, approximately 1.4ha of temporary woodland/scrub would be planted on a bund along the north-western boundary of the development site at the beginning of the construction phase. It would be retained for the duration of the construction period. and would then be removed.

20.6.39 During the restoration of the construction areas, which would take place in the later stages of the construction phase, a further 28.8ha of broad-leaved woodland would be permanently planted in the southern and eastern areas of the development site. This would give a total of approximately 39.7ha of broad-leaved woodland on the restored areas, which is over five times the area of woodland that would be lost. This further woodland would be created using species that are typical of ancient semi-natural woodland in the surrounding area.

20.6.40 After an initial aftercare period of three years, the newly created woodlands within the development site would be subject to long-term management for the benefit of biodiversity, which would include creating a diverse age structure. Management activities would include the margins being fenced to prevent grazing by stock, localised gap creation, restocking/natural regeneration as appropriate and the creation of rides to maximise the amount of woodland edge habitat created. The management proposals, together with specific management objectives, and a programme of management and monitoring would be provided in the ILMP.

20.6.41 This management regime is initially likely to result in the newly planted woodland attracting a wide range of species that are associated with open woodland, scrub and grassland habitats. However, after about 10-15 years, it is likely that the canopy would become closed (other than where there are rides or where gaps are created), and the fauna and, to a lesser extent, the herbaceous flora, would include more woodland species. As the woodland continues to mature, and with the ongoing management programme, its flora and fauna would progressively become more characteristic of established woodland, as would its structural characteristics (e.g. uneven aged trees and the presence of dead wood habitats). After some 30-50 years, the woodlands are likely to be of low biodiversity value but, with the ongoing programme of high quality management, they are likely, in the longer term (e.g. after 100 years), to become of medium biodiversity value.

20.6.42 After 30-50 years, the magnitude of the biodiversity gain is assessed as medium on a low value resource, resulting in a **minor beneficial** impact. At this stage, the new woodland would not contain trees that are as old as many of those within the existing woodland and there would be likely to be less dead wood and associated fauna, and fewer woodland ground flora species. However, there would be a wider range of woodland habitats, reflecting the tailored management programme, within an area that is over five times the extent of the area that would be lost. Thus, although there would be a period of time when the newly created woodland does not fully compensate for the loss of woodland (i.e. the ten year construction phase plus up to some 30-50 years thereafter), it is assessed that the new woodland would, after this period, at least compensate for the loss of woodland, and, over subsequent years, would progressively more than compensate for the loss.

20.6.43 During construction and without best practice control measures, conditions that could cause fugitive dust/PM_{10} to travel towards the off-site woodland within the CWS would occur less than 28% of the time and, any impact resulting from this would be limited to within 50m of the source (taken to be the development site boundary). Furthermore, it is likely that the activities that generate the most dust/PM_{10s} would not always coincide with the meteorological conditions most conducive to the transport of airborne dust (see **Chapter 12** of this volume of the ES). With good practice control measures, the area affected is likely to be less, but given the proximity of the off-site woodland to the site, there remains the potential for an adverse impact to occur. No impacts are predicted in the construction phase in relation to on-site or off-site exhaust emissions and air pollutant deposition (see **Chapter 12** of this volume of the ES).

20.6.44 Operation of the development would not have any direct impacts on the woodland habitats adjacent to the site or on those created during the construction phase. Indirect impacts could occur on these habitats through the generation of nitrogen and sulphurous and nitrous oxides. However, as concluded in **Chapter 12 of Volume 2** of the ES, any changes in NO_x, SO_2 and NH3 during the operational phase would be below the critical levels for these pollutants in relation to woodlands.

20.6.45 Impacts on the woodlands could also result from the nitrogen deposition plume from the EPR units. As the plume is most likely to be focused to the east of the restored construction site (see **Chapter 12** of this volume of the ES), impacts on the created on-site woodlands are likely to very low magnitude. However, maximum deposition rates of 1.05kg N ha^{-1} yr^{-1} and 3.14kg N ha^{-1} yr^{-1} (see **Chapter 19**) are predicted within the off-site CWS woodlands during the start of operation and during routine testing from the EPR units respectively. The available information on the existing average local deposition rate (as provided by APIS [Ref. 20.72]) indicates that, for broad-leaved woodland, the baseline deposition rate is currently higher than the critical load range. Therefore, the additional nitrogen deposition rate resulting from the operational phase would increase the baseline exceedance in relation to off-site woodland within the CWS by a maximum of 13%, although this is considered to be a worst case scenario (as the weather conditions will not always result in the highest deposition rates). Impacts on off-site woodland during the construction and operation phases as a result of air quality changes are therefore assessed as a medium magnitude impact on a low value receptor, which results in a **minor adverse** impact.

v. Hedgerows

20.6.46 All the hedgerows within the development site would be lost during the construction phase, with the exception of the majority of the hedgerow that runs east-west across the centre of the site (largely along Green Lane), a hedgerow that connects Green Lane to the Common Land (located adjacent to the eastern boundary of the site) and the north-south hedgerow along the development site's western boundary (largely along Benhole Lane). The length of hedgerows that would be lost on the development site would total approximately 9.2km (approximately 83% of the total resource within the site), comprising 5.8km that is species-rich and 3.4km that is species-poor (**Appendix 20R**). A small amount of species-poor hedgerow would also be lost as a result of the highway improvement works.

20.6.47 Of the 58 hedgerows that would be lost, 30 meet the criteria for classification as being ecologically 'important' under the Hedgerows Regulations. All of the retained hedgerows have also been assessed as important and all are currently, and would remain, well connected to other hedgerows and woodland in the wider landscape.

20.6.48 The hedgerow losses would include a length along the eastern section of Green Lane, which needs to be removed in order to accommodate the access road and substation. However, habitat connectivity would be maintained via the retention of an existing hedgerow linking Green Lane to a hedgerow along the Common Land boundary. This hedgerow would be augmented by the creation of a second parallel hedgerow, which would be offset by approximately 5m. This would be planted during winter 2011/2012.

20.6.49 Green Lane would be fenced-off during the construction phase, with an approximately 40m wide strip of land to either side retained (and enhanced by planting with native grassland and wildflower species) to provide a buffer from disturbance during the construction phase. A similar strip of land would also be retained, planted and fenced-off to the east of Benhole Lane (within the site development boundary), thereby protecting this hedgerow.

20.6.50 Relative to the wider hedgerow resource in the local area, a limited area of this low value habitat type would be permanently lost. As such, the loss of hedgerows is assessed as being an impact of medium magnitude and, therefore, a **minor adverse** impact.

20.6.51 During the restoration of the construction area at the end of the construction phase, a hedgerow network, with the planting locations based on the hedgerow layout currently present, would be created using a woody species-mix that reflects the most species-rich hedgerows currently present within the development site. The hedgerow network would comprise wide, single hedgerows together with double hedgerows that are separated by footpaths or grassland. The creation of botanically diverse associated hedgerow flora would be achieved through the application of subsoil along hedge bases and the use of seed mixes of British provenance. This would result in 13.1km of hedgerow and edge habitat being created.

20.6.52 The restored (and retained) hedgerows within the development site would be managed for the benefit of biodiversity. The detailed objectives, prescriptions and programme of management and monitoring would be provided in the ILMP; this would be produced once the development site has been restored as it would need to respond to the specific site conditions at that time. The ILMP would include proposals for regular hedgerow management, which would be designed to ensure that the hedgerows remain species-rich and structurally diverse. Regular surveys of the hedgerows would be carried out to monitor their structure and condition, with the findings being used to determine whether there is any need to modify the management regime.

20.6.53 After about five years, the newly planted woody species are likely to have thickened-up sufficiently to form hedgerows that have few, if any, gaps. The hedgerows would then progressively mature and with their management targeted to deliver biodiversity benefits, would attract an increasing number of faunal species that are characteristic of this habitat type. After some 30 years, it is likely that the newly created hedgerows would be of low biodiversity value. As the habitat creation would be permanent, the outcome would be of a medium magnitude, resulting in a **minor beneficial** impact.

20.6.54 Thus, as with woodland and calcareous grassland, although there would be a period of time when the newly created hedgerows would not fully compensate for the loss of existing hedgerows (i.e. the ten year construction phase plus up to some 30 years thereafter), it is assessed that the new hedgerows would, after this period, at least compensate for the loss, and, over subsequent years, would progressively more than compensate for the loss. This conclusion reflects the new hedgerows and edge habitat not having the maturity of those that currently exist, but there being over twice the current length of these habitats.

vi. Watercourses

20.6.55 The construction phase would result in the loss of one watercourse, with a second watercourse being culverted, resulting in its natural characteristics being lost (approximately 2.0km of this habitat in total). However, during the construction phase, management of the vegetation along Bum Brook, involving willow pollarding, scrub removal and the reduction of the dominance of Himalayan balsam, is likely to increase the biodiversity value of this stretch of watercourse by allowing native species to re-colonise, resulting in increased species-richness. Also, wetland habitats (ponds and reedbeds) would be created within the southern part of the development site, adjacent to Bum Brook, at the beginning of the construction phase. Even allowing for this enhancement, the loss of watercourses on-site, which are of low biodiversity value, would be a medium magnitude impact, reflecting their permanent loss/modification. On this basis, the impacts would be **minor adverse**.

20.6.56 At the end of the construction phase, as part of the restoration of the development site, ditches would be created in the Holford Valley in the centre of the site. These are likely to be seasonally wet and would drain into a wetland area that would be established close to Benhole Lane on the western boundary of the development site (to provide water to Holford Stream). Given their ephemeral nature, the ditches are likely to be of very low biodiversity value and the impact is likely to be of very low magnitude. The impact is therefore assessed as being **negligible beneficial**.

vii. Habitat Networks

20.6.57 The network of habitat features within the development site (hedgerows, woodland and running watercourses), allows a range of species to pass through the area, particularly east-west, but also, to a limited extent (constrained by the coast), north-south. Most of the network would be lost (approximately 11.3km of hedgerows and watercourses) but the retention and enhancement of three larger habitat corridors within or adjacent to the development site would maintain north-south (Benhole Lane) and east-west (Green Lane and Bum Brook) habitat linkages across the site, thereby reducing the impact of severance on the local habitat network.

20.6.58 The impact on the network during the construction phase is assessed as being of medium magnitude on a low value resource, producing a **minor adverse** impact. However, the restoration of the construction site at the end of the construction phase would also create a new habitat network comprising hedgerows, woodland and flower-rich grassland, which would improve the habitat connectivity across the development site to areas such as Hinkley CWS and Wick Moor and also provide habitat linkages within the restored site. It is likely that the habitats would be sufficiently functional in ecological terms to operate effectively as habitat corridors within with a period of five to ten years after construction. The enhanced network representing a medium magnitude beneficial impact on a low value receptor, resulting in a **minor beneficial** impact.

viii. Birds using Terrestrial Areas

20.6.59 If undertaken during the breeding bird season, site clearance activities would have the potential to destroy active bird nests, which would be in contravention of the WCA (Ref. 20.8). To avoid this, vegetation clearance and/or management would, wherever possible, be completed outside of the breeding bird season (which is generally considered to be March to August inclusive). Should vegetation clearance be required during this period, a suitability qualified ecologist would survey the vegetation prior to its removal in order to check for the presence of active nests. If an active nest is found, it would be left undisturbed until the young have fledged.

20.6.60 With the adoption of these measures, there would be **no impact** on breeding birds in relation to legal protection.

20.6.61 Once the vegetation has been removed from the areas where construction activities would take place (i.e. excluding the retained habitats such as Green Lane), the cleared areas are likely to no longer support any of the bird species that currently breed on the development site. These include an estimated three pairs of the scarce lesser whitethroat. Also present are an estimated 23 pairs of skylark, seven of linnet, nine of yellow hammer and between one and 20 pairs of five other species that are listed as being of principal importance for biodiversity under the NERC Act. A small number of some of these species are likely to continue to breed in the areas of retained vegetation, whilst the cleared areas may attract other species.

20.6.62 With the exception of lesser whitethroat (which is assessed separately below), all of the farmland bird species that were recorded on the development site are widespread in lowland South-west England and should therefore be seen as forming part of large populations occurring over an extensive area. Although these species are declining across the UK they are responding to landscape-scale changes, such as the intensification of agriculture, rather than to the development of relatively small areas of suitable habitat. As such, the loss of those pairs that breed on the development site would not have an adverse impact on the conservation status of the species concerned.

20.6.63 The loss of vegetation and soil stripping that would occur during the construction phase would also reduce the amount of food and shelter that is available for the birds that currently occur on-site during the wintering and passage periods. Furthermore, the disturbance from construction activities within the boundary of the development site is likely to discourage the use of on-site habitats by wintering and passage birds (other than waterbirds). Although some birds would continue to use the development site during these periods, many others are likely to be displaced from the site. Notable species that are likely to be wholly or largely displaced are mobile flocks of passerines associated with coastal fields/lowland farmland such as linnet, skylark, redwing and meadow pipit.

20.6.64 The flocks of passerines that were recorded were largely outside of the development area, being most often observed feeding on Wick Moor. Numbers fluctuated markedly and in view of this and the frequency of occurrence during the surveys, it is likely that these mobile flocks were only present sporadically. As the fields within and adjacent to the proposed development area did not frequently support large numbers of birds and the larger flocks were only occasionally of county importance (i.e. in excess of 1% of the county population), the winter and passage bird community of the terrestrial habitats within the development site is of low biodiversity value. The displacement of these wide-ranging birds from the development site during the construction phase is unlikely to affect the conservation status of the species concerned.

20.6.65 On the basis of the assessment that is set out above relating to breeding and wintering birds, the magnitude of the impacts on these species is likely to be low, affecting a low value resource, and the scheme would, therefore, have a **minor adverse** impact in this respect. This impact would be partially compensated by the increased numbers of breeding and wintering birds that would be attracted to use the habitats that would be created as part of the restoration of the construction areas. This would include approximately 3.8ha of a crop grown specifically to benefit farmland birds (an annual cover crop). As the semi-natural habitats progressively mature, they would attract birds for foraging and nesting. Although the range of species that would colonise cannot be accurately predicted the range of habitats to be created is likely to attract many of the same species that are currently present within the environs of Hinkley Point (including declining farmland birds and lesser whitethroat). After about five years the hedgerows, species-rich grassland and other newly created habitats are likely to be sufficiently well established to support low value populations of breeding and wintering birds. This is likely to result in a low magnitude of impact on a low value receptor which would result in a **minor beneficial** impact.

20.6.66 There is also the potential for the construction phase to cause disturbance to birds that breed in close proximity to the development site, resulting in reduced breeding success and, potentially, a decline in their populations. The most likely response of the affected breeding bird community is a reduction in density and a change in composition. Numbers of those species that are well known for breeding in disturbed areas, such as the edges of industrial premises, along roadsides and adjacent to construction areas (including house sparrow, which is a species of principal importance for biodiversity), are unlikely to decline. For more disturbance-sensitive species, disturbance impacts are unlikely to occur over 250m from the development site (Ref. 20.64), within which area the breeding bird population (with the exception of Cetti's warbler, which is addressed separately below) is only of low importance.

20.6.67 Once HPC is operational, noise and human activity would continue to disturb birds that breed in close proximity to the nuclear plant. However, the level of disturbance would be reduced, in comparison to the construction phase, reflecting the fact that a substantial area of the construction site would have been restored to create wildlife habitats and agricultural land and that noise and visual disturbance would be a lower level.

20.6.68 Furthermore, the majority of birds that have been recorded within nearby terrestrial habitats (both during the breeding and wintering periods) have been associated with

Wick Moor. This is adjacent to the existing Hinkley Point Power Station Complex and the species that occur here are likely already to be habituated to the type of operational disturbance that is predicted to occur from the HPC station.

20.6.69 Consequently, as the bird community that is likely to be disturbed is of low biodiversity value and the area of disturbance is relatively small (in the context of the habitats supporting a similar community in the wider area) a very low magnitude of impact is predicted, which would have a **negligible adverse** impact.

ix. Lesser Whitethroat

20.6.70 The construction phase would result in the loss of three territories of lesser whitethroat that occur within the development site. Although there is potential for these birds to move into adjacent areas of retained habitat this cannot be presumed and therefore a medium magnitude of impact is predicted. Given the low biodiversity value of these three territories, their loss would have a **minor adverse** impact. The creation, as part of the restoration of the construction areas, of more edge habitats (e.g. hedgerows and scrub), together with appropriate long term management (tailored to the needs of lesser whitethroat) would be likely to attract at least as many breeding pairs of this species as would be lost. This would therefore be a **minor beneficial** impact, although it would not be achieved until some ten or more years after the hedges and woodland/scrub have been planted.

x. Cetti's Warbler

20.6.71 The population of Cetti's warbler that could be affected exists in areas outside the development site boundary. Cetti's warbler is a bird that is quite tolerant of disturbance, as evidenced by breeding pairs having been recorded close to the centres of human activity and industrial noise associated with the existing Hinkley Point Power Station Complex (and associated infrastructure) and to other busy areas within Somerset (e.g. Apex Leisure Park and Minehead Golf Course – Ref. 20.43). Given the distances from areas of works' activity and the ability of this species to exist in disturbed areas, it is likely that any impact of disturbance during the construction phase would not affect the species' survival. Hence the impact is likely to be of no more than low magnitude.

20.6.72 The types of disturbance that would be associated with the functioning of HPC would be broadly similar to those associated with HPB, which is closer to the population of Cetti's warbler than would be to the proposed HPC station. Therefore it is likely that any impact of disturbance would not affect the species' survival or productivity and would be of very low magnitude.

20.6.73 The combination of low magnitude disturbance during construction and very low magnitude disturbance during the operational phase, affecting a medium value species' population, is likely to result in an impact of **minor adverse** significance.

xi. Birds using Inter-tidal Areas

Construction

20.6.74 There is the potential for birds using the inter-tidal areas close to the development site to be adversely affected by disturbance caused by noise, human activity, lighting and vibration associated with the construction works. Any impacts would be likely to be confined to areas of intertidal habitats that are in close proximity to the construction area and could lead to displacement of waterbirds from the local area. However, the loss of the fields within the development site may also reduce the foraging, roosting and loafing area used by some species.

20.6.75 In assessing what are likely to be the impacts of disturbance, consideration has been given to:

- the numbers and distribution of waterbirds recorded during the intertidal bird surveys that are summarised in Section 20.5(b); and
- the extensive area of similar intertidal habitat in the vicinity of the development site (and further afield, but still within the Severn Estuary SPA and Ramsar Site) that could be used by any birds that are disturbed and is within the likely home-ranges of the species present.

20.6.76 The assessment draws upon the evidence presented below regarding the impacts of disturbance on birds using intertidal areas.

20.6.77 There is relatively limited information on the potential for construction work to act as a disturbing activity on waterfowl populations (through noise and visual disturbance). However, studies by the Institute of Estuarine and Coastal Studies (IECS) focusing on the effects of disturbance caused by construction works associated with flood defence and managed re-alignment on the Humber Estuary provide useful information (Ref. 20.74, Ref. 20.75). A comprehensive analysis of data recorded during a large-scale construction project within Cardiff Bay also provides useful information (Ref. 20.76).

20.6.78 Birds tend to be more affected by the presence of people than by noise from equipment; although the two causes of impacts are usually intimately related (i.e. noise is mainly created concurrently with human presence – Refs. 20.74 and 20.75). Disturbance events may result in a range of behavioural responses from birds within the area. At low levels, disturbance results in a detectable behavioural change with individual birds taking up alert postures; at greater levels of disturbance short-distance flights or movements on foot are undertaken within familiar habitats that are already regularly used (i.e. within a home-range); with large-scale disturbance events, displacement to areas outside of home-ranges may occur.

20.6.79 Disturbance can result in a reduction in energy intake and an increase in energy expenditure, which may ultimately result in a reduction in over-winter survival or subsequent breeding success. However, disturbance events that do not result in displacement are unlikely to result in the energy intake falling enough to result in a reduction in body condition. Disturbance that results in displacement into habitats that are already habitually used by a given individual (i.e. within their home-range) is unlikely to result in a detectable effect on body condition unless core foraging areas or secure roost sites are disturbed frequently. Disturbance that results in displacement into areas outside of a home-range is likely to have a greater impact on individual birds as the level of competition present may be high, the habitat patch quality may be low and the ability of an individual to exploit an unfamiliar habitat patch effectively may be compromised. The level of impact would be moderated by the frequency of disturbance events and their duration.

20.6.80 During works on the Humber Estuary, the responses of birds to visual and aural stimuli differed due to the type of construction activity, species, season, site topography, weather, tidal state and degree of habituation (Ref. 20.74 and Ref. 20.75). In general, however, detectable effects of disturbance were not recorded at distances greater than 250m, although many species continued to feed, loaf or roost within this distance. Reactions were more pronounced when construction activity was visible, with even loud activities (e.g. percussion piling) on the landward side of the seawall (where people were not visible to birds using the intertidal habitat) resulting in only minimal reactions from the birds present.

20.6.81 The Cardiff Bay study, which related to the construction of the Cardiff Barrage during 1991-1999, assessed the wider (i.e. population) influence of construction works on waterbirds. This work (Ref. 20.76) found that over the construction period, the densities of several species of waterfowl (teal, oystercatcher, dunlin, curlew and redshank) on mudflats adjacent to the works decreased in comparison to pre-construction levels. Construction work was also observed to reduce the feeding activity of oystercatcher, dunlin and redshank over these mudflat areas. Burton et al. (Ref. 20.76), on the basis of this work, suggest that disturbance from construction work may affect the ability of intertidal habitat to maintain waterfowl populations during the construction period. Further work on redshank that were completely displaced from Cardiff Bay (due to disturbance and habitat loss) showed that individual birds that moved to new areas had poorer body condition than birds that were already resident in those areas (Ref. 20.77)

20.6.82 When assessing impacts of the predicted disturbance associated with the proposed HPC development, the survey data that need to be used are those for Count Sectors 1-3. This is because Count Sectors 4 and 5 are over 500m east of the potential sources of disturbance and therefore are outside of the 250m zone which the Humber Estuary research indicates is the maximum area over which disturbance impacts are likely to occur (Ref. 20.74 Ref. 20.75). Accounting for both works on land and on the aggregates jetty, the 250m disturbance zone (see **Figure 20.5**) covers 19%, 97% and 26% of the intertidal habitats within Count Sectors 1, 2 and 3 respectively.

20.6.83 Data collected from Count Sectors 1 – 3 show that the cited species of the Severn Estuary SPA and Ramsar Site, and the Bridgwater Bay SSSI that regularly occur in these areas are wintering shelduck, wigeon, pintail and curlew, and passage whimbrel and ringed plover. Other species of note that make use of the inter-tidal areas located adjacent to the development site are herring gull and little egret. A roost of oystercatcher, a species which does not feature as part of the cited interest of any of the statutorily protected sites, is also a regular feature of the inter-tidal area to the west of the development site.

20.6.84 Dunlin, grey plover, lapwing, redshank, shoveler and teal all occurred within Count Sectors 1 – 3 on few occasions (between 0.5 and 6% of all survey dates) and in very small numbers (<1% of the Severn Estuary SPA population); some of the same species also occurred in small numbers on the neighbouring fields. These species can be discounted from the need for further assessment on the basis that they would not be prone to detectable population effects from the proposed construction works as the 250m disturbance zone (see **Figure 20.5**) does not contain areas that are used habitually by these birds. Therefore it is likely that any individuals of these species which are disturbed to such an extent that displacement occurs, would move short distances into areas that they habitually use at other times, which are likely to provide the required resources to support them.

20.6.85 Compared with these species, mallard and wigeon occurred in Count Sectors 1 – 3 more frequently (24% and 22% respectively of all survey dates) although in numbers that never exceeded 1% of the Severn Estuary SPA population. Occurrence was not, however, at a level that makes it likely that Count Sectors 1 – 3 were being used by these species as core foraging or roosting areas. The highest numbers of mallard were noted in Count Sector 1, with very small numbers recorded (four or fewer) in Count Sectors 2 and 3. Wigeon were noted in greatest numbers in Count Sectors 1 and 3 with only two counts of more than ten birds present in Count Sector 2 throughout the survey period. Larger numbers of both species were recorded at greater frequency within Count Sectors 4 and 5, which are therefore more likely to represent core foraging/loafing areas than the predicted disturbance zone within Count Sectors 1 – 3. Therefore it is likely that any individual mallard or wigeon that are disturbed to such an extent that displacement occurs would be able to move a short distance into areas that they habitually use and that are likely to provide the required resources to support them. As a result, detectable declines in the body condition of individuals would be unlikely to occur as the increased energy expenditure required to relocate a short distance would be negligible.

20.6.86 Mallard was noted in very low numbers within the terrestrial habitats within or adjacent to the development area; the peak count being of two individuals. Given this low level of usage it is therefore likely that no detectable effect on the Severn Estuary population of mallard would occur due to the loss of the fields within the development footprint. Wigeon were not recorded in the fields within the footprint of the proposed development or within 250m of the development site boundary.

20.6.87 Pintail was noted using Count Sectors 1 – 3 on six dates during the survey programme; the frequency of occurrence was considerably greater in Count Sectors 4 and 5. The number of pintail exceeded 1% of the Severn Estuary SPA population (with a range of 6 – 60 birds) on three of the six occasions; all these records were within Count Sector 3, where birds were recorded loafing. No foraging activity was recorded in Count Sectors 1 – 3 indicating that it is not a core foraging area; foraging by relatively large numbers of pintail was recorded in Count Sector 5. The data suggest that pintail do not habitually use Count Sectors 1 – 3 and, if disturbed in this area, could relocate to adjacent habitats that they already habitually use without a detectable impact on individual birds or the population as a whole.

20.6.88 Whimbrel occupied Count Sectors 1 – 3 on 12 of the 182 survey dates in numbers ranging from one to five individuals; the number and frequency of occurrence of whimbrel was greater in Count Sectors 4 and 5. Individuals spent time loafing and foraging in the months of April, May and August when these birds were migrating through the estuary. Given the small numbers and the sporadic occurrence, Count Sectors 1 – 3 are unlikely to form a core area where refuelling or resting takes place during the migratory periods. It is therefore likely that any whimbrel that is disturbed will occupy nearby habitats without detectably affecting their energy intake or energy expenditure. Thus their survival rate would not be adversely affected.

20.6.89 Curlew was recorded regularly in Count Sectors 1 – 3 throughout the year, with 141 occurrences over the course of 182 survey dates. Although usage was frequent, numbers were generally small, with a peak count of 25 individuals, representing 0.6% of the Severn Estuary SPA population. The fluctuating numbers in Count Sectors 1 – 3 suggest that individuals also use other areas for foraging, roosting and loafing (as would be expected given usual curlew behaviour of exploiting a variety of habitats, e.g. pasture fields, mudflats, saltmarsh etc.). This is likely to include Count Sectors 4 and 5, where much greater numbers of curlew were recorded foraging, loafing and roosting. Of these two sectors, Count Sector 5 (and the rest of Stert Flats) provides particularly good foraging opportunities for this species as the habitats present support greater densities of curlew's preferred invertebrate prey (e.g. large worms and bivalve molluscs). Given that the numbers of curlew in Count Sectors 1 – 3 are small, and displacement due to disturbance would be local and likely to be within existing home-ranges, it is concluded that no detectable decline in the local curlew population is likely to be realised through disturbance associated with the proposed development.

20.6.90 Curlew was recorded in small numbers (less than 1% of the SPA population) using the fields within and adjacent to the development area for foraging. The displacement of these birds from these fields has the potential to reduce the foraging resource available to this species. However, curlew are birds known to range widely during the winter period and are highly likely to feed across much of the farmland both to the east and west of the proposed development area (as well as on the inter-tidal habitats). It is therefore unlikely that the loss of a small number of fields within a landscape dominated by suitable habitat would be sufficient for a detectable effect on any individuals or the local population to be realised.

20.6.91 Ringed plover was noted 44 times (24% of survey dates) using Count Sectors 1 – 3; the majority were within Count Sector 1, where the potential for disturbance is lower than in the other count sectors (reflecting there being the smallest degree of overlap between the count sector and the disturbance zone). This species was recorded in all months of the year, usually in small numbers (less than five individuals); numbers exceeded 1% of the Severn Estuary SPA population (i.e. seven or more individuals) on only six occasions.

20.6.92 Although ringed plover was recorded throughout the year, its occurrence was sporadic. In view of this and the small numbers, it is likely that the potential disturbance zone does not provide core areas for any individuals. Indeed, due to ringed plovers' foraging preferences, the larger areas of mobile sands and muddy sands to the west of Count Sectors 1 provide better habitat for this species than the rock platforms that dominate the potential disturbance zone. It is therefore concluded that displacement of ringed plover from Count Sectors 1 – 3 would not be likely to result in abandonment (temporary or permanent) of home-ranges with the result that there would be no detectable effect of disturbance on the population.

20.6.93 The majority of shelduck recorded using Count Sectors 1 – 3 were loafing. All large aggregations that were recorded were of birds rafting on the water during the moulting period of July to August (**Figure 20.6**). Many of these birds were likely to be moulting and seeking to stay away from potential predators whilst they were flightless. Avoidance of any disturbance would therefore involve swimming or using the tidal current to move away from the source of disturbance into another nearby area of water (data collected in 2011 demonstrated the ability of shelduck to swim against the tide – see **Appendix 20Q**).

20.6.94 Surveys of shelduck that were undertaken during the moulting period in 2011, together with the surveys undertaken in 2007-2009 (see **Appendix 20Q** and **Figure 20.6** respectively), found that all but one flock of shelduck were outside the 250m disturbance zone around the jetty head. During the construction phase shelduck may also be disturbed by boats docking or leaving the temporary jetty. However, as shelduck are able to swim to avoid disturbance and the level of boat traffic would be low (as docking and disembarking can only take place at high tide), detectable levels of disturbance are not likely to occur.

20.6.95 Very few foraging shelduck were recorded in Count Sectors 1 – 3, which is likely to be due to the majority of the habitat in these areas being unsuitable for their foraging. By contrast, large numbers of foraging birds were regularly observed in Count Sector 5, where the extensive mudflats provide good foraging habitat. The much greater usage of Count Sector 5 together with the types of habitat present within Count Sectors 1 – 3 indicate that the latter count sectors are not likely to be core areas of the home-ranges of any foraging shelduck. Therefore any disturbance of shelduck in Count Sectors 1 – 3 is not likely to result in birds being displaced from their core foraging areas. Therefore no loss of body condition or impacts on survival are likely to occur.

20.6.96 Shelduck's usage of coastal fields within or adjacent to the development area was very limited both in terms of numbers and frequency of occurrence (see **Figures 3.5a-b** and **3.6a-b** in **Appendix 20B**). The loss of these fields is therefore unlikely to result in any detectable impacts on shelduck.

20.6.97 Little egret was regularly recorded in small numbers within the inter-tidal habitats and in the coastal fields. This species is known to move regularly to feed in different places throughout the day (Ref. 20.78) and therefore it is likely that the individuals present are using a variety of feeding opportunities (e.g. rock pools, field drains etc.) in order to forage efficiently. Given that this species is increasing across Somerset and elsewhere in the UK, it is apparent that the availability of foraging areas is not yet a limiting factor. Therefore given this species' ranging behaviour and the extent of suitable habitats in the area, it is unlikely that any displacement of birds from either a small area of intertidal habitat or agricultural fields would result in a detectable effect on the body condition or survival rate of any individual or the local population of this species.

20.6.98 Herring gull is a species that is well known for exploiting disturbed habitats (e.g. landfill sites, city centres etc.); it is also a highly mobile species and an opportunist feeder. Given these characteristics, it is likely that disturbance associated with the construction works would not result in a detectable effect on this species. The loss of a small number of fields to development is also unlikely to provide a significant reduction in the availability of food for this species.

20.6.99 Oystercatchers regularly use the disturbance zone (peak count of 100 foraging birds) for foraging and roosting. There were 554 records of oystercatcher from the 182 survey dates, with the majority (490) being of flocks of no more than 20 birds (there were 430 records of flocks between 1 – 10 birds). Only 13 of the records were of numbers in excess of 50 birds. Roosting usually occurred on the rock platforms adjacent to the inter-tidal habitats in the 2 hours either side of high tide. Most of the roosting birds were in Count Sectors 3 and 4 where disturbance from the proposed development would be minimal, as only about one quarter of Count Sector 3 would be disturbed. Foraging oystercatchers were generally widespread across Count Sectors 1 – 4.

20.6.100 As oystercatchers are widespread across the inter-tidal habitats in Count Sectors 1-5 and on Stert Flats, it is likely that individual birds using the areas within the disturbance zone are also habitually using other habitats in the area for foraging and roosting. Therefore it is likely that any disturbed individuals would only have to move a short distance to re-locate to areas with which they are already familiar. No detectable effects on body condition or the survival of individual oystercatchers are predicted due to the construction of HPC.

20.6.101 On the basis of the assessment that is set out above, the construction phase is likely to have a very low magnitude impact on birds using inter-tidal areas. This would result in a **minor adverse** impact on the high value populations associated with the Severn Estuary SPA and Ramsar Site, and the Bridgwater Bay SSSI.

Operation

20.6.102 During the operational period, there is the potential for birds using the inter-tidal areas to be adversely affected by disturbance caused by noise, human activity and lighting associated with the functioning of the power station and by changes in inter-tidal plant/animal communities caused by the discharge of warm water and/or chemical pollutants from the sub-tidal outfall structure.

20.6.103 The level of disturbance on the foreshore would be reduced significantly during the operation of the plant as the temporary jetty that would have been used to import aggregates and other construction materials would have been removed, thereby eliminating much of the human and boat activity that is visible to waterbirds along the foreshore. Disturbance is therefore likely to be similar to that caused by the operational use of the existing Hinkley Point Power Station Complex.

20.6.104 Bird data for Count Sectors 4 and 5 show large numbers of birds using intertidal areas adjacent to the existing Hinkley Point Power Station Complex. This suggests that the activity associated with these industrial areas is compatible with waterbirds making extensive use of nearby intertidal habitats. On this basis, it is likely that any disturbance impacts on birds using the intertidal areas adjacent to HPC would be of very low magnitude.

20.6.105 The overall magnitude of the operational impact on inter-tidal birds would, however, also be influenced by the discharge from the HPC plant of warm water, chlorine and hydrazine, which has the potential to reduce the number and/or biomass of invertebrates present within Bridgwater Bay. Information from BEEMS Report TR184 (see **Chapter 19** in Volume 2 of this ES) shows that the modelled dispersal of the thermal plume from the sub-tidal outfall structure of HPC is largely in areas that are offshore. However there is an overlap with a proportion of the intertidal habitats of Stert Flats; a very small overlap with Berrow Flats is also predicted (**Chapter 19** in Volume 2 of this ES). Modelling shows that the thermal plume is likely to result in an increase in temperature of between 0-3°C across these areas. This is likely to affect populations of the Baltic tellin (*Macoma balthica*) and the brown shrimp (*Crangon crangon*).

20.6.106 Conservative modelling predictions suggest that the numbers of *M. balthica* within the mudflats would not fall; rather the individuals present would suffer a reduction in growing season (this species does not grow in warmer temperatures e.g. as typically occur in the summer months). The population of *M. balthica* present within the inter-tidal habitats of Bridgwater Bay comprises small and young individuals with large and old specimens being largely absent. Therefore a reduction in growing season is unlikely to disrupt the recruitment rate to the population (as the data suggest that *M. balthica* on Stert Flats is derived from reproduction elsewhere); rather a similar number of smaller individuals would persist. It should be noted that the density and size of *M. balthica* currently resident within the thermal plume of the operational HPB station is no different to that across Stert Flats suggesting that the modelled impacts are highly precautionary.

20.6.107 Across Stert Flats (to the east of Hinkley Point) the predicted reduction in biomass of *M. balthica* is 11% with a further 2% reduction across Berrow Flats (to the north of the River Parrett). This prediction is based on HPC operating at 100% of capacity alongside HPB operating at 70% (its current output). It should be noted that HPB would eventually be decommissioned which would reduce the predicted effect to a 6.7% reduction in biomass across Stert Flats and less than 2% across Berrow Flats.

20.6.108 *M. balthica* is a species that is preyed upon by a number of birds that feed in Bridgwater Bay. The species that occur frequently in this area that are known to include *M. balthica* in their diet are shelduck, mallard, pintail, grey plover, dunlin, black-tailed godwit, whimbrel, curlew and redshank. None of these species however, specialise on *M. balthica*.

20.6.109 The distribution of *M. balthica* is not uniform, with greater levels of biomass being present on the lower shore. On the mid and upper shores of Stert Flats species such as *Hediste diversicolor*, *Hydrobia ulvae* and *Nephtys hombergii* provide a significant amount of the prey biomass present (**Chapter 19** in Volume 2 of this ES). Despite these distributional differences in prey composition the distribution of waterbirds does not mirror this pattern (Appendix 20C); this suggests that individual birds are more generalist feeders. As *M. balthica* represents between 30% – 90% of the biomass in various areas of Stert Flats the reduction of up to 11% of this resource (i.e. 3.3% to 9.9% of biomass) is relatively small and is likely not to reduce significantly the prey resource available to the birds present. However, given that there is no current detectable effect on the size or abundance of *M. balthica* due to the HPB plume (**Chapter 19** in Volume 2 of this ES), it is likely that the impact on this species would be lower than is predicted by the model.

20.6.110 As the predicted reduction in *M. balthica* biomass is relatively low and is within the usual range of between year fluctuations, the conservative nature of the modelling output and the amount of alternative prey available for the birds using Stert and Berrow Flats, it is unlikely that the number of birds that could be supported in the area would be reduced.

20.6.111 It is also of note that brown shrimp numbers could increase due to the warm water outfall as the higher temperatures are likely to increase growth and metabolic rates. This increase in a different prey item could benefit a number of species that feed on crustaceans.

20.6.112 An individual-based model of the bird/invertebrate system (i.e. a model that addresses the impacts on individual birds) for the area affected by the thermal plume has also been constructed (**Chapter 19** in Volume 2 of this ES). This model (known as the MORPH model) supports the conclusions drawn from the evidence described above as its initial outputs suggest that the birds present within the affected area would not suffer a reduction in body condition or survival due to the predicted effects of the thermal plume.

20.6.113 A further factor that influences the assessment of birds during the operational phase relates to the use of chlorine or hydrazine in the reactor cooling system (as is likely to be necessary from time to time). This would result in, breakdown products from these chemicals being released from the sub-tidal outfall structure. Modelling of these chemicals (**Chapter 19** in Volume 2 of this ES) shows that concentrations of hydrazine are not likely to be at a level that would result in any effects on the invertebrates that inhabit the mudflats to the east of Hinkley Point. The by-products of chlorination are likely to result in effects on the in-fauna around the HPB outfall if both HPB and HPC are operational at the same time. As the extent of the area affected is very limited and the predicted levels of chlorination are very low, no detectable impact on birds using the Severn Estuary is likely to be realised.

20.6.114 On the basis of the assessment that is set out above, the warm water outfall and chemical output is likely to have a very low magnitude impact on birds using inter-tidal areas, as is disturbance. The combination of these changes is likely not to result in a reduction in birds' body condition or survival, with the result that the overall magnitude of the impact would be very low, resulting in a **minor adverse** impact on the high value populations associated with the Severn Estuary SPA and Ramsar Site, and the Bridgwater Bay SSSI.

xii. Badgers

20.6.115 The clearance of the development site during the construction phase would result in the loss or reduction in size of the territories of up to nine badger social groups and the destruction of approximately 25 setts. To ensure that this sett destruction work does not contravene the Protection of Badgers Act 1992 (Ref. 20.14), it would be undertaken in accordance with measures that have been developed in association with a specialist badger consultant, and in consultation with NE and Somerset County Council's ecologists. These measures are set out in a confidential report that has been submitted to NE, and provided the basis upon which a mitigation licence was granted in July 2010 (**Appendix 20D**). The measures include the creation of six permanent and two temporary artificial setts, and supplementary feeding of badgers.

20.6.116 In the unlikely event of blasting being required to extract rock for use in the construction phase, information would be gathered about any nearby badger setts and a strategy would be devised to avoid disturbance that would result in the Protection of Badgers Act being contravened. Similarly, during operation, information about the location of setts would be used to ensure that the management of the restored part of the site is undertaken in such a way that the Protection of Badgers Act is not contravened.

20.6.117 With the adoption of these measures, there would be **no impact** on badgers in relation to legal protection.

20.6.118 Once restoration of the construction area is complete, the created habitats would be available for foraging and sett building by the badgers that were relocated to artificial setts outside of the development site at the start of the development. Therefore, it is expected that the territories of the adjacent badger social groups would alter to incorporate the new resources. However, impacts relating to biodiversity conservation value are not likely to be significant for the reasons set out in **Appendix 20N**.

xiii. Barbastelle

20.6.119 No barbastelle roosts would be directly affected by the proposed development, but site clearance during the construction phase would result in the permanent loss of habitat that is used by barbastelle for commuting and foraging. The habitat that would be lost is primarily arable land (97.6ha) and agriculturally improved grassland (46.7ha), which are habitats of low value for foraging barbastelle (e.g. Ref. 20.79), but also includes approximately 2.4ha of hedgerow and 7.9ha of woodland/scrub, habitats that are more valuable to barbastelle (**Appendix 20R**).

20.6.120 Other existing areas of habitats of value to commuting and foraging barbastelle would be retained within the development site, namely Green Lane and the associated hedgerow connecting to the Common Land, and Benhole Lane. These habitat corridors, combined with structures and tree planting to bridge the gaps created in Green Lane as a result of the haul roads, would ensure habitat connectivity and opportunistic foraging for barbastelle are maintained throughout the construction phase.

20.6.121 The on-site habitat creation proposals during the early stages of the construction phase would provide some compensation for the habitats that are loss. This would include 18.6ha of wildflower grassland, 12.3ha of woodland/scrub and 0.6ha of hedgerow. In addition, a further 1ha of woodland has been created off-site, together with 0.3ha of species-rich hedgerows. These permanent off-site areas will also provide valuable habitat for barbastelle.

20.6.122 However, in order to avoid a potential decrease in the availability of foraging habitat for barbastelle during the construction phase, a further 25ha (approximately) of off-site arable or agriculturally improved grassland would be converted temporarily (for the duration of the construction phase) to species-rich wildflower grassland. This would be done prior to the commencement of construction (further information is provided in the **Habitats Regulations Assessment** report).

20.6.123 During the final stages of the construction phase, the construction area would be restored to a mosaic of semi-natural habitats, which would include species-rich grassland, woodlands and double hedgerows (which with the retained semi-natural habitats would total approximately 94ha – **Appendix 20R**). This mosaic would be designed to provide good foraging habitat for barbastelle, with micro-climatic conditions that would support a wide range of invertebrates. The habitats would also provide a network of commuting routes, linking to off-site habitats. The benefits of the new grasslands would accrue in the short term, whilst woodland and hedgerows would take longer to be of value to barbastelle.

20.6.124 In addition, the **Lighting Strategy** has been designed to minimise any adverse impacts on retained and created habitats during the construction phase. It is also designed to limit light spill during operation, when lighting would be confined to the access road, the built development and the security zone immediately adjacent to the security fence.

20.6.125 The overall magnitude of impact on barbastelle during construction, taking account of the habitat retention and creation during the early stages of the construction phase and the lighting strategy that would be adopted is assessed as very low, resulting in a temporary **minor adverse** impact on this high value receptor. In the longer term (likely to be from about ten years after restoration onwards), the habitats that are created during the restoration phase are likely to result in there being better habitat for barbastelle than currently exists on the site, representing at least a low magnitude benefit on a receptor of medium value, resulting in a **minor beneficial** impact.

xiv. Bat assemblage (including lesser horseshoe and greater horseshoe bats)

Impacts on Roosting

20.6.126 The construction phase would result in the loss of three confirmed ephemeral common pipistrelle roosts, all of which are in disused, derelict barns (a fourth barn and associated bat roost is being retained). A single confirmed but ephemeral bat roost within a tree would also be lost. Given the small number of bats using the roosts and the common species recorded, it is likely that their loss would not affect the conservation status of the local bat population[10]. Measures would be implemented during the demolition of the barns in order to minimise the potential to disturb roosting bats. These measures would include a requirement for additional bat surveys, using lights to discourage bats from returning to roost in the barns and phased demolition/soft-felling under ecological supervision. These works would also occur during the summer months in order to ensure that disturbance to potential hibernating bats is minimised.

20.6.127 In order to provide a replacement roost for the bats that would be displaced from the demolished barns, a purpose built, permanent ‘bat barn’ was constructed during August and September 2011. The bat barn has been designed to provide improved conditions for roosting pipistrelle, compared to the roost structures that are to be lost, and also incorporates features that could be used by a wider range of species (such

[10] To ensure compliance with the legal protection afforded to bats, no destruction of the barns with bat roosts or removal of trees with significant potential to support roosts would be undertaken until a method statement has been submitted to NE and a European Protected Species (EPS) licence for the works has been issued.

as *Myotis* species, long-eared and horseshoe bats). The building is located in a sheltered position that will remain unlit, along the development site's south-western boundary, adjacent to Benhole Lane, as this is close to the barns that would be demolished and is also located along a route that is used by commuting bats. The supplementary planting of scrub around the building would darken the local area, making it more attractive to bats. The detailed design of the new building has been worked up in consultation NE, and draws on best practice and examples of recent successful projects.

20.6.128 With respect to the loss of trees, each medium and high potential roost feature on trees that are to be lost, as well as the confirmed roost, have been replaced by three bat boxes, resulting in 60 boxes being erected (a mix of Schwegler 2F and 1FF boxes). These have been installed in Branland Copse North and South and Hankley Brake. Two boxes have been attached to each suitable tree to provide different micro-climatic conditions.

20.6.129 With the adoption of the measures described above, there would be **no impact** on bats in relation to legal protection.

Impacts on Foraging and/or Commuting

20.6.130 The loss of most of the hedgerows and all of the woodlands on the development site would reduce the habitat that is available for use by foraging and commuting bats. Retention of the hedgerows along most of Green Lane (with the addition of the structures and tree planting to bridge the gaps created by the haul roads) and on Benhole Lane, combined with Bum Brook, would ensure that habitat connectivity and commuting routes are maintained around and across the construction site. Whilst these retained areas would also provide some foraging habitat, the additional woodland planting and wildflower seeding along the western and southern boundaries of the development site (on land that is currently in arable use and which provides limited foraging opportunities for bats), and the woodland, hedgerows and wildflower grassland off-site, is likely to increase the invertebrate biomass available to foraging bats than would otherwise be available during this phase of development.

20.6.131 Furthermore, the **Lighting Strategy** would ensure that these retained habitats are not adversely affected by light spill during construction, so that they continue to be of value to, and used by, light-sensitive species such as long-eared and horseshoe bats.

20.6.132 Towards the end of the construction phase, a total of approximately 94ha of semi-natural habitats would be available to the bat assemblage, as described above for barbastelle. As the created habitats mature, they would progressively provide better habitats for foraging and commuting bats. Through adherence to the **Lighting Strategy**, light spill into these habitats from the operational lighting (which would be confined to the access road, the built development and the security zone immediately adjacent to the security fence) would be limited.

20.6.133 Overall, the magnitude of the construction phase impact is assessed as low on a medium value receptor. Construction would therefore have a **minor adverse** impact, on the bat assemblage. In the longer term (likely to be from about ten years after restoration onwards), the habitats that are created during the restoration phase are likely to result in there being better habitat for the bat assemblage than currently exists on the site. This would represent at least a low magnitude impact on a receptor of medium value, resulting in a **minor beneficial** impact.

xv. Otters

20.6.134 Otter is known to occur on watercourses adjacent to the development site and in the wider area, but frequent use of the watercourses on the site is unlikely due to their size, lack of connectivity and seasonal nature, which provide very limited foraging and breeding opportunities as found during the surveys to support this ES. Therefore, the permanent loss of watercourses on the development site is not likely to affect the conservation status of the local otter population. The woodland and scrub that is created close to the Bum Brook, as part of the restoration scheme, could provide temporary day-resting places for otter, but this enhancement is also unlikely to affect the species' conservation status. Overall, impacts would therefore be of very low magnitude on a low value resource, resulting in a **negligible adverse** impact. There would be **no impact** on otter in relation to legal protection.

xvi. Reptiles

20.6.135 A small population of slow-worm is present on part of the Green Lane. This part of Green Lane would be retained (with an adjacent strip of species-rich grassland planted) and fenced off during the construction phase to avoid damaging the reptile habitat and the reptiles present. This would avoid harming the slow-worms along the Green Lane and prevent the associated contravention of the WCA (Ref. 20.8).

20.6.136 It is likely that small numbers of reptiles (e.g. grass snake) occur where there is suitable habitat both at other locations within the development site and at some of the highway improvement sites. To avoid contravention of the WCA in these circumstances, a strategy would be implemented such that suitable areas of reptile habitat away from Green Lane and on the highway improvement sites (e.g. areas of rough grassland or ruderal habitat) would be identified by a suitably qualified ecologist and visually checked (which would including checking under potential refugia if present) to ensure that reptiles are not present prior to works at the start of each day. If present, reptiles would be re-located to suitable habitat outside of the construction works' area.

20.6.137 Management of the restored site would be undertaken so as to ensure that harm to reptiles is avoided. This would be achieved, for example, by managing habitats suitable for reptiles during the winter months or using a phased approach (that allows reptiles to passively move away from a managed area).

20.6.138 With the adoption of the measures outlined above, there would be **no impact** on reptiles in relation to legal protection.

20.6.139 The restoration would include extensive areas of habitat, such as south-facing calcareous grasslands, scrub, hedgerows and woodland edges, which would provide a much larger extent of suitable reptile habitat than is currently present on-site. It is likely that much of the newly created habitat would provide suitable habitat for reptiles within about five years after restoration takes place. Reptiles are likely to colonise these habitats (e.g. from the mosaic of habitats south of the existing Hinkley

Point Power Station Complex) and increase the current population, resulting in a beneficial impact. However, impacts relating to biodiversity conservation value are not likely to be significant for the reasons set out in **Appendix 20N**.

xvii. Great crested newts

20.6.140 The proposed works at those highway improvement sites where there is the potential for great crested newts to occur would result in vegetation removal or management of very small areas of rough grassland and scrub. These areas could provide suitable terrestrial habitat for small numbers of great crested newt, although they do not provide habitat for hibernation. To avoid these works harming individual great crested newts, which would be in contravention of the WCA (Ref. 20.8) and the Habitats and Species Regulations 2010 (Ref. 20.9), a strategy would be implemented with the objective of ensuring that the works are completed in a manner that minimises the risk of encountering and harming great crested newts. The strategy is likely to include measures such as completing the works during the winter when great crested newts are hibernating, using habitat manipulation to make the small works' areas unsuitable for great crested newts and/or supervised phased clearance of vegetation. These works would be completed under a Method Statement.

20.6.141 With the adoption of the measures outlined above, there would be **no impact** on great crested newts in relation to legal protection at the highway improvement sites. Impacts relating to biodiversity conservation value are not likely to be significant for the reasons set out in **Appendix 20N**.

xviii. Invertebrate assemblage

20.6.142 Most of the invertebrates recorded within the development site are common, typical of the habitats present and of low biodiversity value, although the assemblage as a whole is assessed as being of medium value. The loss, during the construction phase, of areas of semi-natural habitat within the development site (e.g. some areas of woodland, calcareous grassland and cliff vegetation) would result in a reduction in the population size of the species present, but this is unlikely to alter their conservation status within the context of the wider populations of which they are likely to form a part. Light spill onto the retained habitats would be minimised to minimise potential impacts on nocturnal invertebrates. The construction phase would therefore result in a low magnitude and **minor adverse** impact.

20.6.143 Operation of the development would not have any further direct or indirect impacts on the invertebrate assemblage. However, the restored site would provide a diverse range of species-rich, semi-natural habitats that are likely to attract a wide range of invertebrates, including those notable species that are currently found within the woodland and calcareous grassland habitats within the development site. After about five to ten years following the completion of the construction stage, the newly created habitats on the development site are likely to have matured sufficiently to support an invertebrate assemblage that is of at least low value. The magnitude of the impact on invertebrates is assessed as low, resulting in a **minor beneficial** impact.

xix. Somerset Notable Plant Species (on-site)

20.6.144 All the Somerset notable plant species recorded on-site are located within areas of calcareous grassland that will be permanently lost during the construction phase of the development. As a result, these species will also be permanently lost from the development site during this phase and no direct or indirect impacts on them are likely during the operational phase. This is assessed as a medium magnitude impact on a low value receptor, which results in a **minor adverse** impact.

20.6.145 The seeds that were collected from the on-site calcareous grassland during 2009 and 2010 were from species that included the Somerset notable species present within the development site. This seed would be used in creating new areas of calcareous grassland as part of the construction area restoration. Furthermore, all the Somerset notable plant species that would be lost from the development site are also present within the calcareous grassland located within the adjacent retained area of the Hinkley CWS, from which at least some of these species are likely to spread naturally into the newly created grassland. The notable species are therefore likely to be able to re-colonise the development site.

20.6.146 Consequently, it is likely that the newly created calcareous grassland on the restored construction area would support the Somerset notable plant species that would have been lost from the development site during the construction phase. This would represent a low magnitude impact on a low value resource, resulting in a **minor beneficial** impact.

xx. Bridgwater Bay SSSI

20.6.147 As set out in the sections above, potential impacts on two of the designated features of the Bridgwater Bay SSSI have been identified. These are the bird community, and the ditch and grazing marsh habitats.

20.6.148 During the construction and operational phases, there is the potential for low level disturbance of waders and wildfowl and for a potential reduction in the prey resource caused by thermal and chemical discharges. These impacts have been assessed as minor adverse.

20.6.149 Three potential impacts have been identified in relation to the ditches and grazing marsh that form part of the SSSI (in relation to changes in water quality and volume, changes in groundwater and changes in air quality). These have been assessed collectively as minor adverse.

20.6.150 Based on the assessments described above in relation to the bird community and the ditches and grazing marsh within the SSSI, and the measures that have been included within the scheme design to reduce potentially significant adverse impacts, no adverse impact on the integrity of the Bridgwater Bay SSSI is likely. Therefore, the magnitude of impact is assessed as very low, resulting in a **minor adverse** impact on the high value Bridgwater Bay SSSI.

xxi. Hinkley County Wildlife Site

20.6.151 Those parts of the Hinkley CWS that would be lost as a result of the construction phase (approximately 24ha in total, which is approximately 58% of the total CWS area) largely comprise improved grassland, tall ruderal vegetation and secondary woodland, all of which are of low nature conservation value; the majority of the habitats within the CWS that are of higher biodiversity value would not be affected. Nonetheless, the losses during construction would reduce the extent of the CWS's mosaic of habitats, and its woodland and calcareous grassland cover, which supports several Somerset County Notable species (the primary reason for the CWS designation) that are found throughout the extent of the CWS.

20.6.152 As described above, impacts on the calcareous grassland within the CWS during construction and operation resulting from changes in air quality are assessed as negligible adverse. However, impacts on the woodland within the CWS have been assessed as medium magnitude with an overall minor adverse impact predicted in relation to air quality changes. As it is the calcareous grassland habitat that supports the majority of the Somerset notable vascular plant species (for which the CWS has been designated), it is unlikely that changes in air quality would significantly impact Hinkley CWS

20.6.153 However, it is assessed that overall the development would have an adverse effect on the integrity of the CWS, primarily as a result of habitat loss during the construction phase. This is assessed as a high magnitude impact on a medium value receptor, leading to a **major adverse** impact.

20.7 Additional Good Practice Measures

20.7.1 In addition to the good practice measures that are set out in Section 20.6.1, a range of other standard good practice measures, which are not receptor-specific, would be implemented including:

- provision of an Ecological Clerk of Works (ECoW) during all site clearance activities;
- ecological supervision by the ECoW of activities that have been incorporated into the proposed development in order to avoid or reduce adverse impacts on wildlife; and
- provision of an escape route for animals in deep trenches.

20.7.2 Additionally, the following good practice measures would be implemented to minimise disturbance to wintering and passage intertidal birds during the construction phase.

- Erection of construction fencing along the northern boundary of the development site to restrict access by construction workers to the inter-tidal area to the north.
- The jetty and approach road (through the inter-tidal) would be constantly rather than intermittently lit each night during the construction phase. This would be through the use of directional lighting (with cowling), so that only the jetty and immediate works area is lit and light spill into the inter-tidal is limited. This would

allow bird species using the inter-tidal and inshore waters to habituate to the development area rather than being regularly displaced from roosting areas by changes in lighting.

- Movement of personnel outside of the footprint of the works (e.g. on to the inter-tidal rock platforms and open mud in Count Sectors 4 and 5, to the low water mark and west into Count Sector 1) would be restricted.
- Construction of the jetty would be undertaken and, as appropriate, scheduled to avoid or reduce impacts on birds using the inter-tidal areas (e.g. as far as possible piling on the foreshore would be scheduled to take place over the summer period July – September).

20.7.3 Regular monitoring surveys of fauna present within the retained and created habitats during the construction phase would be undertaken as part of the ILMP to ensure that, if legally protected species colonised these habitats, the development would continue to avoid contravention of the legislation relating to protected species. This may require additional, appropriate mitigation measures, which would be devised and employed, in consultation with NE where appropriate.

20.7.4 Environmental impacts and disturbance arising from development site activities would be managed through a range of control measures and monitoring procedures which are outlined in an Environmental Management and Monitoring Plan (EMMP) and detailed in associated Subject-Specific Management Plans (SSMPs).

20.8 Summary of Impacts

20.8.1 **Table 20.15** provides summary information about the impacts that have been assessed.

Table 20.15: Summary of Environmental Measures incorporated into the Scheme and Likely Significance of Residual Impacts

Receptor	Potential Impact	Magnitude	Description	Value/Sensitivity	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Off-site ditches and grazing marsh	Changes in quality of the receptor as a result of the combined impacts of changes in water flows, groundwater and air quality	Very low	Adverse	High	Minor adverse	None required (measures in scheme design)	Minor adverse
Off site wetland areas	Changes in groundwater altering the water level	Very low	Temporary Adverse	Medium	Minor adverse	None required (measures in scheme design)	Minor adverse
Lowland calcareous grassland	Loss of habitat within Hinkley CWS	Medium	Adverse, permanent	Medium	Moderate adverse	None required (measures in scheme design)	Moderate adverse
	Loss of habitat outside of CWS	Medium	Adverse, permanent	Medium	Minor adverse	None required (measures in scheme design)	Minor adverse
	Creation of calcareous grassland	Medium	Permanent Beneficial	Medium	Moderate beneficial	None required (measures in scheme design)	Moderate beneficial
Woodland	Loss of woodland habitat	Medium	Adverse, permanent	Low	Minor adverse	None required (measures in scheme design)	Minor adverse
	Creation of woodland habitat	Medium	Permanent Beneficial	Low	Minor beneficial	None required (measures in scheme design)	Minor beneficial
	Reduction in quality of off-site woodland as a result of changes in air quality	Medium	Adverse	Low	Minor adverse	None required (measures in scheme design)	Minor adverse

Receptor	Potential Impact	Magnitude	Description	Value/Sensitivity	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Hedgerows	Loss of hedgerow habitat	Medium	Adverse, permanent	Low	Minor adverse	None required (measures in scheme design)	Minor adverse
	Creation of hedgerow and edge habitats	Medium	Permanent Beneficial	Low	Minor beneficial	None required (measures in scheme design)	Minor beneficial
Watercourses	Loss of habitat	Medium	Adverse, permanent	Low	Minor adverse	None required (measures in scheme design)	Minor adverse
	Creation of ditch habitat	Very low	Beneficial Permanent	Very Low	Negligible beneficial	None required (measures in scheme design)	Negligible beneficial
Habitat networks	Loss of habitat connectivity	Medium	Temporary Adverse	Low	Minor adverse	None required (measures in scheme design)	Minor adverse
	Creation of habitat corridors	Medium	Permanent Beneficial	Low	Minor beneficial	None required (measures in scheme design)	Minor beneficial
Birds using terrestrial areas	Damage to active nests (contravention of WCA)	No impact	No impact	LP	No impact	None required (measures in scheme design)	No impact
	Reduction in breeding and wintering bird populations as a result of habitat loss	Low	Adverse	Low	Minor adverse	None required (measures in scheme design)	Minor adverse
	Increase in populations caused by increase in habitat area	Low	Beneficial, permanent	Low	Minor beneficial	None required (measures in scheme design)	Minor beneficial

Receptor	Potential Impact	Magnitude	Description	Value/Sensitivity	Significance	Proposed Mitigation/ Best Practices	Residual Impact
	Decline in population caused by disturbance	Very low	Adverse permanent	Low	Negligible adverse	None	Negligible adverse
Lesser whitethroat	Loss of three breeding pairs due to habitat loss	Medium	Adverse	Low	Minor adverse	None	Minor adverse
	Increase in habitat availability due to habitat creation	Low	Permanent Beneficial	Low	Minor beneficial	None required (measures in scheme design)	Minor beneficial
Cetti's warbler	Decline in population caused by disturbance	Low	Adverse	Medium	Minor adverse	None	Minor adverse
Birds using inter-tidal areas	Changes in the survival of waterbirds affecting their conservation status	Very low	Adverse	High	Minor adverse	None required (measures in scheme design)	Minor adverse
Badgers	Harm to badgers and disturbance of active setts	No impact	No impact	LP	No impact	None required (measures in scheme design)	No impact
Barbastelle	Decline in population resulting from loss of commuting and foraging habitats	Very low	Adverse	High	Minor adverse	None required (measures in scheme design)	Minor adverse

Receptor	Potential Impact	Magnitude	Description	Value/Sensitivity	Significance	Proposed Mitigation/ Best Practices	Residual Impact
	Increase in suitable habitat availability	Low	Permanent Beneficial	Medium	Minor beneficial	None required (measures in scheme design)	Minor beneficial
Bat assemblage	Harm to individual bats during roost destruction, thereby contravening legislation in respect to bats	No impact	No impact	LP	No impact	None required (measures in scheme design)	No impact
	Decline in population resulting from loss of roosts, foraging and commuting habitat	Low	Adverse	Medium	Minor adverse	None required (measures in scheme design)	Minor adverse
	Increase in population due to increased habitat availability	Low	Beneficial, permanent	Medium	Minor beneficial	None required (measures in scheme design)	Minor beneficial
Otter	Decline in population due to disturbance and loss of habitat	Very low	Adverse	Low	Negligible adverse	None required (measures in scheme design)	Negligible adverse
	Harm or disturbance to otters, thereby contravening the legislation in relation to otters	No impact	No impact	LP	No impact	None required (measures in scheme design)	No impact
Reptiles	Harm to reptiles	No impact	No impact	LP	No impact	None required (measures in scheme design)	No impact

Receptor	Potential Impact	Magnitude	Description	Value/Sensitivity	Significance	Proposed Mitigation/ Best Practices	Residual Impact
Great crested newts	Harm to individual great crested newts	No impact	No impact	LP	No impact	None required (measures in scheme design)	No impact
Invertebrate assemblage	Decline in populations resulting from loss of habitat	Low	Adverse	Medium	Minor adverse	None required (measures in scheme design)	Minor adverse
	Increase in populations due to increased habitat availability	Low	Beneficial, permanent	Low	Minor beneficial	None required (measures in scheme design)	Minor beneficial
Somerset Notable plant species (on-site)	Loss of individual plants	Medium	Adverse	Low	Minor adverse	None required (measures in scheme design)	Minor adverse
	Increase in local distribution	Low	Beneficial, permanent	Low	Minor beneficial	None required (measures in scheme design)	Minor beneficial
Bridgwater Bay SSSI	Impact on site integrity	Very low	Adverse	High	Minor adverse	None required (measures in scheme design)	Minor adverse
Hinkley CWS	Loss of habitat and impact on site integrity	High	Adverse, permanent	Medium	Major adverse	None required (measures in scheme design)	Major adverse

***Key:** LP = Legally Protected.*

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CHAPTER 21: RADIOLOGICAL

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21. RADIOLOGICAL

21.1 Introduction

21.1.1 This chapter provides an assessment of the potential radiological impacts during the construction and operation of the proposed development of two UK EPR reactor units and associated facilities (including the Interim Spent Fuel Store (ISFS)) at Hinkley Point C (HPC). Where reasonably practicable, mitigation measures are identified to prevent or reduce any potential adverse impacts that are assessed to be of significance.

21.1.2 The HPC site is adjacent to the existing Hinkley Point A (HPA) and Hinkley Point B (HPB) nuclear licensed sites and lies on the south side of Bridgwater Bay which forms part of the Bristol Channel. The Hinkley Point A and B sites are authorised to discharge strictly limited quantities of liquid and gaseous radioactive effluent into the environment under environmental permits issued by the Environment Agency. The combined impact of HPA, HPB and HPC (collectively referred to as the 'Hinkley Point Sites') is assessed.

21.1.3 This assessment of the potential radiological impact of the development considers the extent to which any radiological contamination, if already present in the soil or groundwater on the HPC site, could result in the radiation exposure of members of the public or workers if mobilised during the construction phase of the proposed development.

21.1.4 This assessment considers the impacts of permitted discharges of radioactive liquid and gaseous effluents and disposal of solid radioactive wastes from routine activities during the operation of the UK EPR reactor units. During operation, the generation of radioactive effluents and wastes will be minimised as far as is reasonably practicable. Some radioactive waste is unavoidably produced by activities associated with operating and maintaining the HPC reactors and associated facilities and, ultimately, from decommissioning the plant. As a result of start-up, operation at power and shutdown for refuelling of each reactor, HPC will produce:

- liquid radioactive discharges;
- gaseous radioactive discharges; and
- solid radioactive waste.

21.1.5 Systems for collecting and treating primary circuit water, fuel pool purification systems, operation of a radioactive laundry facility on-site and washings from plant decontamination result in the generation of liquid radioactive effluents. Techniques are applied to minimise the amount of radioactivity produced. After treatment to reduce as far as is reasonably practicable the radioactive content of the effluent, it is sampled and monitored prior to final discharge via the cooling water outfall. Before entering the sea, the effluent it is subject to considerable dilution with cooling water before entering the sea.

21.1.6 Gaseous radioactive effluents are a by-product of degassing the water in the primary circuit of each reactor. Techniques are used to minimise the amount of radioactive gaseous effluents generated at source. Radioactive gaseous effluents are treated by processing systems to reduce the radioactive content. Radioactive gaseous effluents are also produced from maintenance and operations in building areas containing radioactivity. Ventilation systems filter and reduce the radioactive content of the effluent before discharge to atmosphere through dedicated stacks. The height of the stacks is optimised to ensure the impacts are minimised. Discharges from the stacks are continuously sampled and monitored.

21.1.7 The treatment of gaseous and liquid radioactive effluents and maintenance of radioactive plant and equipment produces solid radioactive waste. This includes spent ion exchange resins and spent filter media. In addition, wastes arise from worn-out components, contaminated protective clothing and tools, rags and waste oil.

21.1.8 Solid radioactive wastes that can be disposed of will be treated, packaged and transported to appropriately permitted facilities. Solid radioactive wastes requiring interim storage prior to disposal will be stored in secure facilities on the HPC site. These facilities have the potential to contribute to the radiation exposure of workers and members of the public in the immediate vicinity of the site. The management of spent fuel and radioactive waste are detailed **Chapter 7** of this volume. This approach is consistent with the Government's policy of "*concentrate and contain*" radioactive wastes in a solid form where practicable (Ref. 21.1).

21.1.9 The assessment of radiological impacts from HPC takes into account:

- the current radiological baseline of the site;
- the maximum proposed permitted radioactive discharges during operation;
- the estimated direct radiation exposure from the storage of spent fuel and radioactive waste, and the transport of radioactive materials to and from the site;
- appropriate risk assessment methodology and criteria;
- mitigation measures in place in the design of the UK EPR; and
- cumulative impacts with HPA and HPB.

21.2 Scope and Objectives of Assessment

21.2.1 The scope of this assessment has been developed through the consideration and application of radiological protection principles to humans and non-human species. It has also been informed by the on-going Generic Design Assessment (GDA) process and the pre-application consultation. The assessment of radiological impacts on human and non-human species arising from the proposed development have been undertaken by adopting the methodologies described in Section 21.4. The existing baseline conditions, against which the likely environmental effects of the development are assessed have been determined through a combination of literature reviews and site surveys, are described in Section 21.5; this section also identifies existing and future receptors.

21.2.2 This chapter summarises the current radiological baseline of the HPC development site, for seawater, groundwater, surface water and soil. Results of the site investigations for Hinkley Point C provide no evidence of elevated levels of anthropogenic (man-made) radioactive contamination on the proposed HPC development site at levels at which they could be considered radioactive as defined by the relevant legislation (see **Chapter 14** of this volume). The radiological risk to workers and members of the public during the construction phase is therefore considered to be negligible. In accordance with the definitions of contaminated land (Ref. 21.2), as the land is not contaminated with radioactivity and harm is not being caused, nor is there significant possibility of such harm being caused, a radiological assessment has not been undertaken for the construction phase.

21.2.3 Potential radiological impacts on humans and non-human species as a result of liquid discharges to the Bristol Channel and gaseous discharges to the atmosphere during operation of HPC are described and assessed in Section 21.6. This chapter also contains an assessment of the annual dose to the most exposed members of the public from direct radiation exposure and an assessment of the radiological impact due to the transport of radioactive waste and fuel from the site.

21.2.4 The cumulative future impacts from the HPA, HPB and HPC sites are assessed. The assessment:

- is based on discharges at current authorised limits for HPA and HPB and uses the limits proposed by EDF Energy for HPC;
- assumes that discharges from HPA and HPB continue for the next 50 years and in parallel with those from the proposed HPC site. This is a conservative assumption, as HPA is planned to be decommissioned in the next 50 years. HPA will be decommissioned into a quiescent state known as 'care and maintenance' and HPB is planned to be shut down, defuelled and, after a period of care and maintenance, decommissioned;
- assumes that the discharges from HPB during decommissioning will not increase above their current permitted limits. Any increases that could arise are likely to be limited in time to address specific activities during the decommissioning programme to reduce the hazard on site to assist in achieving the site's restoration. Any changes to the proposed limits at HPB would be subject to regulatory review and approval;
- is based on the fact that after initial decommissioning activities on site, HPB will enter a period of care and maintenance where there will be only low levels of radioactive discharges. The main period of decommissioning activity on the HPB site will take place after this period of care and maintenance, and this is currently scheduled to take place after HPC has ceased operation; and
- takes account of HPC's proposed plan for decommissioning and site restoration which means that most of the activities on the HPC site (except for the ongoing operation of the ISFS) are expected to be completed before HPB final site clearance work begins. This assumption is in full accord with the UK Strategy for Radioactive Discharges published by DECC in 2009 (Ref. 21.3), which describes the anticipated discharges from the nuclear power sector over time. The UK strategy anticipates a continued and progressive reduction in discharges over time from the existing fleet of power stations as they enter decommissioning. In this light, the assumption of current discharge limits is considered a reasonable and conservative basis for predicting the combined impacts of the stations, particularly so given that the actual discharge levels from HPB are typically less than half of the current limits and often far lower than this for specific groups of radionuclides that are limited in Hinkley Point B's permit.

21.2.5 Discharges from commissioning of HPC will be no greater than those during operation, therefore for the purposes of this assessment it is assumed that the impacts from commissioning will be bounded by those for the operation of HPC.

21.2.6 This assessment does not address radiological impacts during decommissioning of HPC. These impacts will be addressed under a separate Environmental Impact Assessment (EIA) carried out under the specific legislative framework of the Nuclear Reactors (Environmental Impact Assessment for Decommissioning) Regulations 1999 (Ref. 21.4). The radiological impacts to members of the public from decommissioning are expected to be less than those arising during the operational period.

21.2.7 Appropriate mitigation measures aimed at reducing the impact of HPC on humans and non-human species is presented in Section 21.7. The assessment of residual impacts following the implementation of the mitigation measures are identified in Section 21.8.

21.2.8 Separate to the ES, an assessment of the impact on human health from the operation of HPC including radiological impacts is presented in the **Health Impact Assessment** (**HIA**), this also includes details on radioactive environmental monitoring (Ref. 21.63).

21.3 Legislation, Policy and Guidance

21.3.1 This section provides an overview of the principle sources of legislation that apply to radiological protection, starting with international agreements and protocols and then describing how these cascade down through European legislation and are implemented in the United Kingdom. A central requirement of much legislation centres on maintaining doses to members of the public and workers to ensure they are As Low As Reasonably Achievable (ALARA) or As Low As Reasonably Practicable (ALARP). The latter is specifically applied in the UK and requires the employer (or operator of a nuclear facility) to provide systems (engineered means, operational means and protective equipment) to reduce the radiation dose until the cost of implementing those measures (in time, trouble or money) is considered to be grossly disproportionate to the radiation risk averted. Both terms are, however, used in published UK regulatory guidance, ALARP generally by the Office of Nuclear Regulation (ONR) and ALARA by the Environment Agency.

a) International

i. Human Radiological Protection Principles

21.3.2 The framework for radiation protection worldwide is based on the International Atomic Energy Agency (IAEA) Basic Safety Standard (BSS) (Ref. 21.5). Although the IAEA BSS has no legal standing per se, it is used by Member States as a basis for their legal radiological protection systems.

21.3.3 The scientific basis of the BSS (Ref. 21.5) is based on the recommendations of the International Commission on Radiation Protection (ICRP). Its latest published recommendations are ICRP 103 (Ref. 21.6). However, the recommendations in current use within the BSS (Ref. 21.5) are ICRP 60 (Ref. 21.7) owing to the time taken for the recommendations to become legally adopted in those States where they are applied. It is likely that the 2007 recommendations will be in place in the UK once HPC is operational.

21.3.4 Other organisations provide input into the IAEA BSS (Ref. 21.5), including the Food and Agriculture Organisation of the United Nations; the International Labour Organisation; the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development; the Pan American Health Organisation and the World Health Organization.

21.3.5 The principles for radiation protection described in the ICRP 60 (Ref. 21.7) recommendations and developed in the ICRP 103 (Ref. 21.6) recommendations are those of:

- Justification: Any decision that alters the radiation exposure situation should do more good than harm;
- Optimisation of protection: The likelihood of incurring exposures, the number of people involved and the magnitude of their individual doses should all be kept as low as reasonably achievable, taking into account economic and societal factors; and
- Dose limitation: The total dose to any individual from regulated sources in planned exposure situations, other than medical exposure of patients, should not exceed the appropriate limits recommended by the ICRP.

ii. Non-human Radiological Protection

21.3.6 In the past, non-human species have been considered to be adequately protected by the radiation protection systems developed for the protection of humans. For example, ICRP 60 (Ref. 21.7) states that:

> *"The Commission believes that the standard of environmental control needed to protect man to the degree currently thought desirable will ensure that other species are not put at risk. Occasionally individual members of non-human species might be harmed but not to the extent of endangering whole species or creating imbalance between species."*

21.3.7 More lately, ICRP Publication 91 describes a framework for assessing the impact of ionising radiation on non-human species (Ref. 21.8). This was designed to harmonise with the existing ICRP approach to the protection of human beings, but not to set regulatory standards. It sets out a systematic, risk-based approach to assessing radiological impacts on non-human species. This approach has been reiterated in the ICRP 103 (Ref. 21.6) recommendations. Other organisations have developed assessment tools to determine the risk of radiation exposure to non-human species. These are described in later sections of this chapter.

21.3.8 The IAEA (Ref. 21.5) and ICRP (Ref. 21.6 and Ref. 21.7) documents have no legal standing in their own right. However, they do influence the development of the legal system for radiation protection internationally.

iii. Transport

21.3.9 The IAEA formulates regulations for the Safe Transport of Radioactive Materials that give standards of safety for radiation, criticality and thermal hazards to persons, property and the environment due to the transport of radioactive materials. The regulations were first published in 1961 and have been subject to periodic reviews, the latest of which were published in 2009 (Ref. 21.9). The IAEA also publish supporting advisory material and guidance.

21.3.10 In addition, the United Nations publish Recommendations on the Safe Transport of Dangerous Goods known as the "Orange Book" (Ref. 21.10) where goods are divided in to nine classes, Class 7 being radioactive materials. An expert group of the Economic and Social Council of the United Nations issued a resolution that entrusted the task of establishing recommendations for the safe transport of radioactive materials to the IAEA thus ensuring compatibility between IAEA regulations (Ref. 21.9) and the "Orange Book" (Ref. 21.10).

b) European

i. Human Radiological Protection

21.3.11 The Euratom Treaty (Ref. 21.11) came into force on 1st January 1958 and established a European Atomic Energy Community, widely known as Euratom. Under Articles 31 and 32 of the Treaty, the Commission of the European Communities is required to develop radiological protection standards for application in Member States in three formats:

- Regulations - Apply directly to Member States;
- Directives and Decisions of Council - Set goals and standards that must be translated into Member States legislation; and
- Recommendations and communications – These are not mandatory.

21.3.12 Central to these and implementing the IAEA BSS (Ref. 21.5) is Council Directive 96/29/Euratom BSS dated 13th May 1996, which lays down basic safety standards (BSS) for the protection of the health of workers and the general public against the dangers from ionising radiations. This Euratom BSS (Ref. 21.12) also provides the dose coefficients required to calculate doses to members of the public from intakes of radionuclides.

ii. Non-human Radiological Protection

21.3.13 In Europe, there are no regulations for the protection of non-human species from radiation hazards. However, the Habitats and Birds Directives (Ref. 21.13) covers general requirements for the protection of non-human species (plants, animals) and their habitats. The regulators in the UK (the Environment Agency, Scottish Environment Protection Agency and Northern Ireland Environment Agency, 'the Environment Agencies') have a duty to comply with the implementation of these, in particular covering:

- Existing authorisations, consents, licences and permissions or variations for discharges of chemicals; and
- Ensuring that no Agency-authorised activity or permission results in an adverse effect, either directly or indirectly on the integrity of identified European sites (Natura 2000 sites).

iii. Transport

21.3.14 In Europe, the IAEA Regulations for the Safe Transport of Radioactive Materials have been implemented into separate regulations and agreements depending on the mode of transport. These are the “International Regulations Concerning the Carriage of Dangerous Goods by Rail” (RID) (Ref. 21.14); the European agreement for the “International Carriage of Dangerous Goods by Road” (ADR), (Ref. 21.15) and the European agreement for the “International Carriage of Dangerous Goods by Inland Waterways” (ADN) (Ref. 21.16).

c) National

i. Human Radiological Protection

21.3.15 A number of Acts and Regulations govern the exposure or potential exposure of workers and the general public to ionising radiations. The principle ones (that are supported by a wide range of Codes of Practice and guidance) are outlined below, together with their principal requirements.

The Nuclear Installations Act 1965

21.3.16 The Nuclear Installations Act 1965 (amended 1969) (Ref. 21.17) governs nuclear installations in the UK by the issue of site licences by the ONR. The licenses cover a standard set of 36 detailed requirements to be addressed by a site licensee covering, for example, management systems; safety cases, plant safety; construction; plant modifications; operations, accumulation/disposal of radioactive waste and decommissioning.

Ionising Radiations Regulations 1999;

21.3.17 Radiation exposure of the worker and the general public is regulated by the Ionising Radiations Regulations 1999 (IRR99) (Ref. 21.18). These regulations were made under the Health and Safety at Work, etc. Act 1974 and implement the Euratom Basic Safety Directive 96/29/Euratom (Ref. 21.12). The regulations define the dose limits that meet the requirements of the ICRP and also specify that radiation exposures are required to be as low as reasonably practicable (ALARP). The duty is on the employer or operator to ensure that these requirements, amongst others, are complied with. In the case of the general public, the effective dose limit is 1 milli-sievert (mSv) per year from man-made sources.

Environmental Permitting (England and Wales) Regulations 2010

21.3.18 The use, accumulation, storage, disposal and discharge of radioactive materials in the UK was regulated via authorisations issued under the Radioactive Substances Act 1993 (RSA 93) (Ref. 21.19) was recently updated under the Environmental Permitting Regulations 2010 (Ref. 21.20). These require that a person must not operate a regulated facility except under the authorisation of an Environmental Permit issued by the relevant regulatory body. This includes undertaking activities with radioactive substances, where a person uses premises for the purposes of an undertaking and that person disposes of radioactive waste from those premises.

21.3.19 The Environmental Permitting Regulations are regulated by the Environment Agency in England and Wales. It contains the regulatory framework under which permits to make radioactive discharges (gas, solid or liquid) to the environment are issued to operators of premises, including licensed nuclear sites. On a Nuclear Licensed Site, the accumulation of radioactive waste is regulated by ONR under a section of the Nuclear Installations Act (Ref. 21.17), specifically site License Condition 32. A Memorandum of Understanding between the Environment Agency and the ONR ensures a consistent and seamless approach between the control of the radioactive wastes on the sites and any subsequent discharge or disposal.

21.3.20 Permits to discharge radioactive waste are only granted after a rigorous assessment process which includes the requirement for a prospective assessment of the potential radiological impacts on the public. More recently this requirement has been extended to impacts on non-human species. The prospective dose assessments are determined using modelling. This is because it is not practicable to measure exposure directly (or in advance of the operations of the plant) and it is essential to show that any doses received would be below regulatory guidelines and also in accordance with the principles of ALARA (outlined above). Once these and other assessments are completed, there is a period of consultation on the Environment Agency's proposed decision as to whether to grant a permit. The permit will also impose a wide range of requirements to protect the public and environment by the permit holder. After issue, the permits will also be subject to periodic reviews.

21.3.21 Schedule 23, Part 3 of the Environmental Permitting Regulations 2010 (Ref. 21.20) implements the relevant requirements of the Basic Safety Standards (BSS) Directive (Ref. 21.12) which are:

- all public ionising radiation exposures from radioactive waste disposal are kept ALARA;
- the sum of doses arising from such exposures does not exceed the individual public dose limit of 1 mSv per year;
- the individual dose from any single site (referred to as the site constraint) does not exceed 0.5 mSv per year and;
- the individual dose received from any new discharge source (referred to as the source constraint) since the 13 May 2000 does not exceed 0.3 mSv per year.

ii. Radiological Protection Due to Radioactive Transport in the UK

21.3.22 In the UK, the ADR (Ref. 21.15) and RID (Ref. 21.14) have been adopted in the Carriage of Dangerous Goods and the Use of Transportable Pressure Equipment Regulations 2009 (Ref. 21.21). These regulations apply to the transport of radioactive materials by road and rail and detail any UK specific derogations. Dose limitation is enforced through the IRR99 (Ref. 21.18) for both members of the public and workers.

iii. Radiological Protection of Non-human Species in the UK

21.3.23 As for European legislation, in the UK there are no specific regulations for the protection of non-human species from radiation sources. However, UK regulations are in place to enforce the European Directives in the UK, the main one being the Conservation (Natural Habitats) Regulations (Ref. 21.22). These implement the Habitats Directive (1992) (Ref. 21.13) in the UK and require steps to maintain and restore to favourable conservation status the habitats and species of EU Community level interest.

21.4 Methodology

21.4.1 This section describes the methodology that has been adopted for the production of the assessment presented in this chapter.

a) Study Area

21.4.2 The geographical extent of the study area for this assessment includes:

- the HPC development site;
- four habitats of interest in the vicinity of the HPC site; and
- communities within a radius of approximately 20km of the HPC site.

b) Baseline Assessment

21.4.3 The area surrounding HPC has been the subject of monitoring and assessment for many years. This is primarily due to the presence of the adjacent HPA and HPB sites. The methodology for the baseline assessment has been to use these existing data and to complement them with additional surveys. Primary sources of information to develop the baseline are:

- Radioactivity in Food and Environment Reports - these are prepared annually by the Environment Agencies of England, Wales, Scotland and Northern Ireland and the Food Standards Agency. They present the results of a comprehensive programme of monitoring and sampling of foodstuff and the environment. They provide a retrospective assessment of the dose to members of the public based on measurements of external radiation levels local to a site and the concentration of radionuclides measured in various foodstuffs farmed or caught near nuclear sites.
- HIA. This provides a summary of the discharges made from the existing HPA and HPB sites and the measured concentration of radioactivity in the environment around Hinkley Point for the calendar year of 2008.
- A number of surveys undertaken to determine the radiological characteristics of the proposed development site at HPC and the surrounding area.
- Sampling and analysis of sea water, groundwater and surface water.
- Walkover radiation surveys to detect man-made (anthropogenic) radionuclides.
- Surveys and sampling to determine the concentration of radionuclides in the soil and marine sediment.

c) Assessment Methodology

i. Summary of Approach for the Assessment

21.4.4 The following sections describe the methodology adopted for assessing the actual and potential radiological impacts from the proposed HPC development. The Environment Agency has published, along with other relevant parties, guidance on undertaking prospective dose assessments (Ref. 21.46). This document describes a series of principles that should be considered when undertaking dose assessments of future discharges. The approach used in this assessment is consistent with the relevant principles of this guidance. The graded approach adopted is also entirely consistent with the guidance.

21.4.5 There is currently no statutory defined method for carrying out an assessment of radiological impacts for EIA. General guidelines are available in, for example, the Department of the Communities and Local Government (Ref. 21.23), IEMA (2006) (Ref. 21.24) and the Environment Agency (Ref. 21.25). Using these guidelines, the approach adopted in this chapter of the ES is based on the following steps:

- Definition of the current baseline within and around the site.
- Undertake the impact assessment - this covers the radiological impacts from HPC and assessment of these against recognised radiological protection standards for a specified range of human and non-human receptors. The method estimated discharges from two UK EPR reactors and associated facilities on the HPC site based on operating feedback from existing pressurised water reactors (PWR) of similar design and information provided in the Generic Design Assessment (GDA) PCER, the subsequent movement of which through the environment (air, water, soil) and into the food chain is predicted using a range of industry-standard computer models. Non-human species cover a generic range plus some site-specific species selected on the basis of ecological surveys of the site.
- Identify mitigation measures - this includes design and management controls which reduce the potential impact, and are consistent with the legal requirement to use 'Best Available Techniques' (BAT) to ensure the radiological impact of radioactive effluent discharges and waste disposals are minimised and to reduce radiation doses to members of the public and workers to As Low As Reasonably Achievable (ALARA).
- Assess any residual impacts - undertaken following the implementation of any proposed mitigation measures.

ii. Basis for the Assessment

21.4.6 EDF Energy uses risk factors published by the International Commission of Radiological Protection (ICRP), which are the basis of those used by the UN International Atomic Energy Agency, the European Commission and regulatory bodies across the world, including those in the UK. These factors are supported by a wide range of sources covering a range of epidemiological data including Japanese atomic bomb survivors, post-Chernobyl studies, exposures following atmospheric testing of nuclear weapons, nuclear industry workers and their children, those exposed to X-rays for therapeutic or diagnostic reasons, patients and workers exposed to radioisotopes of radium, patients exposed to thorium in the contrast medium Thorotrast, and workers and members of the public exposed to radon and its decay products, among other studies.

21.4.7 The Committee Examining Radiation Risks of Internal Emitters (CERRIE) was an independent committee established by the UK Government because of concern that public perception of the risks from exposure to radiation from radionuclides deposited within the body may be at variance with official scientific advice. The Committee operated between 2001 and 2004. CERRIE's remit was to *"consider present risk models for radiation and health that apply to exposure to radiation from internal radionuclides in the light of recent studies and to identify any further research that may be needed"*. It comprised a broad spectrum of the scientific community and included those critical of ICRP. In its final report (Ref. 21.26) CERRIE concluded that *"it was important that doses and risks from internal emitters should be calculated on the basis of best current information, using central values, and with no bias towards 'conservatism' or 'pessimism' (as is sometimes implied). Introduction of such subjective considerations had no place in an objective assessment.*"

21.4.8 The Committee on Medical Aspects of Radiation in the Environment (COMARE) was established in November 1985 to advise Government and the devolved authorities on the health effects of natural and man-made radiation and to assess the adequacy of the available data and the need for further research. It is an independent group of experts from a variety of relevant disciplines. COMARE endorsed the approach advocated by CERRIE in their 9th report (Ref. 21.27).

21.4.9 CERRIE recognised that, *"amongst the very broad array of natural and man-made radionuclides, some were more hazardous than others*" and that the "degree of hazard did not depend on their origin, but on their individual physical, chemical and radiological properties". Furthermore the Committee "unanimously agreed that radionuclides did not differ intrinsically in their effectiveness depending on whether they were man-made or naturally occurring."

21.4.10 CERRIE investigated a number of biological mechanisms that could affect the current understanding. CERRIE concluded that there was general agreement that induced genomic instability, bystander effects, minisatellite mutation induction and specific issues of microdosimetry were *"real and some may well be an integral part of cellular and tissue response"*. There was, however, substantial disagreement as to whether the available data were sufficient to draw firm conclusions on the implications for radiation-induced health effects. CERRIE members were "*less persuaded*" on the scientific argument that these phenomena challenged the current estimates of low dose effects that were held by a minority of the Committee.

21.4.11 Most members were not persuaded of the existence of the biphasic response or of its generality. Serious shortcomings in the data and the presentation were noted. The majority view of CERRIE was that the evidence available substantially contradicted the second event theory. With respect to hot particles, *"most of the Committee agreed that little information existed which supported enhanced risks from exposures to 'hot' particles, although most studies used relatively high doses."* The majority of the Committee remained unconvinced on the possibility that 'warm' particles presented a high risk, though this could not be ruled out mainly because of the paucity of evidence presented.

21.4.12 Based on the work undertaken by CERRIE and the subsequent review by COMARE, EDF Energy believes it is using the best available information in determining the impacts of its radiological releases.

21.4.13 Furthermore, in response to concerns raised during earlier consultations relating to health risks (especially in light of local studies carried out in the areas purporting to establish a link between radiation exposure resulting from operations at the existing power stations and cancer and other adverse health effects), EDF Energy refers to the information presented by the Health Protection Agency, the South West Public Health Observatory, and the COMARE. The Health Protection Agency provides expert information on the effects of exposure to radiation and has a significant advisory role in the UK – that part of the Health Protection Agency dealing with radiation, the Radiation Protection Division (RPD), was formerly the National Radiological Protection Board (NRPB). The Health Protection Agency is supported by the Advisory Group on Ionising Radiation (AGIR) and its sub-groups, composed of independent experts. The South West Public Health Observatory investigates those factors affecting public health in South West England.

21.4.14 The Health Protection Agency has published information on how the risks to health resulting from exposure to radiation are identified and quantified. Reports reviewing radiation risks are available on their web-site (www.hpa.org.uk) and include HPA-RPD-055 (Ref. 21.28) and HPA-RPD-066 (Ref. 21.29). The extensive scientific evidence on the effects of radiation is assessed by international expert bodies such as the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the International Agency for Research on Cancer (IARC) of the World Health Organisation (WHO), and various national bodies such as the US National Academies and the Health Protection Agency. These scientific reviews are regularly evaluated by the International Commission on Radiological Protection (ICRP), which makes recommendations in an international context on radiological protection measures, and these recommendations are in turn assessed by national bodies like the HPA for incorporation into national radiological protection legislation.

21.4.15 The Health Protection Agency, among other bodies, has considered in some detail the arguments raised by groups such as Green Audit that radiation risk estimates have been seriously underestimated. Although there are inevitably some uncertainties in radiation risk estimates the Health Protection Agency has concluded that claims that risks have been grossly underestimated are "*unsubstantiated*", and that "*Current estimates are as likely to overestimate as to underestimate the very low risks at very low doses*." On the opposite wing of opinion to groups such as Green Audit are those who believe that low levels of exposure to radiation pose no risk, or are even beneficial. Indeed, a report of the French Academy of Sciences and National Academy of Medicine concluded that the risk models currently underlying radiological protection produce "*a probably marked over-estimation of the risk of doses lower than a few dozen mSv*". The Health Protection Agency in its report HPA-RPD-066 (Ref. 30.29) concludes, "*The system of protection recommended by the ICRP is based on sound scientific analyses published by international bodies*."

21.4.16 In its Tenth Report published in 2005 (Ref. 21.30), COMARE considered the incidence of childhood leukaemia and other childhood cancers in the vicinity of nuclear installations in Great Britain between 1969 and 1993. Based on an assessment of 32,000 cases, it concluded that "*there is no evidence from this very large study that living within 25 km of a nuclear generating site in Britain is associated with an increased risk of childhood cancer*" (Ref. 21.30). COMARE found that the incidence of childhood leukaemia and of other childhood cancers around Hinkley Point was at expected levels.

21.4.17 COMARE has recently published its fourteenth report (Ref. 21.31) which considers information from other international studies, notably the Kinderkrebs in der Umgebung von Kernkraftwerken (KiKK) study (Ref. 21.32 and 21.33) but also including studies from France, Spain, Sweden, Finland, USA, Canada and Japan. In addition, this report reviews the evidence from Great Britain including the extension of the original dataset used in the COMARE Tenth Report to cover the period 1969 to 2004, as well as presenting a new geographical data analysis for British nuclear power plants. COMARE reviewed the evidence from all these studies, often using different methodologies, to determine whether there is an increased risk of childhood leukaemia in the vicinity of nuclear power plants. It has also considered additional factors that may have influenced the results of each study, including the status of cancer registries, the types of reactors used in the various countries, and the associated radionuclide discharges and doses to the general public from these discharges and other sources of exposure. COMARE also investigated the proposal that there is a substantial underestimation of the risk of childhood cancers from the intake of radionuclides and that discharges of tritium and carbon-14 may be responsible, in part, through in-utero exposure of embryos and foetuses; COMARE found that evidence presented to date "*does not support this suggestion*". Based on this exhaustive and systematic review, COMARE reaffirms the advice in its 2005 review (Ref. 21.30) that there is "*no evidence to support the view that there is an increased risk of childhood leukaemia and other cancers in the vicinity of NPPs (nuclear power plants) in Great Britain*".

21.4.18 COMARE has been asked to review various studies conducted by Green Audit and has made a number of critical observations on the methods used in these studies (see www.comare.org.uk/comare_docs.htm#statements), which are self-reported by Green Audit rather than being published in the usual way in mainstream scientific journals that check studies meet the required scientific standards prior to publication. Specifically, COMARE was asked by the Department of Health to undertake a detailed consideration of the Green Audit report entitled 'Cancer in Burnham-on-Sea North – Results of the PCAH [Parents Concerned About Hinkley] Questionnaire' and advise on the implications it may have for the health of people living in Burnham-on-Sea. Green Audit reported the results of a household survey of the Burnham North ward, which claimed that there were excess cancers associated with exposure to man-made radioactivity via the local estuarine sands.

21.4.19 Further work carried out by the South West Cancer Intelligence Service (SWCIS, now part of the South West Public Health Observatory) at the request of Somerset Coast Primary Care Trust showed that the Green Audit study only covered a small sample of the cases arising in the ward. When the complete cancer registration data set for the ward was used, SWICS showed there was no cancer excess other than for leukaemia. When this excess of leukaemia cases was investigated, the majority of the extra cases proved to be chronic lymphocytic leukaemia (CLL), a cancer not considered by previous investigators and reviewers to be associated with exposure to radiation. The report concluded, "*SWCIS has found no evidence of increased risk of cancer linked to radiation in these wards*".

21.4.20 The Green Audit report was intended to address the concerns of the local community, and did indeed involve them; however, COMARE concluded that "*it is so deeply flawed that it cannot provide any reliable information or conclusions about rates of cancer in Burnham*". COMARE also requested that Green Audit withdrew its report "*so as not to cause further unjustified local concern*", stating that:

> *"The community's interest in establishing the facts are not well served by studies with such deficiencies and it is essential that future studies should have the highest possible standards of design".*

21.4.21 COMARE further requested that in future Green Audit should follow normal scientific practice and submit their reports for peer review rather than releasing their reports without such review. COMARE concluded that "*the Green Audit study and report* *provide no reliable information whatsoever about cancer in Burnham-on-Sea*" and "*the SWCIS study conclusively demonstrates that there is no association between cancer incidence in Burnham-on-Sea and its local estuary and Hinkley Point Nuclear Power Station*".

21.4.22 The South West Public Health Observatory has investigated claims by Green Audit of increased levels of infant mortality around Hinkley Point. The Observatory found no evidence of increased infant mortality in the area, and notes that the statistical analysis undertaken by Green Audit "*is misleading and might easily cause unnecessary anxiety to local people*".

21.4.23 The methodology used in this assessment of radiological consequences is based on the internationally recognised and scientifically rigorous approaches currently available, consistent with regulatory guidance and expectation. As with all scientific work the data used is subject to some uncertainty and knowledge continues to grow, primarily focussed on further reducing these uncertainties. EDF Energy supports this work to improve our understanding based on rigorous and diligent scientific endeavour. Work to date, including that undertaken by independent bodies such as COMARE, continues to support the scientific basis for the data used in the assessments presented in support of the DCO application.

iii. Initial Radiological Assessment (IRA) - Impact on Humans

21.4.24 The Environment Agency has provided a methodology for carrying out an Initial Radiological Assessment (IRA). This methodology document consists of two parts: (i) a user report containing an overview of the methodology and tables of "*dose per unit release*" (DPUR[1]) for a large number of radionuclides; and (ii) a methods and input data report.

21.4.25 The purpose and scope of the initial assessment methodology is to provide a system for undertaking an initial cautious prospective assessment of the dose arising from sources of radioactive discharges to the environment and to identify those sources of discharges for which a more detailed assessment should be undertaken. The assessment consists of up to three stages:

- **Stage 1**: the Initial Radiological Assessment (IRA) is carried out using default data as defined in the IRA methodology. If the assessed dose is greater than 20 micro-sieverts per year (µSv y^{-1}) then a Stage 2 Assessment must be completed.
- **Stage 2**: the assessment uses refined data, as defined in the IRA methodology, which is more suited to the site in question. If assessed doses are greater than 20 µSv y^{-1} then a Stage 3 Assessment must also be completed.
- **Stage 3**: this assessment is a separate site-specific assessment.

21.4.26 In the IRA the Environment Agency states that if direct radiation exposure of the public from sources on a site is known to occur, an assessment of direct radiation dose should be made. This is provided in **Appendix 21A,** the HIA and is

[1] In Calculating the DPURs, discharges are assumed to be continuous, uniform routine releases that continue for 50 years. Dose assessment calculations are carried out at the 50th year. It is a modelling assumption that most radionuclides will reach equilibrium in the environment within 50 years.

summarised in this chapter. An assessment of the potential radiation exposure from the transport of radioactive material is also included, although it should be noted that this is not considered as part of the assessment of direct radiation 'shine' from the site.

21.4.27 In order to complete an assessment of dose to members of the public, it is necessary to determine which individuals would be subject to the highest exposure to each of the sources of radioactivity. This is done by modelling potential discharges and environmental concentrations and making assumptions regarding the habits of individuals who may receive a radiation dose as a result of discharges to the environment. For prospective assessments, i.e. those assessments looking at the impact of discharges made in the future, it is usual practice to define a set of characteristics for a hypothetical group of people whose habits would result in them being subject to the highest exposure to any radioactive discharges from the site. The hypothetical group of people following these habits has been termed the 'Critical Group'. Although this term is being replaced with the term 'representative person' the concept is the same. Within this assessment, the phrase 'Critical Group' is used throughout to avoid confusion and ensure consistency with many of the regulatory guidance documents that have been published.

21.4.28 In order to undertake a rigorous and robust assessment a range of 'Candidate Critical Groups' have been identified, that cover different groups of individuals with habits (including food consumption patterns) that might potentially result in them receiving the highest dose due to discharges and direct radiation (excluding transport). The subsequent assessments then allow those who are predicted to receive the highest dose (the Critical Group) to be identified.

21.4.29 Habit data and food intake patterns for the Hinkley Point area that enable the calculation of ingestion dose are taken from reports produced by the Centre for Environment, Fisheries and Aquaculture Science (CEFAS). The survey used in this assessment was conducted around Hinkley Point in 2006 (Ref. 21.34).

21.4.30 The IRA for HPC identifies two local candidate Critical Groups for assessment. These are:

- releases to air - local resident farming family; and
- releases to coastal water - fisherman family.

21.4.31 The criteria for assessment of the impact on humans are individual radiation dose exposures and collective radiation exposure (referred to as collective dose) over a defined population.

Individual Dose Assessment Criteria

21.4.32 The criteria used for determining the magnitude of radiological impacts on individual members of the public are based upon the constraints summarised in **Table 21.1**. In the assessment section the estimated doses from the operation of HPC are also compared against baseline doses resulting from natural background sources.

Table 21.1: UK Dose Limits, Constraints and Guidelines derived from International and European Regulations and Guidance

Dose	Source of the Dose Criterion used in the Assessment
1.0 mSv y^{-1}	1.0 mSv y^{-1} is the UK public dose limit as defined in the Ionising Radiations Regulations 1999 (Ref. 21.18). It includes all contributions from man-made sources but excludes medical or occupational exposure.
0.5 mSv y^{-1}	0.5 mSv y^{-1} is the site dose constraint to a member of the public from discharges from Hinkley Point A, Hinkley Point B and the proposed impacts from HPC. The site constraint is defined in the Environmental Permitting Regulations (England and Wales) 2010 (Ref. 21.20).
0.3 mSv y^{-1}	0.3 mSv y^{-1} is the source dose constraint for members of the public for a single power station and includes the contribution from discharges and direct radiation. The site constraint is defined in the Environmental Permitting Regulations (England and Wales) 2010 (Ref. 21.20).
0.02 mSv y^{-1}	0.02 mSv y^{-1} is the screening value defined by the Environment Agency used in radiological assessments below which further detailed studies are not warranted (Ref. 21.20).
0.01 mSv y^{-1}	0.01 mSv y^{-1} follows statutory guidance issued to the Environment Agency for England & Wales, below which regulators should not seek further reductions in public dose, provided the operator is using best available techniques to limit discharges (Ref. 21.35).

21.4.33 Advice regarding the use of the 10 µSv per year (0.01 mSv per year) criterion is relatively recent. Older documents, and this assessment necessarily makes a comparison to a 20 µSv per year criterion. In either case the risk is broadly comparable (approximately 10^{-6} per year) and BAT continue to apply to the reduction of radioactive discharges and hence radiological impacts.

Collective Dose Assessment Criteria

21.4.34 Collective dose is the sum of doses received by members of a population from all the significant exposure pathways from a given source. It is a means by which the radiological impact on society rather than the individual is assessed. The concept of collective dose can be a useful tool in optimising the level of radiological protection. For instance, it can help to ensure a proper balance between individual and societal protection. Wherever practicable, doses should be distributed in a way which is equitable and a reduction in doses to members of the public may not be justified if it results in a very high individual dose to a worker, or group of workers. ICRP state that collective effective dose is not intended as a tool for epidemiological risk assessment, and it is inappropriate to use it in risk projections. Furthermore, "*the aggregation of very low individual doses over extended time periods is inappropriate, and in particular, the calculation of the number of cancer deaths based on collective effective doses from trivial individual doses should be avoided*." (Ref. 21.6).

21.4.35 There is no legal dose limit on collective doses. However, the International Atomic Energy Agency (IAEA) has presented dose criteria which are considered sufficiently low that doses arising from sources or practices that meet these criteria may be exempted from regulatory control. This criterion, included in UK regulatory guidance, is that the collective dose should be less than about 1 man Sv per year of operation (Ref. 21.46).

21.4.36 The average individual dose within a population can be determined by dividing the collective dose by the number of people exposed. This value, known as a per caput dose, gives an indication of the individual risk across a population. In combination with the estimated Critical Group dose it gives an indication of the potential health risks associated with the operation of a particular facility.

21.4.37 The Environment Agency interim guidance document for the assessment of prospective public doses principles (Ref. 21.46) stated that discharges giving rise to per caput doses of less than a few nano-sieverts (nSv) per year of discharge can be regarded as "*minuscule and the contribution to total doses to individuals will be insignificant*.".

iv. Radiological Impact Assessment - Impact on Non-human Species

21.4.38 Radiological impacts on non-human species, unlike those on humans, have no absolute regulatory or universal 'value'. This is because different non-human species or their habitats have different perceived values depending on, for example, their rarity, sensitivity or location. After estimating the level of significance from the doses there is therefore a need to consider these aspects of the species or habitat affected and draw a final conclusion on the magnitude of the radiological impact and its significance. The methodology for undertaking this evaluation follows the generic methodology set out in **Volume 1**, **Chapter 7** of the ES.

21.4.39 The International Commission for Radiological Protection (ICRP) Publication 91 describes a framework for assessing the impact of ionising radiation on non-human species (Ref. 21.8). It sets out a systematic, risk-based approach, reiterated in the ICRP 103 recommendations (Ref. 21.6).

21.4.40 There are no specific UK regulations for the protection of non-human species from radiation sources. However, UK regulations are in place to enforce the European Directives in the UK, the main one being The Conservation of Habitats and Species Regulations 2010 (formerly the Conservation (Natural Habitats &c. Regulations 1994 (Ref. 21.36). These implement the European Union (EU) Habitats Directive (1992) (Ref. 21.13) in the UK and require steps to maintain and restore to favourable conservation status the habitats and species of EU Community level interest.

21.4.41 In the GDA Process and Information Document (Ref. 21.37) the Environment Agency requires that an assessment of the likely impact of the radioactive discharges on non-human species is carried out. They refer to Environment Agency Research and Development Publication 128 (Ref. 21.38) and make recommendations for carrying out generic radiation dose assessments.

21.4.42 The Environment Agency concluded that it is unlikely there will be any significant effects in populations from ionising radiation at the chronic dose rates listed below:

- 40 µGy h^{-1} for terrestrial animal populations;
- 400 µGy h^{-1} for terrestrial plant populations;
- 400 µGy h^{-1} for populations of freshwater and coastal organisms; and
- 1,000 µGy h^{-1} for populations of organisms in the deep ocean.

21.4.43 The computer modelling code ERICA (Ref. 21.39) and associated radiological effects database FREDERICA (Ref. 21.40) are assessment tools for predicting the dose and effects on non-human species from radioactivity in the environment. The ERICA default screening dose rate is 10 µGy h^{-1}. Therefore assessments falling below this screening level would cause no measurable harm to non-human species and so 10 µGy h^{-1} can be regarded as the bounding dose assessment criteria.

21.4.44 EDF Energy recognises the regulatory screening level of 40 µGy h^{-1} for all non-human species (Ref. 21.41). In undertaking our assessment we have applied the more stringent screening level used in the ERICA tool of 10 µGy h^{-1}.

d) Limitations, Constraints and Assumptions

21.4.45 The UK EPR is a pressurised water reactor drawing on aspects of previous designs but including additional evolutionary features that, among other things, reduce the amount of waste per unit electrical generation. Generation of electricity by all forms of pressurised water reactors unavoidably results in the generation of some liquid and gaseous radioactive effluents and solid radioactive waste. Techniques are applied to minimise the amount of radioactive effluents and waste generated in the first place and then abatement measures are used to further reduce the amount of liquid and gaseous radioactive effluents discharged. Storage buildings on the site are designed and built to minimise direct "shine" of radiation but nevertheless may result in some very small addition to background radiation from natural sources (such as soil or materials used in houses).

21.4.46 More details on the operation of HPC can be found in **Chapter 4** of this volume and more details on the management of solid radioactive waste and spent fuel can be found in **Chapter 7** of this volume. Details on limitations, constraints and assumptions are provided below.

i. Radioactive Liquid Discharges

21.4.47 As noted in Section 21.1, systems collecting and treating primary circuit water, fuel pool purification systems, operation of radioactive laundry facilities and washings from plant decontamination will result in the production of radioactive liquid effluents. There will be a small contribution to the liquid effluent arisings from the ISFS. These liquid effluent arisings from the ISFS are included in the assessment of radiological impacts.

21.4.48 Radioactive liquid effluents associated with HPC will be collected in engineered systems, preventing leakage. These systems segregate the different liquid effluent streams to facilitate their effective management and treatment. Particular types of liquid effluent will, where practicable, be recycled whilst other effluent streams will be processed in an Effluent Treatment Building (ETB). Liquid radioactive effluents will be treated using a variety of techniques including, evaporation, ion exchange and filtration to reduce the radioactive content of the effluents prior to storage in the holding and monitoring tanks.

21.4.49 Liquid radioactive effluents in the holding and monitoring tanks will be discharged into the cooling water discharge system after sampling and monitoring. Each discharge will thus be subject to a considerable dilution with cooling water before entering the sea. **Table 21.2** below shows the estimated maximum annual radioactive content of liquid discharges and the proposed limits from the operation of HPC (Ref. 21.42).

21.4.50 In light of information presented in the GDA draft decision document (Ref. 21.43) prepared by the Environment Agency and further detailed assessment of site and operator specific aspects, the proposed discharge limits have been amended. This has been done in order to envelope the levels foreseeably required at all stages over the operating life of the facility. The assessment is based on the revised levels. Notwithstanding this, the changes have not resulted in a material change in the impacts to the public and non-human species as presented in earlier consultations.

21.4.51 Notably, the following changes have been made:

- EDF Energy has responded to the Environment Agency GDA Public Consultation Document noting that a prospective operator may choose to have a different operating regime that could result in peaked rather than uniform discharges of tritium in liquid discharges. Although this does not affect the total quantity of tritium discharged in a fuel cycle, typically in the order of 18 to 22 months, the 12-month rolling limit required in the RSR environmental permit could be affected. To address this, and consistent with EDF Energy's response to the Environment Agency, this application proposes a limit of 200 TBq for a 12-month rolling period. The increase in the proposed limit of tritium from 150 to 200 TBq does result in a corresponding increase in doses from tritium. In real terms the increase in liquid tritium discharges adds less than 0.001 μSv y^{-1} to the dose to the most exposed age group in the critical group and represents an increase of 0.001% to the most exposed age group for liquid and gaseous discharges. Given the doses are reported to two significant figures, the increases in the doses from the additional tritium discharge are not observed in the final reported results.
- A separate limit for caesium-137 in liquid discharges is proposed for HPC. The proposed limit for caesium-137 is consistent with the data presented in the PCER (Ref. 21.44). The limit has been rounded to two significant figures from 1.89 GBq y^{-1} to 1.9 GBq y^{-1}. This has the affect of increasing the discharge by 0.5%. This has a corresponding increase in doses from caesium-137 through relevant pathways.
- A limit for the aqueous discharge of Iodine-131 is not proposed due to the very low levels of discharge resulting in a corresponding small impact. The limitation of other radionuclides provides a better mechanism for ensuring regulatory compliance. This is consistent with the approach outlined in the Environment Agency GDA Draft Decision Document (Ref. 21.43). The impact of discharges of liquid effluent containing iodine-131 has been included in the dose assessment presented in this chapter.

Table 21.2: Maximum Estimated Activities expected in Liquid Discharges from HPC

Radionuclide	Annual liquid discharge rates GBq y^{-1}	Proposed Limits GBq y^{-1}
H-3	200,000	200,000
C-14	190	190
Ag-110m	1.14	18.1
Mn-54	0.54	
Sb-124	0.98	
Sb-125	1.630	

Radionuclide	Annual liquid discharge rates GBq y^{-1}	Proposed Limits GBq y^{-1}
Te-123m	0.52	
Cr-51	0.12	
Co-58	4.14	
Co-60	6	
Ni-63	1.92	
Cs-134	1.12	
Cs137	1.9	1.9
I-131	0.1	–

21.4.52 Details of the production mechanisms for each of the specific nuclides (such as tritium and carbon-14) and groups of nuclides (such as Co-60 and Co-58, which are activation products, or Cs-137 and I-131, which are fission products) are given in the Chapter 2 of the Radioactive Substances Regulations Environmental Permit Submission for HPC (Ref. 21.45).

21.4.53 The discharge of radioactivity into the marine environment has the potential to cause a number of impacts, and these are assessed in this chapter:

- internal radiation exposure to members of the public from the consumption of local foodstuffs containing radioactivity;
- internal radiation exposure to members of the public from the inhalation of sea spray containing radioactivity from discharges; and
- external radiation exposure to members of the public from radioactivity present in shoreline or estuary sediment.

21.4.54 This approach is consistent with assessing the impact of relevant future exposure pathways as described in the environment agencies Joint Guidance (Ref. 21.46). An assessment on the impact of radiation exposure on non-human species has also been included.

ii. Radioactive Gaseous Discharges

21.4.55 As noted in Section 21.1 of this chapter, gaseous radioactive effluents are primarily a by-product of degassing the water from the primary circuit of each reactor. Gaseous effluent processing systems reduce the radioactive content of this ‘reactor off-gas’ using a combination of radioactive decay and adsorption ‘beds’, high efficiency filters and recombination units.

21.4.56 Gaseous radioactive effluent is also a by-product of maintenance and operations in buildings. These areas are serviced by ventilation systems which filter and reduce the radioactive content of the effluent before discharge to atmosphere through dedicated stacks. The particulate content of the effluent is filtered using high efficiency filters to retain particulate material, and charcoal adsorption filters can also be used to reduce the concentration of radioactive iodine in the discharge.

21.4.57 All gaseous discharges to atmosphere from each main discharge stack will be continuously sampled and monitored. The height of the stack for each UK EPR unit has been optimised for the Hinkley Point site to ensure dispersal under all prevailing local weather conditions.

21.4.58 Discharges of radioactive gaseous effluent may be carried out from ‘minor routes’, such as the stack associated with an ISFS. The radioactive content of these discharges will be significantly lower than discharges from the main stacks. The contribution from these minor routes will be assessed and reported but is considered to be a very small component of the overall discharges and so ‘minor route’ discharges are not considered separately in this assessment but are included in the proposed site limits and therefore the radiological impact assessment.

21.4.59 In light of increased understanding of UK custom and practice and reflecting the position proposed in the Environment Agency GDA Public Consultation Document (Ref. 21.43) a separate limit for the gaseous discharges of iodine-131 is proposed rather than a combined limit for isotopes of iodine. The proposed limit is based on a rounded value of 0.4 GBq y^{-1}. This change represents a slight uplift in the values used in the dose assessment, however, the impact of this increase in dose on the most exposed age group in the critical group is 0.027 μSv y^{-1} and represents less than 0.6% of the critical group dose. Given the doses are reported to 2 significant figures, the increase in the doses from the rounding of the gaseous iodine-131 limit is not observed in the final reported results. A separate limit on iodine-131 is proposed which is consistent with the input data used in the dose assessment presented in this chapter. The dose assessment includes iodine-131 and iodine-133, although the latter is not included in the proposed limit.

21.4.60 **Table 21.3** below shows the estimated maximum annual radioactive content of gaseous discharges from the operation of HPC (Ref. 21.47) and these have been used in this assessment.

Table 21.3: Maximum Estimated Activities expected in Gaseous Discharges from HPC

Radionuclide	Annual gaseous discharge rates GBq y^{-1}	Proposed Limits GBq y^{-1}
H-3	6,000	6,000
C-14	1,400	1,400
Kr-85	6,260	45,000
Xe-133	28,400	
Xe-135	8,920	
Ar-41	1,306	
Xe-131m	135	
I-131	0.364	0.4
I-133	0.436	–
Co-58	0.0612	0.24
Co-60	0.0722	
Cs-134	0.0562	
Cs-137	0.0504	

21.4.61 Details of the production mechanisms for each of the specific nuclides (such as tritium and carbon-14) and groups of nuclides are given in the Chapter 2 of the HPC Radioactive Substances Regulations Environmental Permit Submission (Ref. 21.45).

21.4.62 The discharge of radioactivity into the atmosphere has the potential to cause a number of impacts, and these are assessed in this chapter:

- internal radiation exposure to members of the public from the consumption of local foodstuffs containing radioactivity;
- internal radiation exposure to members of the public from the inhalation of radioactivity in a gaseous discharge plume; and
- external radiation exposure to members of the public from radioactivity present in the terrestrial environment.

21.4.63 This approach is consistent with assessing the impact of relevant future exposure pathways as described in the environment agencies Joint Guidance (Ref. 21.46). An assessment on the impact of radiation exposure on non-human species has also been included.

iii. Sources of Direct Radiation Exposure

21.4.64 Direct exposure to radiation from the reactor buildings for members of the public will be negligible as the concrete shielding present will ensure contact radiation dose rates for the buildings are very low. Thus, direct radiation from the reactor buildings will not be measurable at the site boundary. The waste stores will be designed to limit escape of radiation shine but that, nevertheless, small amounts of shine will contribute a small additional component to the normal radiation background around the site. In the UK, assessments of direct radiation are usually carried out by monitoring radiation levels at the site boundary and at the nearest habitation.

21.4.65 It will also be necessary to transport radioactive materials to and from the HPC site. These materials may include radioactive sources for non-destructive testing and examinations, fresh nuclear fuel, radioactive equipment or plant components requiring off-site examination or maintenance, and radioactive waste. HPC will have an ISFS but the transport of spent nuclear fuel is conservatively included in the assessment. Members of the public may be exposed to direct radiation whilst the material is being transported. Although not included as part of the 'direct radiation' component for the purposes of assessing the impact on the most exposed person in the vicinity of Hinkley Point, this radiological impact is assessed against the relevant criteria.

21.5 Baseline Environmental Characteristics

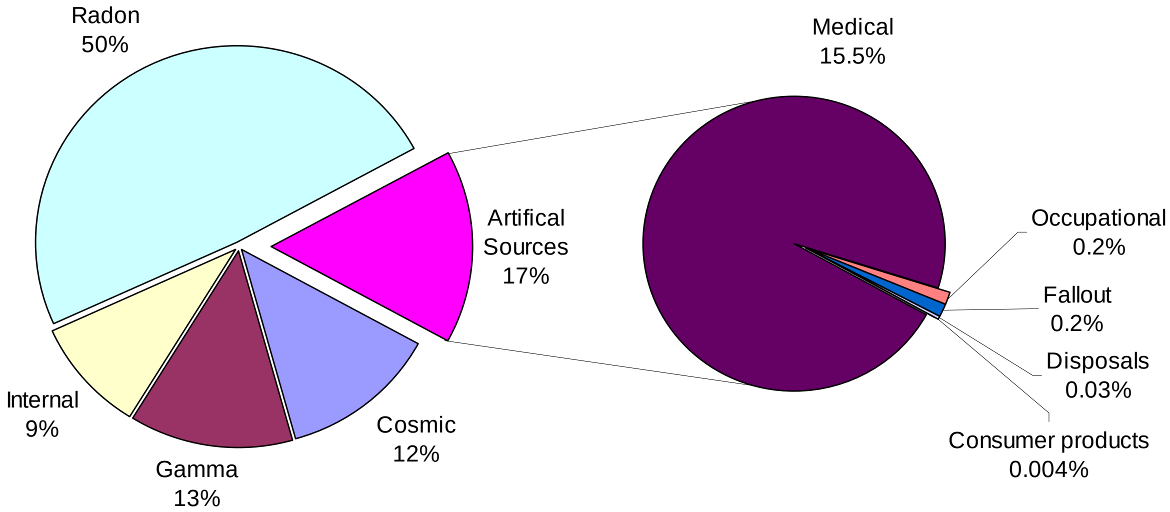
a) Sources of Ionising Radiation Exposure in the United Kingdom

21.5.1 Radiation describes any process in which energy travels through a medium (other than by conduction) or through space. There are two broad classes of radiation: ionising radiation from sources such as radioactive materials or x-ray machines and which causes ionisation in material it interacts with and non-ionising radiation (such as radio waves or infrared and visible light) originating from other sources. For the purposes of this assessment, only ionising radiation is considered.

21.5.2 All individuals in the UK are exposed to ionising radiation to a varying degree from natural and anthropogenic sources. Natural sources include cosmic radiation from the sun and stars, gamma radiation from soil and rocks, internal exposure from naturally occurring radioactive material (such as potassium-40) in food and within the body, and exposure to the radioactive gas radon. Anthropogenic sources include medical exposure to radiation (such as X-rays), occupational exposure for persons working with ionising radiation, fallout from the testing of nuclear weapons, exposure to products containing radioactivity (such as smoke detectors) and discharges from the nuclear industry.

21.5.3 The 2005 review of ionising radiation in the UK by the Health Protection Agency (Ref. 21.48) evaluated the magnitude of exposure of individuals in the UK to ionising radiation. The average radiation exposure for individuals in the UK has been stated to be 2,700 µSv y^{-1}, most of which is from natural sources with the majority of the man-made component being due to medical sources. The contribution from radioactive discharges from the nuclear industry is stated to be 0.9 µSv y^{-1}, i.e. less than 0.1% of total radiation exposure (Ref. 21.48). The breakdown of the UK annual average dose from Reference 21.48 is illustrated in Plate 21.1.

Plate 21.1: Annual Average Exposure of the UK Population from all Sources of Ionising Radiation



Taken from Health Protection Agency (2005) Ionising Radiation Exposure of UK Population: 2005 review (HPA-RPD-001).

21.5.4 The dose limit for members of the public in the UK is 1 mSv per year (or 1,000 µSv y^{-1}) (Ref. 21.18), this is consistent with international guidance and legislation. With the exception of medical exposures, no activity is permitted to give rise to discharges which would cause this limit to be exceeded. The dose limit applies to the sum of current and past licensed activities.

21.5.5 In addition to dose limits, the environmental legislation (Ref. 21.20) also applies dose constraints, these are levels at which doses from routine operations should not exceed. A source dose constraint ensures that an individual does not receive a dose from any new discharge source that exceeds 300 µSv y^{-1}. A site constraint ensures that an individual does not receive a dose from a single site that exceeds 500 µSv y^{-1}.

21.5.6 For the purposes of this assessment HPC is considered to be a single source and the contribution from HPA, plus HPB and HPC, is considered to be a single site (the Hinkley Point Sites) for the purposes of assessment against the site constraint.

b) Existing Monitoring Data from Around Hinkley Point

21.5.7 Since 1995 the environment agencies of the United Kingdom and Northern Ireland and the Foods Standards Agency have undertaken independent radiological monitoring of food and environmental samples in the UK, especially near nuclear sites. The results are produced in an annual Radioactivity in Food and the Environment (RIFE) report (Ref. 21.49/50/51/52/53/54/55/56/57/58/59/60/61/62) and are available to the public. The RIFE reports also present retrospective dose assessments based on the measured activity concentrations in various foodstuffs farmed or caught locally to nuclear sites. In addition, dose rates recorded from the environment and local occupancy and habit data (such as the consumption of local foodstuffs) are used to determine the level of exposure.

21.5.8 This monitoring undertaken by the environment agencies and Foods Standards Agency is separate and in addition to the monitoring carried out by the site operators as part of their obligations under their discharge permits.

21.5.9 Summaries of radioactive liquid and gaseous discharges made from existing sites in the Hinkley Point region and of measured concentrations of radioactivity in the environment around Hinkley Point for the calendar year 2008 are provided in the HIA (Ref. 21.63). The annual radiation dose to the most exposed person (also referred to as the Critical Group, or representative person) is reported in the RIFE report for 2008 (Ref. 21.62) to be 37 µSv y^{-1} for seafood consumers and 6 µSv y^{-1} for terrestrial foodstuff consumers. An assessed hypothetical total annual dose integrating across all pathways and including the contribution from direct radiation from proximity to the existing HPA and HPB sites is reported to be 45 µSv y^{-1}.

21.5.10 Recent RIFE reports (RIFE-8 to RIFE-14 inclusive (Ref. 21.49 to 21.62) include an extensive list of nuclides and measurement types. The reports show that:

- the only nuclide consistently detected in drinking water and surface water is naturally occurring potassium-40;
- a consistent positive result for gross beta, considered to be the presence of the naturally occurring radionuclide potassium-40, is measured in sea water;
- mud and sediment taken from 1.6km from the discharge pipeline, from Watchet and from Stolford shows consistent positive results for caesium-134 and caesium-137. The RIFE reports suggest that this represents the combined effect of releases from HPA and HPB, plus other nuclear establishments, along with historic contributions from Sellafield and fallout from historical weapons testing and Chernobyl. This is consistent with the results of site investigation carried out at the HPC proposed development site (see Section d), below); and
- external gamma radiation dose rate measurements were barely above the limits of detection (for the survey equipment used).

21.5.11 From the review of the RIFE reports, monitoring of food and the environment in the vicinity of Hinkley Point indicates that current radiation doses to the most exposed members of the public from radioactive discharges and direct radiation shine are a small fraction (less than 5%) of the 1 mSv y^{-1} public dose limit.

c) Surveys of the HPC Proposed Development Site

21.5.12 Radiation and radioactive contamination surveys of the proposed development site at Hinkley Point have been carried out as detailed in **Chapter 4** of this volume and are summarised in **Appendix 21A**.

21.5.13 Soil monitoring surveys for radioactive contamination were carried out for the Built Development Area West (BDAW) in July and October 2008 and for the Built Development Area East (BDAE) and Southern Construction Phase Area (SCPA) commencing October 2009.

21.5.14 The results from the BDAW show that there is no evidence of significant contamination with anthropogenic radionuclides. The concentration of radioactivity in soils was similar to background levels found throughout the UK, with caesium-137 radioactivity consistent with atmospheric fallout from the Chernobyl accident in 1986. Other radionuclides, such as tritium and carbon-14 which can be present both naturally and from man-made sources were detected in some samples at levels consistent with anticipated background levels. Some naturally occurring radionuclides, such as protactinium-234m and radium-226, were detected in the samples. However, no samples were found to be “radioactive” as defined by the Environmental Permitting (England and Wales) Regulations 2010 (Ref. 21.20).

21.5.15 A walkover survey on the BDAE and the SCPA was completed in October 2009. In general, the walkover survey recorded measurements that were low and at levels either at or below anticipated background levels for the area. Enhanced readings above general background were found in the north-east corner of the BDAE. These elevated readings are thought to be due to external radiation originating from a building on the HPA site used to store radioactive waste rather than any radioactivity in the ground.

21.5.16 During the course of these surveys two locations were identified with elevated readings. Further samples were collected from these locations and submitted for additional testing. The results for these samples provided no evidence of contamination by anthropogenic radionuclides. A small area of the BDAE, which was the site of a former sewage works, was found to contain elevated levels of natural uranium, which was associated with granitic material observed in this area. The levels found were below the limit specified in The Radioactive Substances (Phosphatic Substances, Rare Earths etc.) Exemption Order (Statutory Instrument, 1962, No.2648) and would not be of regulatory concern. The remaining results for the BDAE and the SCPA were entirely consistent with those found and reported for the BDAW.

21.5.17 Direct radiation measurements performed and presented in **Appendix 21A** show the contribution from the background levels of radioactivity as well as any contribution from the neighbouring facilities. These levels are comparable with UK national average values.

21.5.18 The radiological risk to workers and members of the public during the construction phase can be regarded as very low and further assessment is not warranted.

21.5.19 In addition, analysis for anthropogenic radionuclides in sea water, groundwater and surface water samples was undertaken, the results of which were as follows:

- the sea water samples monitoring showed levels to be at, or very close to, the limit of detection;
- the groundwater samples monitoring showed the presence of tritium in some samples but at levels considerably lower than the Drinking Water Inspectorate's (DWI) screening value (100 Bq l^{-1}). No other artificial radionuclides were measurable in the samples; and
- the surface water analysis showed some very low levels of radioactivity in some samples (all tritium and gross beta analyses were below the DWI screening levels; one result for gross alpha results (0.15 Bq l^{-1}) was recorded above the DWI screening level but this was well below World Health Organisation screening level (0.5 Bq l^{-1}). This result was not repeated in subsequent sampling campaigns.

Therefore all of the results would not present a hazard to human and non-human health or be of regulatory concern.

21.5.20 Surveys of soil and groundwater on the proposed development site at HPC show that there is no evidence of elevated anthropogenic radioactive contamination being present. Harm as defined in the relevant statutory guidance (Ref. 21.2) is not being caused, nor is there a significant possibility of such harm being caused. The radiological risk to workers and members of the public during the construction phase can be regarded as very low and further assessment is not warranted.

21.6 Assessment of Impacts

a) Operational Impacts

21.6.1 For the reasons stated in Section 12.2 separate radiological assessments have not been undertaken for the construction or commissioning phases of HPC.

i. Generic Design Assessment (GDA)

21.6.2 A Stage 1 assessment was undertaken as part of the Pre-Construction Environmental Assessment (Ref. 21.44), submitted for the Generic Design Assessment (GDA) carried out by the Health and Safety Executive (HSE) and the Environment Agency to assist the licensing process. The PCSR report is based on a single unit UK EPR. As described in **Appendix 21A**:

- A Stage 1 assessment is intentionally highly conservative.
- Estimated doses to the Critical Group exceeded 20 µSv y^{-1} and therefore a Stage 2 assessment was appropriate.

21.6.3 A Stage 2 assessment was completed for a single UK EPR unit as part of the PCER (Ref. 21.44). As noted in **Appendix 21A**:

- Conservative assumptions were made regarding an effective stack height and a local marine compartment volumetric exchange rate.
- All other assumptions and parameters remained unchanged from the Stage 1 assessment.

- It is appropriate for a Stage 2 assessment to sum the doses from all release routes to estimate a potential Critical Group dose.
- Estimated doses to the Critical Group exceeded 20 µSv y^{-1} and therefore a Stage 3 assessment was appropriate.

21.6.4 A Stage 3 assessment was completed for a single UK EPR as part of the PCER (Ref. 21.44). As described in **Appendix 21A**:

- The 'site' was derived from conservative characteristics of the environment around existing UK nuclear sites, with respect to dispersion of liquid and gaseous discharges, habitation distances from sites and weather conditions.
- A standard assessment tool (PC-CREAM 98) (Ref. 21.64) was used to calculate individual doses from routine releases.
- Three scenarios (a 'farming family', a 'fishing family' and a 'local resident') were assessed in order to determine those representative members of the public subject to the highest exposures (i.e. the Critical Group).
- Direct radiation doses were assessed to be very low (less than 5 µSv y^{-1}).
- Estimated total doses to the Critical Group were 25.8 µSv y^{-1}, exceeding 20 µSv y^{-1}, and therefore a site-specific radiological impact assessment was appropriate.

ii. Hinkley Point Site-specific Assessment for Impacts on Humans

Introduction to the Site-specific Assessment

21.6.5 **Appendix 21A** outlines a methodology for the assessment of the impact on the human population around HPC. These methods were used to assess doses from HPA and HPB in order to determine the cumulative dose from the Hinkley Point Sites, and the methods were consistent with the general methods developed for the GDA and the relevant Environment Agency guidance (Ref. 21.46). The methods were confirmed in the **HIA** (Ref. 21.63) that they represented reasonable approaches and are based on widespread methods adopted within the UK. HPA and HPB and the proposed HPC (the Hinkley Point Sites) are assumed to discharge into the same local marine environment and the local terrestrial environment and give rise to exposures via the same exposure pathways.

21.6.6 Assessment methodologies were developed (see **Appendix 21A**) to assess the impacts from a number of scenarios. These are for:

- the assessment of individual doses as a result of continuous releases of gaseous and liquid discharges to the environment;
- the assessment of direct radiation dose exposures;
- the assessment of radiation exposure from transport;
- the assessment of collective doses;
- the assessment of individual doses as a result of short-term releases to atmosphere;
- the assessment of individual doses as a result of build-up of radioactive materials in the environment; and

- annual dose assessment of the Critical Group.

21.6.7 The assessments were based upon the proposed limits of discharges to the environment, as summarised in Section 21.3 of this chapter and site specific characteristics relating to the two UK EPR units and associated facilities (discharge, dispersion and dose uptake pathways). The proposed limits for discharge values used in the assessment are derived from operational feedback from current PWRs (of similar design to the UK EPR) and are appropriate for carrying out a site specific radiological assessment for HPC. Site characteristics detailed in **Appendix 21A** are based on best available information.

The Assessment of Individual Doses from Continuous Releases

21.6.8 Two Candidate Critical Groups (the 'farming family' and the 'fishing family') were used as the basis for determining the Critical Group from all HPC discharges. The group subject to the highest exposure would then be considered the Critical Group.

21.6.9 It was conservatively assumed that a farming family living near the coast could be exposed to gaseous discharges through the terrestrial pathways of:

- ingestion of contaminated foodstuffs (green vegetables, root vegetables, domestic fruit and wild/free fruits, dairy products and meat) grown or raised on the farm; and
- inhalation of, and external exposure to, the plume and deposited radionuclides.

21.6.10 The two foodstuffs contributing the highest fraction of dose were assumed to be consumed at the 'critical' (maximum) rates in the appropriate CEFAS reports and all other foodstuffs were assumed to be consumed at average rates. This is known as the "Top Two" method. It ensures a realistically conservative estimate of ingestion dose for prospective assessments and is consistent with the GDA study method but applies local habit data (Ref. 21.34) rather than generic national data for a more realistic assessment.

21.6.11 It was also conservatively assumed the farming family could be exposed to marine discharges through the marine pathways of ingestion of locally sourced seafoods, external exposure to beach sediments and inhalation of sea spray when spending recreational time on a local beach. Average consumption rates of fish and shell fish and recreational activity times were taken from the CEFAS (Ref. 21.34) study to determine exposures. This Candidate Critical Group is therefore referred to as the 'farming family with marine and gaseous exposure'.

21.6.12 As detailed in **Appendix 21A** it is assumed that a fishing family could be exposed to liquid discharges through:

- contact with contaminated fishing gear and beach sediments;
- from ingestion of seafoods; and
- inhalation of seaspray.

21.6.13 This fishing family could live locally and would therefore be exposed to the same terrestrial pathways as the 'farming family'. It was conservatively assumed that this family might live at the same location as the 'farming family with marine and gaseous exposures' and thus would also be exposed to the highest airborne and deposited activity concentrations from gaseous discharges from HPC. It was also assumed that they would consume locally grown produce at average rates. They are therefore referred to as the 'fishing family with marine and gaseous exposure'.

21.6.14 In each case, individual doses were calculated for three age groups: adult, 10 year old child and one year old infant. The calculated doses are presented in **Table 21.4** below.

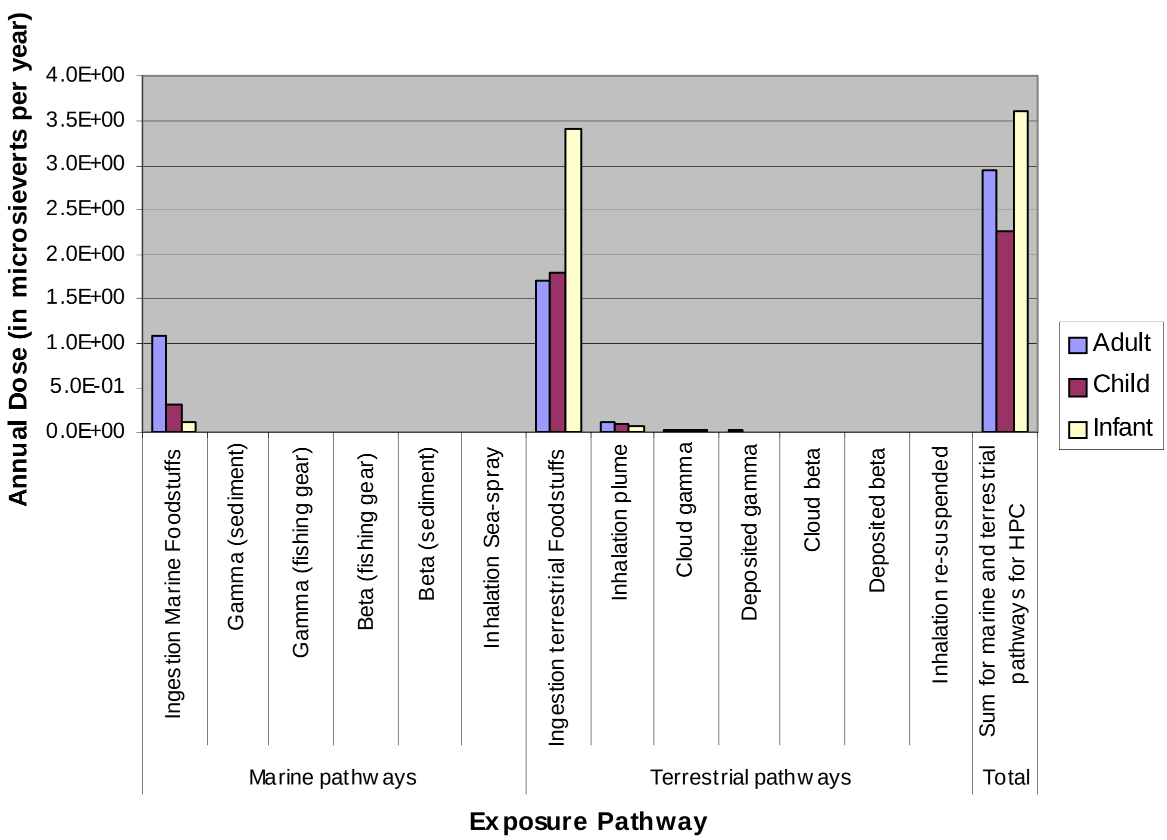
Table 21.4: Candidate Critical Group Doses from HPC Discharges

Doses in Microsieverts per Year (µSv y^{-1})			
	Adult	**Child**	**Infant**
Farming Family			
Terrestrial pathways	2.4	2.2	4.4
Marine pathways	0.3	0.3	0.1
Total	**2.7**	**2.5**	**4.5**
Fishing Family			
Terrestrial pathways	1.9	2.0	3.5
Marine pathways	1.1	0.3	0.1
Total	**3.0**	**2.3**	**3.6**

21.6.15 The 'farming family with marine and gaseous exposure' represents the Candidate Critical Group who may be exposed to gaseous discharges from the proposed HPC reactors and via marine pathways. As noted above detailed in **Appendix 21A**, ingestion rates, inhalation rates and occupancy factors were assigned for members of the family. It was assumed that these individuals do not participate in fishing and therefore are not exposed through the handling of fishing gear exposure pathway.

21.6.16 The predicted doses to the 'farming family with marine and gaseous exposure' Candidate Critical Group were calculated to be 2.7, 2.5 and 4.5 µSv y^{-1} for adults, children and infants respectively. **Plate 21.2** presents the breakdown of the doses by exposure pathway for each age group of the Candidate Critical Group. The dose of 4.5 µSv y^{-1} is the highest dose estimated due to radioactive liquid and gaseous discharges from the HPC site. The estimated doses are dominated by contributions from discharges of C-14, tritium and, for the infants, iodine-131. Carbon-14 and tritium account for about 90% and 3% respectively of the total dose received by the Candidate Critical Group.

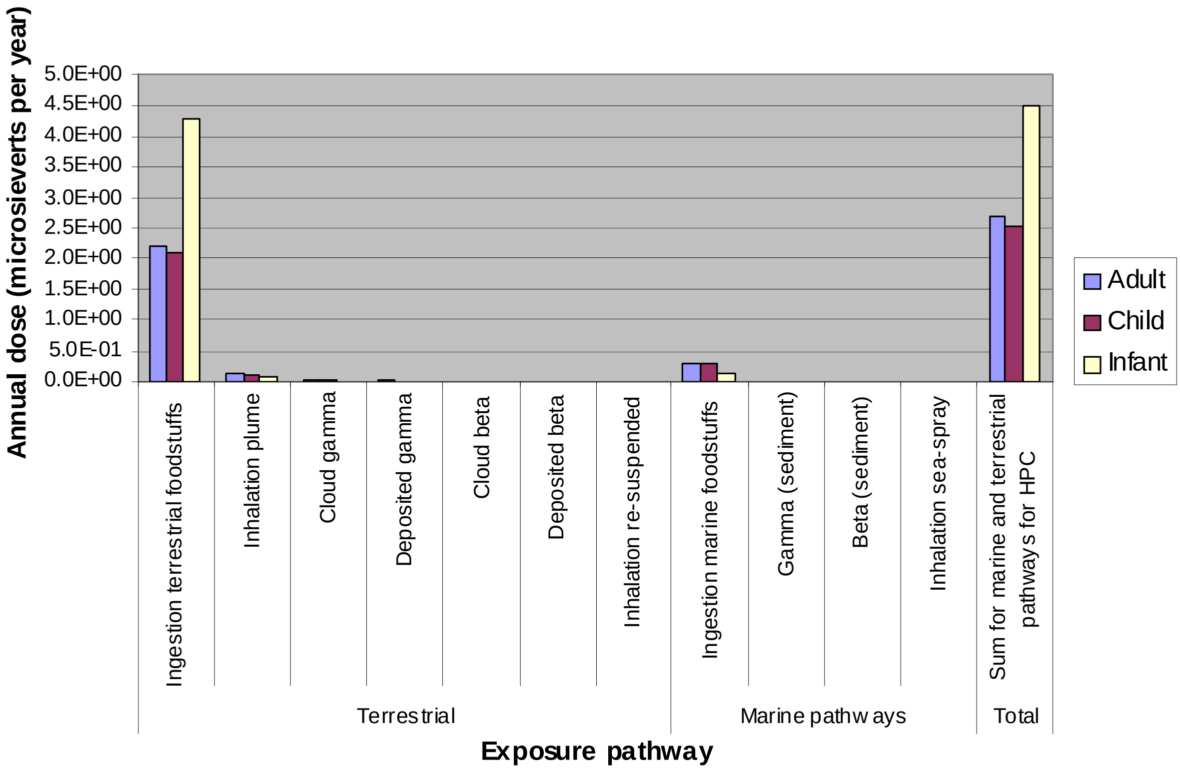
Plate 21.2: Breakdown of Dose by Pathway to the Fishing Family with Marine and Gaseous Exposure



21.6.17 The 'fishing family with marine and gaseous exposure' represents the Candidate Critical Group who may be exposed to radiation and radioactivity from discharges into the marine environment and via terrestrial pathways. The radiation exposure to the same three age groups as the 'farming family with marine and gaseous exposure' was determined, using assigned ingestion rates, inhalation rates and occupancy factors. There are some foodstuffs (marine plants and algae) consumed by members of the public in the CEFAS survey (Ref. 21.34) that have not been included in the current assessment, because they are only consumed in small quantities by very few individuals.

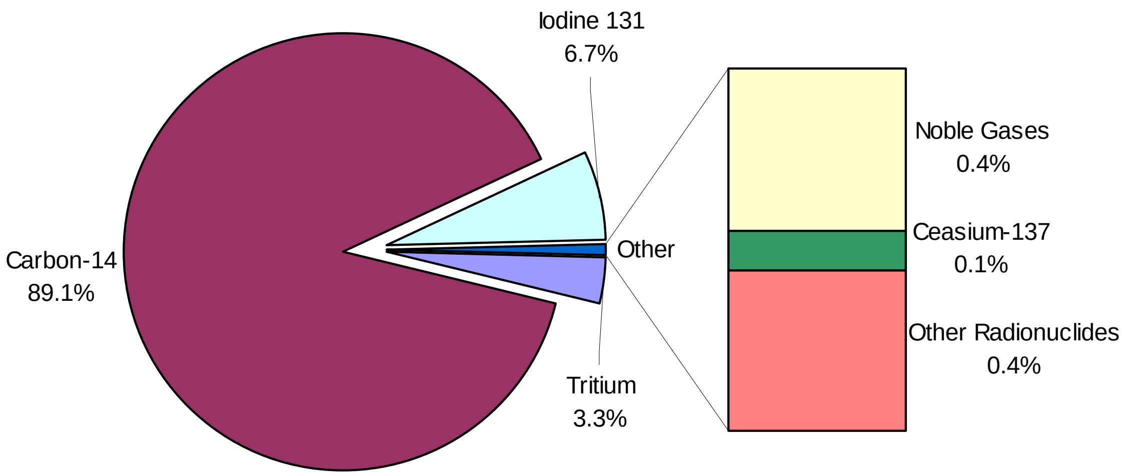
21.6.18 The predicted doses to the 'fishing family with marine and gaseous exposure' Candidate Critical Group were calculated to be 3.0, 2.3 and 3.6 µSv y^{-1} for the adult, child and infant members respectively. **Plate 21.3** presents the breakdown of the doses by exposure pathway for each age group of the Candidate Critical Group. The estimated doses are dominated by contributions from discharges of C-14, tritium and, for the infants, iodine-131. Carbon-14 and tritium account for about 90% and 3% respectively of the total dose received by the Candidate Critical Group.

Plate 21.3: Breakdown of Dose by Pathway to the Farming Family with Marine and Gaseous Exposure



21.6.19 The highest doses due to discharges from HPC are those to infants in the ‘farming family with marine and gaseous exposure’. This is therefore the Critical Group for all radioactive discharges to the environment from HPC. **Plate 21.4** illustrates the breakdown of the critical group dose by radionuclide. The assessed dose of 4.5 µSv y^{-1} can be regarded as low.

Plate 21.4: Breakdown of Dose by Radionuclide to Infant Age Group for the Farming Family with Marine and Gaseous Exposure Critical Group for HPC



The Assessment of Direct Radiation Exposure from HPC

21.6.20 As described in Section 12.3 of this chapter direct exposure to radiation (also referred to as radiation ‘shine’) from the reactor buildings for members of the public will be negligible, as the thickness of concrete shielding present in the building structures will ensure external contact dose rates are low and would be difficult to measure at the site boundary.

21.6.21 Direct radiation emanating from the Interim Storage Facility for Intermediate Level Waste (ILW) store and the ISFS will contribute to radiation exposure for a member of the public. In the UK, assessments of direct radiation are usually carried out by monitoring radiation levels at the site boundary and at the nearest habitation. Estimates of direct radiation exposure from HPA and HPB to local residents living within 1km of the existing Hinkley Point Site, including contributions from discharges, were 4 µSv y^{-1} in 2007 (Ref. 21.61).

21.6.22 **Appendix 21A** outlines the conservative assumptions made during the assessment of potential direct radiation dose from HPC. A radiation dose rate appropriate for an 'undesignated' building was assumed to be at a distance of 1 metre from the outer wall of the building. For the purposes of this assessment, an ILW and a Spent Fuel building were assumed to be located at a distance of approximately 40m from the coastal footpath that runs parallel to the northern boundary of the Hinkley Point Site. The dose rate at this location was calculated for several exposure scenarios:

- A reasonably conservative scenario where a person walks along the nearby coastal path over a distance of about 800m daily, spending about 20 minutes walking past the site and would receive an additional dose of 1.5 µSv y^{-1}.
- A local resident spending the whole year in close proximity to the HPC site, at a distance of ~1.3km, but also taking into account the reduced dose rate while indoors (due to shielding effects of the walls of the dwelling), was calculated to receive an additional annual dose of 0.0014 µSv y^{-1}.

21.6.23 A summary of the doses from direct radiation from the proposed HPC site is shown in **Table 21.5** below:

Table 21.5: A summary of the doses to the public due to direct radiation from an Interim Facility for Spent Fuel and ILW on the HPC site.

Scenario	Estimated Dose µSv y^{-1}
Coastal path	1.5
Closest dwelling	0.0014

21.6.24 The data in **Table 21.5** shows that the impacts on these receptors are 'very low', especially considering that the assumptions used in the assessment are conservative and actual doses are expected to be less than those estimated.

21.6.25 The dose rate due to direct radiation from these facilities on the HPC site at the more distant location assumed for the 'farming' or 'fishing' families with exposure from HPC liquid and gaseous discharges is estimated to be smaller than for the dwelling above and so need not be considered in assessing the dose from the HPC site to these two Candidate Critical Groups.

The Assessment of Direct Radiation Exposure from Transport

21.6.26 An assessment of the radiological consequences of the transport of radioactive materials to and from HPC was carried out and considered the transport of the following radioactive materials:

- radiography sources (used for non-destructive testing (NDT) of plant and equipment);
- spent fuel assemblies;
- new uranium fuel assemblies; and
- low-level radioactive waste (LLW).

21.6.27 An assessment of radiation doses arising from spent fuel transport from the HPC site was included in the assessment however this is a conservative assumption, since the ISFS is expected to be on HPC pending disposal at the UK Geological Disposal Facility. The transport of ILW was excluded from the assessment, since interim storage is assumed to be on site.

21.6.28 The assumptions of the number of radioactive material consignments, the surface radiation dose rates, the proximity to dwellings in the Hinkley Point area during transport are all described in **Appendix 21A** The highest annual dose received by a member of the public living adjacent to the Bridgwater railhead and exposed to spent fuel flasks was estimated to be 2 μSv y^{-1}. Members of the public standing at a bus stop could receive doses of up to 1.8 μSv y^{-1} should they be exposed to all four material scenarios (NDT sources, spent fuel, new fuel, LLW). Members of the public living in a house close to a road have been conservatively estimated to receive doses of up to 1.67 μSv y^{-1} from transports of new fuel.

21.6.29 Assuming that spent fuel will be stored on the HPC site, annual assessed doses would be reduced to a maximum of 1.67 μSv y^{-1}. These assessed doses are well below the relevant dose limit for members of the public of 1 mSv y^{-1} from man made sources (specified in the Ionising Radiations Regulations (Ref. 21.18)) and which is applicable to exposure due to transport operations. Furthermore, the scenarios considered are conservative and the assessed doses are unlikely to be realised in practice.

The Assessment of Radiation Dose exposure from Gaseous and Liquid Discharges and Direct Radiation

21.6.30 **Table 21.6** summarises the prospective doses to members of the two Candidate Critical Groups due to discharges and direct radiation from HPC. It is noted that the small dose from direct radiation would not add measurably to the doses assessed from discharges only.

Table 21.6: Summary of Prospective Doses to Candidate Critical Groups from Liquid and Gaseous Radioactive Discharges and Direct Radiation from HPC

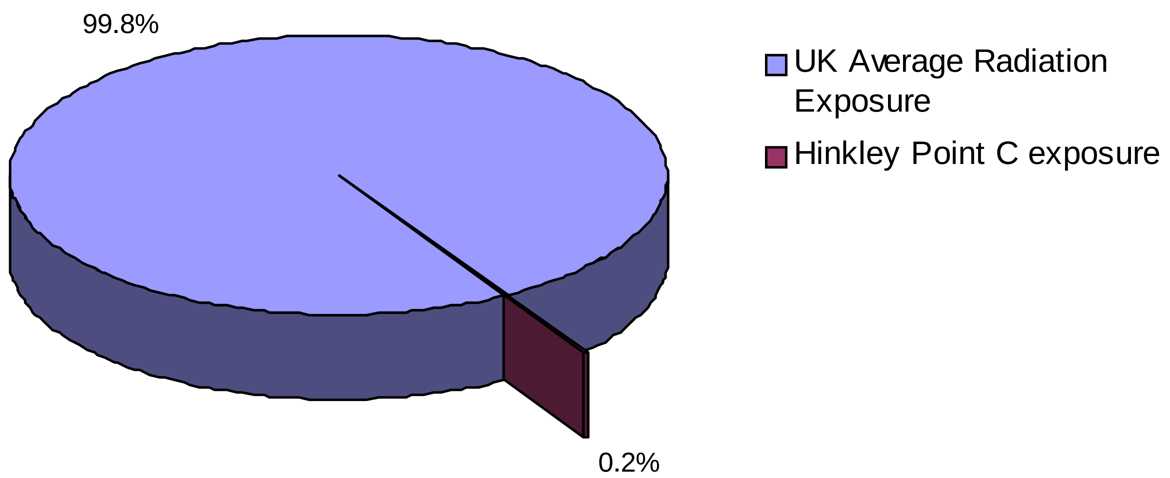
Summary of Prospective Doses in Microsieverts per Year (µSv y^{-1})		
Age Group	**Farming Family with Marine and Gaseous Exposures**	**Fishing Family with Marine and Gaseous Exposures**
Adult	2.7	3.0
Child	2.5	2.3
Infant	4.5	3.6

21.6.31 The highest doses due to discharges and direct radiation from HPC are those to infants in the 'farming family with marine and gaseous exposure'. This is therefore the Critical Group for all radioactive discharges to the environment and direct radiation from HPC.

21.6.32 As previously indicated the source dose constraint of 300 µSv y^{-1} is the maximum dose to people that may result from discharges from a single new source. The critical group doses to adults, children and infants are respectively 2.7, 2.5 and 4.5 µSv y^{-1} for HPC. The doses to this group are much lower (approximately 1.5%) than the source dose constraint of 300 µSv y^{-1}.

21.6.33 The estimated dose for discharges at proposed limits is below 10 µSv y^{-1}. This is the level at which the UK Government in its statutory guidance to the Environment Agency (Ref. 21.35) has indicated that it would not seek further progressive reductions in discharge limits as long as the application of best available techniques continues to be implemented. **Plate 21.5** illustrates the relative proportion of the critical group dose compared to the national average annual exposure from all sources of ionising radiation. It equates to approximately 0.2% of the total annual average exposure. The assessed dose of 4.5 µSv y^{-1} can be regarded as low.

Plate 21.5: Comparison of National Annual Average Exposure in the UK to the Dose to the HPC Critical Group



The Assessment of Collective Radiation Dose Exposure

21.6.34 Collective doses from gaseous and liquid discharges were calculated using the PC-CREAM (Ref. 21.64) modelling tool. The HPA and HPB sites which are already built in to the model, were used to define the population and agricultural product distribution within the European Community and the regional marine compartment into which the discharge is released. An effective stack height of 23.3m was used to represent the physical stack height of 70m to account for the impact of plume rise and buildings on the site. Collective doses were truncated at 500 years consistent with the Environment Agency guidance (Ref. 21.46).

21.6.35 The population groups to be considered are the UK, Europe and the world. The population data for the UK, Europe and the world was assumed to be 55 million, 700 million and 10 billion respectively as these are the values used by PC-CREAM 98 (Ref. 21.64) to estimate collective doses.

21.6.36 Average individual doses ('per caput') for populations in the collective dose assessment were also calculated, allowing per caput doses to be compared with dose constraints. The collective and per caput doses to the UK, European and world populations from HPC gaseous and marine discharges are presented in **Table 21.7** below.

Table 21.7: Collective Dose to the UK, European and World Populations from HPC Discharges

Collective Dose Results			
	UK	**Europe**	**World**
Collective Dose (Man Sv)			
Atmospheric	0.36	3.0	24.6
Liquid	0.02	0.2	2.2
Total Collective dose	0.4	3.2	26.8
Average per Caput Dose (nSv)			
Atmospheric	6.6	4.3	2.5
Marine	0.4	0.3	0.2
Total per caput dose	6.9	4.6	2.7

21.6.37 Total HPC discharges will result in *per caput* doses of less than 7 nSv to the UK population. The Health Protection Agency has stated that discharges giving rise to per caput doses of less than a few nano-sieverts per year of discharge can be regarded as "*minuscule and the contribution to total doses to individuals will be insignificant*" (Ref. 21.46).

21.6.38 The estimated collective dose in the UK is 0.4 manSv which is very low by comparison with the national collective doses from medical exposures of 24,000 manSv (Ref. 21.65). In addition it is less then the IAEA criterion used in the UK regulatory guidance of 1 man Sv per year of practice below which the IAEA would consider that such a practice be exempt from regulatory control (Ref. 21.46).

The Assessment of Individual Doses Resulting from Short-term Discharges

21.6.39 Doses have been calculated arising from potential short-term gaseous discharges from a single UK EPR stack with separate calculations undertaken for the UK EPR Unit 1 and Unit 2 stacks for the same receptor location and assumed total discharge amounts and discharge rates. Potential short-term doses, including via the food chain, were calculated for a local Critical Group based on the methods described in NRPB-W54 (Ref. 21.66). The doses were then compared with the assessment criteria.

21.6.40 The pathways of exposure and the exposure times which have been considered to assess the short-term impact are the following:

- ingestion of foodstuffs (the associated dose is calculated in the year following the short-term release);
- inhalation and external irradiation from the plume (the associated doses are calculated for the period of the passage of the plume);
- ingestion doses were calculated using the 'Top Two' method described above; and
- external irradiation from deposited radionuclides (the associated dose is calculated for the year following the release).

21.6.41 The results for the assumed intake rate (Ref. 21.34) were 0.26, 0.23 and 0.45 µSv per discharge for adult, child and infant age groups respectively. For infants (the most exposed individual) the most significant exposure route is ingestion (97% of the dose received) followed by inhalation (2%). The most significant radionuclide is C-14 (95% of the dose received) followed by tritium (2%).

21.6.42 The predicted short-term dose is significantly less than the predicted dose due to the continuous release and therefore the calculations of doses to the Critical Group bound the radiological assessment for HPC. The prospective doses estimated due to the short-term gaseous discharges from HPC are significantly less than the relevant dose criteria, that is the source constraint of 300 µSv y^{-1} or the public dose limit of 1,000 µSv y^{-1}.

The Assessment of Individual Doses from the Build-up of Radionuclides

21.6.43 EDF Energy has designed the facilities and will operate them in such a manner to minimise the discharges of gaseous and aqueous effluents through the application of Best Available Techniques. The proposed techniques will need to satisfy regulatory scrutiny through the determination of the relevant environmental permit applications. EDF Energy has included an assessment of the potential build-up of the radioactivity in the marine and terrestrial environment to show that the operations of HPC would not prejudice the future use of the land and sea.

21.6.44 The Environment Agency has highlighted that at the end of the life of a power station, land may not be able to return to free and unrestricted use due to potential build-up of radionuclides. Build-up refers to the accumulation of radionuclides in environmental media due to discharges and accounts for the effects of gradual accumulation of radionuclides over the operating life of the plant. A range of potential groups can then be exposed to this source of radioactivity.

21.6.45 Potential activity concentrations in soil were assessed using calculated activity concentrations in air. Activity concentrations in sea water and on the local beach were also calculated (see **Appendix 21A)**. The significance of the impact of the build-up of radioactivity will depend on the future use of the land and activities in the sea.

21.6.46 A methodology for estimating doses to members of the public from future use of land previously contaminated with radioactivity was used (Ref. 21.67). A review of potential uses of the sea was carried out based on uses discussed in the CEFAS study (Ref. 21.34). Scenarios where occupancies are high and/or intakes of radionuclides occur will give the highest doses. Potential uses included:

- water sports;
- beach combing/walking;
- hobby fishing (including consumption of catches);
- commercial fishing, and
- houseboat dwelling.

21.6.47 The results for the airborne concentrations and consequent concentration in soil at the off-site location with the highest concentration are described in **Appendix 21A**.

21.6.48 The most restrictive scenario for which the build-up of discharges to the atmosphere has been assessed would be construction on potentially contaminated land (**Appendix 21A)**. It has been assumed that the most contaminated land off-site would be used for a future development and the total dose to a construction worker as a consequence of the future build-up of nuclides due to the emissions from the HPC reactors has been calculated to be 0.0044 µSv y^{-1}. It should be noted that the predicted annual exposure to a future-use construction worker is based on the build-up of activity at the location of maximum predicted concentration outside the site boundary. The extent of this area of maximum concentration is relatively small and will reduce with distance from the site.

21.6.49 The dose to members of the public from future use of the sea has been assessed for the 'fishing family' group, but excluding the atmospheric contribution. The total dose to the 'fishing family' from marine discharges was calculated to be 1.08, 0.3 and 0.12 µSv y^{-1} to adults, children and infants respectively.

21.6.50 Based upon the calculated doses, the radiological impact of the potential build-up of radionuclides from discharges from the proposed HPC can be regarded as very low.

iii. HPC Assessment for Impacts on Non-human Species

21.6.51 To enable the assessment of the radiological impact on non-human species resulting from continuous discharges from HPC, four representative habitats were selected for the species they are likely to support in the vicinity of the proposed power station site:

- Habitat 1: lies adjacent to the HPC boundary, whilst it is not within a Site of Special Scientific Interest (SSSI) it is directly adjacent to Bridgwater Bay SSSI and is part of the Hinkley Point Wildlife Site.

- Habitat 2: comprises the coastal mudflats and marine habitat of the adjacent estuary and is within the boundaries of the nationally recognised Bridgwater Bay SSSI, the Severn Estuary Special Area of Conservation (SAC) and Special Protection Area (SPA) and the internationally designated Severn Estuary Ramsar site.
- Habitat 3: lies within the Bridgwater Bay National Nature Reserve and includes both shoreline and a fringing terrestrial area.
- Habitat 4: comprises a small freshwater pond and lies within Habitat 1 and hence is immediately adjacent to Bridgwater Bay SSSI.

A map describing the location of the assessed habitats is presented in **Plate 21.6**.

21.6.52 For the assessment of impacts upon marine biota from liquid radioactive discharges, by assessing the average activity concentration in a small area of sea around the discharge point the radiation exposure over a period of time for any biota present is more likely to be determined (see **Appendix 21A**). The local compartment defined for modelling HPC was used to determine concentrations in seawater and seabed sediments.

21.6.53 For the assessment of impacts from gaseous radioactive discharges, using meteorological data it was possible to calculate at specific bearings and distances from the HPC stacks the concentration in soil and air of gaseous discharged radionuclides.

21.6.54 A summary of the results of the assessment on non-human species is presented in **Plate 21.7** to **Plate 21.10**.

21.6.55 The following conclusions can be drawn from the assessments:

- Habitat 1 is adjacent to a Special Site of Scientific Interest (SSSI) and it is a habitat for bats and therefore special protection of the bats and their roosts must be considered. All of the estimated doses from HPC discharges are below the most stringent assessment level (10 µGy h^{-1}) described in Section 12.4.
- Habitat 2, as part of Bridgwater Bay, is a designated site and therefore of interest for regulatory purposes. All of the estimated doses from HPC discharges are below the most stringent assessment level (10 µGy h^{-1}) described in Section 12.4.
- Habitat 3 has some sites and habitats within it that have specific designated status and therefore are of high importance to stakeholders. However, all estimated doses from HPC discharges are below the most stringent assessment level (10 µGy h^{-1}) meaning that there would be no measurable effects on these organisms as a result of radioactivity present from radioactive discharges.
- Habitat 4 is adjacent to a SSSI or other designated site and all the estimated doses from the HPC discharges are below the most stringent assessment level (10 µGy h^{-1}).

21.6.56 Overall, the radiological impact on non-human species for discharges from the proposed development at HPC has been assessed as very low.

b) Cumulative Operational Impacts

i. Assessment of Cumulative Radiological Impact on Humans

21.6.57 The methodology used to determine the radiological impact resulting from discharges from HPA and HPB is described in Section 21.4. For HPA and HPB the assessment is based on discharges at current authorised limits rather than actual discharge values, which is a conservative assumption. In addition, the estimates of cumulative impacts assume that discharges from these facilities continue for the next 50 years and in parallel with those from the proposed HPC site, which is also a conservative assumption, since within the next 50 years HPA is planned to be decommissioned into a quiescent state known as 'care and maintenance' and HPB is planned to be shut down, defuelled and decommissioned.

21.6.58 For the purposes of assessing the cumulative impact from radiological discharges it has been assumed that the discharges from HPB during decommissioning will not increase above their current permitted limits. Any increases that could arise are likely to be limited in time to address specific activities during the decommissioning programme to reduce the hazard on site to assist in achieving the site's restoration and would need to be agreed in advance with the regulator and approved. It is expected that after initial decommissioning activities on site, HPB will enter a period of care and maintenance where there will be only low levels of radioactive effluent discharges. The main period of decommissioning activity on the HPB site will take place after this period of care and maintenance, and this is currently scheduled to take place after HPC has ceased operation. The proposals for the decommissioning of HPC means that most of the decommissioning on the HPC site are expected to be completed (with only the ISFS remaining) before HPB final site clearance work begins.

21.6.59 The discharges from HPA and HPB used for these assessments are presented in **Table 21.8** and **Table 21.9** below.

Table 21.8: Annual Gaseous Discharge Limits for HPA and HPB

Radionuclide	Annual Gaseous Discharge Limits (GBq y^{-1})	
	HPA	HPB
H-3	1,500	12,000
C-14	600	3,700
Ar-41	-	100,000
I-131	-	1.5
Co-60	-	0.1
S-35	-	350
Beta[1]	0.15	1

[1] Assumed to be Co-60 for HPA and HPB discharges

Table 21.9: Annual Liquid Discharge Limits for HPA and HPB

Radionuclide	Annual Liquid Discharge Limits (GBq y^{-1})	
	HPA	HPB
H-3	1,800	650,000[1]
Co-60	-	10
Cs-137	1,000	100
S-35	-	2,000
Other radionuclides[2]	700	80

[1] 0.025% of H-3 assumed to be discharged as Organically Bound Tritium (OBT)

[2] Assumed to be Cs-134 for HPA and HPB

ii. Cumulative Effects on the Candidate Critical Groups from the Hinkley Point Sites Discharges

21.6.60 The doses to the two Candidate Critical Groups of the farming and fishing families assumed to reside at the same locality and where maximum exposure to airborne and deposited activity from HPC gaseous discharges occurs, but due specifically to discharges from HPA and HPB, were estimated. The methodology was the same as that used to estimate doses to these two Candidate Critical Groups due to discharges from HPC.

Doses to the Farming Family Candidate Critical Group

21.6.61 The cumulative doses to the 'farming family with marine and gaseous exposure considered in the current assessments from liquid and gaseous discharges from the collective Hinkley Point Sites are given in **Table 21.10**. These cumulative doses conservatively assume all three reactor sites discharge at the authorised limits simultaneously. A breakdown of how these total cumulative doses are built up from those due to the discharges from the Hinkley Point Sites is provided in **Appendix 21A**.

Table 21.10: Cumulative Dose to the 'Farming Family with Marine and Gaseous Exposure' exposed to liquid and gaseous discharges from Hinkley Points A, B and C

Age Group	Total Predicted – Cumulative Dose μSv y^{-1}
Infant	17.2
Child	7.3
Adult	6.8

21.6.62 Overall, the infant members of the 'farming family with marine and gaseous exposure' receive the greatest dose from cumulative discharges. The dose to all age groups is dominated by contributions from the terrestrial pathways which, in the case of the infant make up 98% of the cumulative dose received. C-14 and S-35 again dominate these cumulative doses to all age groups and make up 40% and 53% respectively of that to the infant age group, through the consumption of milk and milk products.

21.6.63 The cumulative dose from all three reactor sites to all ages in the fishing family Critical Group are a fraction (less than 3%) of the site dose constraint of 500 μSv y^{-1}.

Doses to the Fishing Family Candidate Critical Group

21.6.64 The cumulative doses to the 'fishing family with marine and gaseous exposure' Candidate Critical Group considered in the assessments from liquid and gaseous discharges from the Hinkley Point Sites are given in **Table 21.11**. These cumulative doses conservatively assume all three reactor sites discharge at the authorised limits simultaneously. A breakdown of how these total cumulative doses are built up from those due to the discharges from the Hinkley Point Sites is provided in **Appendix 21A**.

Table 21.11: Cumulative Dose to the 'Fishing Family with Marine and Gaseous Exposure' exposed to Liquid and Gaseous Discharges from Hinkley Point A, B and C (the Hinkley Point Sites)

Age Group	Total predicted Cumulative Dose μSv y^{-1}
Infant	13.2
Child	6.5
Adult	7.8

21.6.65 Overall, the infant members of the 'fishing family with marine and gaseous exposure' receive the greatest dose from cumulative discharges. Although this is classed as a fishing family, the dose to all age groups is dominated by contributions from the terrestrial pathways which, in the case of the infant make up 98% of the cumulative dose received. C-14 and S-35 again dominate these cumulative doses to all age groups and make up 41% and 55% respectively of that to the infant age group, through the consumption of milk and milk products. Therefore although it is a fishing family candidate critical group, the bulk of the exposure is due to terrestrial routes.

21.6.66 The cumulative dose from the Hinkley Point Sites to all ages in the 'fishing family with marine and gaseous exposure' Critical Group are a fraction (less than 3%) of the site dose constraint of 500 μSv y^{-1}.

Critical Group for the Hinkley Point Sites from all Gaseous and Liquid Discharges

21.6.67 For both these Candidate Critical Groups, approximately half of the cumulative dose to adults and three-quarters of the cumulative dose to infants is due to the discharges from the HPB site, which is currently operating. These would therefore decrease significantly when the HPB site ceases operation, current scheduled to close in 2016 if no life extension occurs. A much smaller fraction of the cumulative dose is due to discharges from the HPA decommissioning site.

21.6.68 The highest doses due to all gaseous and liquid radioactive discharges from the Hinkley Point Sites are those to the infants in the 'farming family with marine and gaseous exposure'. This is therefore considered to be the Critical Group.

21.6.69 **Plate 21.11** shows a breakdown of the prospective cumulative doses due to liquid and gaseous discharges from the Hinkley Point Sites to each of the age groups in the Critical Group of the 'Farming Family with marine and gaseous exposure' (as a percentage of the cumulative dose for each age group). Discharges from HPA account for between about 3% to 15% of the cumulative prospective dose to the three age groups. Discharges from HPB account for between about 47 and 70% and those from HPC account for between about 26 and 40% of the cumulative prospective dose.

21.6.70 **Plate 21.12** shows that the cumulative prospective doses to the in farming family with marine and gaseous exposure Critical Group are dominated by contributions from S-35 and from C-14. S-35 makes up the bulk of the dose to the infant, whilst C-14 dominates that to the child and adult. All of the dose from S-35 is attributable to the HPB reactor site. Cumulative doses from C-14 are due mainly to HPC. Information presented earlier shows that methods to mitigate the discharges of this from the UK EPR are consistent with best international practice and subject to on-going assessments to ensure compliance with the requirements of BAT.

21.6.71 In summary, the data shows that the HPA and HPB sites make the largest contribution to the cumulative doses to all age groups for both Candidate Critical Groups. The Critical Group dose of 17.2 µSv y^{-1} from the cumulative liquid and gaseous discharges from the Hinkley Point Sites is significantly below the site constraint of 500 µSv y^{-1}.

iii. Total Dose from the Hinkley Point Sites

21.6.72 To allow comparison of the Hinkley Point Sites discharge doses with the with the Public Dose Limit from man-made sources (excluding medical sources) of 1,000 µSv y^{-1}, it is necessary to take into account historical and future discharges from HPA, HPB and HPC and future direct radiation from other facilities on the Hinkley Point Sites.

21.6.73 Retrospective Critical Group doses as a result of discharges from the existing Hinkley Point Sites are assessed annually in the RIFE reports. The highest retrospective dose in recent years was 40 µSv to seafood consumers. This dose also includes a contribution from discharges from the GE Healthcare Cardiff site, which produces H-3 and C-14 for medical research.

21.6.74 Direct radiation dose from the existing HPA and HPB stations was measured to be 4 µSv y^{-1} in 2007 in Table A4.1 of RIFE-13 (Ref. 21.61). This value is appropriate to use as the future direct radiation dose for the Hinkley Point Sites as it was determined that the direct radiation dose at the closest dwelling to HPC would be 0.0014 µSv y^{-1} and as HPA and HPB are decommissioned direct radiation doses from these facilities should reduce.

21.6.75 Summing the retrospective Critical Group dose (40 µSv to seafood consumers) with the direct radiation dose and the future exposures Critical Group dose (from 50 years of combined discharges from the Hinkley Point Sites) results in the summated dose for the site of 61 µSv. This is highly conservative and includes discharges not originating from each of the Hinkley Point Sites.

21.6.76 The total dose, including the contribution from historic discharges to the environment should be compared against the public dose limit of 1 mSv per year (Ref. 21.46). The assessed total dose of 61 µSv y^{-1} represents 6% of the public dose limit.

iv. Cumulative Collective Dose from Hinkley Point Sites Discharges

21.6.77 The collective doses to the UK, European and world populations due to gaseous and liquid discharges from the Hinkley Point Sites are presented in **Table 21.12** below.

Table 21.12: Collective Dose to the UK, European and World Populations from Hinkley Point Site Discharges

Collective Population			
	UK	Europe	World
Collective Dose (Man Sv)			
Gaseous discharges	1.9	13.5	100.3
Liquid discharges	0.025	0.2	2.2
Total Collective dose	1.9	13.7	102.5
Average per Caput Dose (nSv)			
Gaseous discharges	34.5	19.3	10
Liquid discharges	0.45	0.3	0.2
Total per caput dose	35	19.6	10.3

21.6.78 The collective dose due to liquid and gaseous discharges from the Hinkley Point Sites is dominated by carbon-14, which accounts for 74, 92 and 100% of the dose to populations of the UK, Europe and the world respectively.

21.6.79 Per caput doses from all Hinkley Point Site discharges are in the nSv y^{-1} range and thus in accordance with Environment Agency guidance (Ref. 21.46) the contribution to total doses to individuals will be insignificant. The per caput doses to the UK and European populations that are above this ‘few nSv’ range are still well below those of a ‘few µSv’ and can be considered as ‘trivial’ and well below those in the higher end of the µSv range that the Environment Agency state might require some additional consideration. Therefore, collective and per caput doses from the Hinkley Point site have been assessed as low.

v. Build-up Due to Cumulative Discharges from the Hinkley Point Sites

21.6.80 Calculated results for the soil concentration at the area off-site with the highest concentration at year 60 due to all Hinkley Point gaseous discharges to the atmosphere and the activity concentration in the sea water and seabed sediment off the coast of Hinkley Point at year 60 from all Hinkley Point Site marine discharges are presented in **Appendix 21A**.

21.6.81 Following the methodology previously outlined in this chapter, the total dose to a construction worker as a consequence of the build-up of nuclides as a result of emissions from the Hinkley Point Sites has been calculated to be 0.018 µSv y^{-1}.

21.6.82 The annual exposure due to the future use of the marine environment resulting from the cumulative discharges from the Hinkley Point Sites is likely to be associated with commercial fishing and leisure activities. Therefore the dose to members of the public from future use of the sea has been assessed as the ‘fishing family’ group. The dose due to build-up to the ‘fishing family with marine and gaseous exposure’ from all marine discharges from the Hinkley Point Sites was calculated to be 2.8, 0.67 and 0.24 µSv y^{-1} for adults, children and infants respectively. When compared against the site constraint of 500 µSv y^{-1} and the annual average UK dose exposure from all sources of 2,700 µSv y^{-1}, this has been assessed as having very low impact.

vi. Assessment of Cumulative Radiological Impact on Non-human Species

21.6.83 The biota in the freshwater habitat most affected by cumulative liquid and gaseous discharges from the Hinkley Point Sites was calculated to be insect larvae, which would experience a dose of 2.97 µGy h^{-1}. This is below the ERICA screening value of 10 µGy h^{-1} and well below the Environment Agency regulatory screening level of 40 µGy h^{-1}. All other biota and habitats are even further below the ERICA screening level.

c) Post-operational Impacts

21.6.84 As stated in Section 21.2, discharges of radioactive effluent during decommissioning of HPC are expected to be lower than those that will occur during operations. Decommissioning impacts are, therefore, bounded by the assessment undertaken for operational activities.

21.6.85 Similarly, the assessment of the cumulative future impacts from the Hinkley Point Sites includes discharges from decommissioning of each of the sites. Cumulative post-operational impacts are, therefore, bounded by the assessment undertaken for operational activities.

21.7 Mitigation of Impacts

a) Management of Radioactive Waste Using Best Available Techniques

21.7.1 The Environmental Permitting (England and Wales) Regulations 2010 (Ref. 21.20) translate the European Commission Basic Safety Standards (1996) (Ref. 21.12) into UK law and require the Environment Agency to ensure that:

> *"all exposures to ionising radiation of any member of the public and of the population as a whole resulting from the disposal of radioactive waste are kept as low as reasonably achievable, taking into account economic and social factors."*

21.7.2 BAT is a term defined in the OSPAR Convention (Ref. 21.68) and Directive 2008/1/EC on Integrated Pollution Prevention and Control (IPPC) (Ref.21.69). These definitions are essentially the same. They state that:

> *"Best available techniques shall mean the most effective and advanced stage in the development of activities and their methods of operation which indicate the practical suitability of particular techniques for providing in principle the basis for emission limit values designed to prevent and, where that is not practicable, generally to reduce emissions and the impact on the environment as a whole, special consideration shall be given to:*
>
> *a) comparable processes, facilities or methods of operation which have recently been successfully tried out;*
>
> *b) technological advances and changes in scientific knowledge and understanding;*
>
> *c) the economic feasibility of such techniques;*
>
> *d) time limits for installation in both new and existing plants;*

e) the nature and volume of the discharges and emissions concerned.

'techniques' shall include both the technology used and the way in which the installation is designed, built, maintained, managed, operated and decommissioned,

'available' techniques shall mean those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator,

'best' shall mean most effective in achieving a high general level of protection of the environment as a whole."

21.7.3 BAT is the means by which an operator optimises the operation of a practice in order to reduce and keep exposures from the disposal of radioactive waste into the environment as low as reasonably achievable (ALARA), economic and social factors being taken into consideration. Those techniques which represent BAT are also taken to have met the requirements of optimisation and ALARA. This means that if further reductions in exposure are reasonably practicable then they should be implemented.

21.7.4 This approach is reinforced by the relevant regulatory requirements, and it means that sites will operate at levels considerably below the prescribed dose limits.

21.7.5 The environmental permit granted under the Environmental Permitting (England and Wales) Regulations 2010 (Ref. 21.20) would include specific conditions to address this legal requirement. BAT is required to optimise performance, taking into account the broad range of factors indicated above to prevent, or where this is not possible, minimise the:

- activity in the radioactive waste produced;
- activity discharged in gaseous and aqueous effluents;
- volume of solid waste produced; and
- risks and environmental impacts of discharges and disposals.

21.7.6 As part of the Generic Design Assessment (GDA) of candidate nuclear power plant designs in the UK, the Environment Agency has published a Process and Information Document (PID) (Ref. 21.37) for requesting parties to provide an evaluation of options considered in the design of their nuclear power plants. The analysis should include an evaluation of abatement options and show that the Best Available Techniques (BAT) will be used to minimise the production and discharge or disposal of waste.

21.7.7 As part of the GDA for the UK EPR, the use of BAT for abatement of discharges has already been discussed and further developed in relevant sections of the Pre-Construction Environmental Report (Ref. 21.70). Demonstrating the application of BAT remains an on-going consideration throughout the rest of the design, operational and eventually the decommissioning phases of the UK EPR. The demonstration of environmental optimisation is a key element of the environmental permit submission (Ref. 21.71).

21.7.8 Permits are only granted after a rigorous assessment process which includes the prospective assessment of the impacts on the public and non-human species. The prospective assessments are determined using modelling because it is not practicable to measure the exposure directly and it is essential that it can be shown that any doses received would be below regulatory guidelines and ALARA.

21.7.9 The fundamental aim in the application of BAT is to prevent and, where that is not practicable, minimise waste generation and discharges to the environment. There is no lower limit on doses below which the general requirement for optimisation does not apply. DECC and the Welsh Assembly Government (Ref. 21.35) have issued Statutory Guidance to the Environment Agency for England and Wales which includes the provision that, *"where the prospective dose to the most exposed group of members of the public is below 10 µSv y^{-1} from overall discharges… the Environment Agency should not seek to reduce further the discharge limits in place, provided that the holder of the authorisation applies and continues to apply BAT"*.

21.7.10 A permit for the disposal of radioactive effluents and waste from the proposed new development at HPC has been applied for separately from the DCO application. The information that supports the permit application demonstrates the application of environmental optimisation in the design and management of the plant through the application of BAT. The permit requires the 'environment case' that supports the application of BAT to be maintained, reviewed and updated (Ref. 21.71).

21.7.11 BAT is not merely concerned with abatement and other end-of-pipe controls. It applies across the whole lifecycle of the plant from design, through procurement, construction, commissioning, operation and decommissioning.

21.7.12 BAT also applies to the operation, maintenance, testing, calibration, sampling, measuring and analysis of relevant plant, systems and equipment. It also relates to the procedures and management systems that may impact on environmental performance.

21.7.13 The fundamental design of the reactor circuit, the material composition of components in the reactor circuit that could produce radioactivity by neutron activation and the management arrangements for the control of reactor circuit chemistry will all minimise the production of radioactivity at source. BAT applies not only to the design but also how it is constructed, commissioned, operated and, ultimately decommissioned. BAT applies to the technology and the way they technology is managed and implemented.

b) Overall Minimisation of Liquid Radioactive Discharges

21.7.14 The minimisation of radioactive isotopes in liquid discharges from the UK EPR and the reduction in overall radiological impact from the site centres on the design and management features, details of which are built on the information presented in the PCER (Ref. 21.70) and are further detailed in the RSR Environmental Permit Submission (Ref. 21.71) but are also summarised below:

- Minimisation at source. This includes ensuring the leak-tightness of the fuel pins to minimise release of tritium and other fission products such as iodine into the reactor coolant, and controlling the pH of the coolant to minimise corrosion effects that could give rise to activation products such as Co-60.

- Recycling and re-use of liquids (where practicable) in the reactor systems, to reduce the overall volume and activity of liquid requiring treatment and disposal.
- Partitioning of radionuclides (where practicable) for disposal in the manner which causes the least environmental impact.
- Optimisation of the dispersion of the cooling water by the design of the cooling water outfall, which will minimise the impacts associated with liquid radioactive discharges.
- Treatment of discharges using combinations of filters, ion exchange resins and evaporators that remove activity from the effluents, concentrating and containing them into more compact and easily managed solid waste forms and allow, as far as reasonably possible, recycling of the treated liquid effluents.

c) Overall Minimisation of Gaseous Radioactive Discharges

21.7.15 The minimisation of radioactivity in gaseous discharges from each UK EPR unit centres on the following design and management features. Further details which are built on the information in the PCER (Ref. 21.70) and which are presented in the RSR Environmental Permit Submission (Ref. 21.71) but are also summarised below include:

- Minimisation at source. The minimisation of gaseous activity at source relies on the same basic principles as for the liquids, especially maintaining the leak-tightness of the fuel pins since this is the main source of gaseous and volatile fission products in gaseous effluent streams. Safety considerations are also taken into account in the application of BAT - for example, the nitrogen blanket is used in the chemical and volume control system increases the production and discharge of carbon-14 discharge from the site, but it is a much safer blanketing gas than hydrogen which has been used in other pressurised water reactor designs.
- Recirculation and recycling of gases (where practicable).
- Partitioning of radionuclides (where practicable) for disposal in the manner which causes the least environmental impact.
- Optimisation of the dispersion of the gaseous effluent by the design of the discharge stacks to minimise the impact of radioactive gaseous discharges.
- Treatment of gaseous effluents using charcoal adsorption plant that permits radioactive decay of short half-life isotopes, and filters and catalytic recombination units that remove radioactivity from the effluents, concentrating and containing it into more compact and easily managed solid waste forms.

21.7.16 In the UK EPR, the design and operation of the heating, ventilation and air conditioning systems that extract air from potentially active areas throughout the plant follows a common approach based on currently accepted international methods used in all nuclear facilities. This minimises the risk of elevated radioactive gaseous discharges by ensuring all contaminated air is processed using the techniques noted above.

d) Mitigation for Specific Radioactive Isotopes

21.7.17 From the site-specific assessments described in this chapter, it has been shown that doses to the most exposed members of the local population from the operation of HPC from radioactive discharges are below the 10 µSv y^{-1} criterion below which the Environment Agency will not pursue further reductions in discharge limits as long as BAT continues to be applied (Ref. 21.35). The majority of the doses (approximately 90%) arise from discharges of the radioactive isotopes carbon-14 (C-14) and tritium (approximately 3%). For infants, and to a lesser extent children, iodine contributes between 7 and 3% of their does. Consequently the mitigation measures for these radionuclides are discussed in more detail below.

i. Carbon-14

21.7.18 C-14 in discharges from a PWR occurs in liquids and gases. It is assumed that 80 % of the discharges are as methane ($^{14}CH_4$), and 20 % as carbon dioxide ($^{14}CO_2$) (except for the purposes of dose calculations where a more conservative assumption is assessed). In the UK EPR, C-14 is minimised at source as far as possible by improved utilisation of the reactor fuel, which reduces the amounts of C-14 produced per unit of electrical energy produced. Some increased C-14 production in the UK EPR arises from the use of a nitrogen cover gas in one of the coolant processing tanks attached to the reactor circuit, the Volume Control Tank (VCT), but as noted above this has been implemented to avoid the more routine use of hydrogen that would otherwise present a flammability hazard in this part of the plant.

21.7.19 Within the various primary coolant and liquid effluent processing systems, degasification of liquids assists in the partitioning of C-14 into the gaseous effluent route and the majority of the C-14 is discharged in gases, with only a small proportion being in liquid or solid waste forms. Discharges of carbon-14 in gaseous form generally have a lower radiological impact than those discharged in liquid form.

21.7.20 As part of the overall design philosophy for the UK EPR, an extensive assessment of potential methods for the abatement of C-14 in liquids and gases has been carried out, including reference to IAEA Technical Report 421 (Ref. 21.72). None of these methods are currently used on operational power reactors and some are not technically feasible on a PWR. This is consistent with the conclusion drawn in the Environment Agency Draft Decision Document on the GDA (Ref. 21.43).

21.7.21 Overall, the design of the EPR represents the application of BAT with respect to discharges of C-14, and thus the potential radiological impact from discharges of C-14, provided levels of dissolved nitrogen in the primary coolant (the main avoidable source of this nuclide) are optimised.

ii. Tritium

21.7.22 Tritium makes up the bulk of the total radioactivity discharged in liquids and is about 10% of the total activity discharged in gases from HPC. However, it only makes a small contribution to the overall radiological impact due to discharges from HPC. In liquid discharges from the UK EPR, the majority of the tritium is present as tritiated water and in gases it is present as tritiated water vapour.

21.7.23 In the UK EPR, the generation and release of tritium is minimised at source by a number of measures including the use of Zircalloy M5 fuel cladding which retains the bulk of the tritium formed by fission in the fuel, and the optimisation of boron and lithium concentrations. This includes the use of enriched boron and depleted lithium, combined with the use of burnable poisons in some fuel rods (including avoidance of boron and use of gadolinium) and reducing the beryllium content in the secondary neutron sources.

21.7.24 The recombination unit may help to ensure that tritium in the purge gas in the gaseous effluent treatment system is returned to and retained in the liquid phase, although to date this effect has not been quantified. The majority of tritium is discharged into the environment in liquid discharges. Discharge of tritium in liquid form has a lower radiological impact than the discharge of tritium in gaseous effluent.

21.7.25 As part of the overall design philosophy for the UK EPR, an extensive assessment of potential methods for the abatement of tritium in liquids and gases has been carried out, including reference to IAEA Technical Report 421 (Ref. 21.72).

21.7.26 The overall conclusion is that that the containment and minimisation at source implemented in the UK EPR represents the BAT for this radioactive isotope. This is consistent with the conclusion drawn in the Environment Agency Draft Decision Document on the GDA (Ref. 21.43). The final discharges of tritium have a low radiological impact and are a small fraction of the overall site radiological impact, which has been assessed as very low.

iii. Iodine

21.7.27 Isotopes of radioactive iodine have a relatively short half-life, ranging up to 8 days for iodine-131 (the most significant isotopes of iodine from a dose assessment perspective). Isotopes of iodine are fission products and are largely contained within the fuel by the fuel cladding. Very small quantities of iodine can transfer into the reactor coolant by passing through minute defects in the fuel cladding. Alternatively if there is any contamination on the outside of the fuel this can result in the generation of isotopes of iodine.

21.7.28 The high-quality manufacturing and inspection of fuel is therefore a very important stage in minimising the amount of radioactive iodine that occurs in the reactor coolant. However, once generated iodine is generally retained in the liquid phase. Any isotopes of iodine that are found in the gaseous effluents are effectively abated through the use of charcoal adsorption plant which delay the gaseous effluent long enough for the majority of the radioactivity to decay. Isotopes of iodine are also retained in the iodine traps installed in the building ventilation circuits (these iodine traps are brought into service as required).

21.7.29 Due to the treatment and recycling of primary effluents most isotopes of iodine decay within the primary system and therefore are not discharged. Effluents that do contain isotopes of iodine are treated with abatement systems, including ion exchange resins which effectively remove the activity from the liquid effluent.

e) Mitigation for Direct Radiation and Transport

21.7.30 Doses from direct radiation ‘shine’ to members of the public from the storage of ILW or ISFS on the HPC site have been assessed as very low. Ensuring that these radiation exposures remain ALARA will be by:

- engineering controls, such as the design of the buildings to optimise the thickness of radiation shielding; and
- administrative controls, such as the routine monitoring of the externals of the building to verify that the external radiation doserate is suitable for the area around the building to be 'undesignated'.

21.7.31 Estimated doses to members of the public from the transport of radioactive materials to and from the proposed HPC site are dominated by the transport of spent fuel. As noted in Section 12.5, this was based on the assumption in the assessment that the spent fuel would require movement off-site. Whilst this predicted annual dose is negligible (up to 2 µSv y^{-1}) doses will be mitigated by retaining an on-site ISFS, as is currently described in **Chapters 6** and **7** of this volume.

21.8 Residual Impacts

21.8.1 As described in section 21.2 there will be no radiological impacts associated with construction, and discharges from commissioning of HPC will be no greater than those expected during operations. It has also been assumed that techniques employed to mitigate impacts will be operating during commissioning.

21.8.2 The UK EPR is an evolutionary design which has been developed taking advantage of operational feedback and the wide experience of the EDF Group and AREVA NP. The design and operation of the UK EPR will ensure that the formation of solid radioactive waste (in terms of volume and activity) and the discharge of liquid and gaseous effluents per unit generation of electricity is amongst the best performing compared with current operating PWR plants.

21.8.3 The following overarching goals were included in the design optimisation:

- minimise the generation of radioactive effluents and wastes at source;
- select the best materials of construction to minimise the generation and transfer or wastes, including the design of fuel;
- reduction and control of tritium liquid discharges;
- reduction and control of C-14 liquid discharges;
- reduction of discharges of other radionuclides;
- maximum recycling of boron (used in the primary circuit coolant);
- optimisation of the primary circuit coolant quality (that can affect discharges); and
- overall reduction of chemical discharges.

21.8.4 This chapter has outlined the radiological assessments that have been undertaken for the impact associated with the construction and routine operation of the HPC Power Station and the cumulative radiological impacts due to this new facility and the existing HPA and HPB sites. The receptor groups, details and the overall outcomes of the assessment for the planned development are summarised in subsequent paragraphs.

21.8.5 The dose to the most exposed person from radioactive discharges from HPC and therefore considered to represent the Critical Group, with a calculated dose of

4.5 µSv y^{-1}, was infant members of the 'farming family with marine and gaseous exposure'. This dose can be compared with the average dose to the UK population of 2,700 µSv y^{-1} from all sources of radioactivity (Ref. 21.48).

21.8.6 The Critical Group dose from discharges and direct radiation from HPC was calculated as 4.5 µSv y^{-1}. This Critical Group dose is compared against the source constraint (300 µSv y^{-1}) and represents 1.5% of the value.

21.8.7 All individual doses from HPC from continuous or short-term discharges and direct radiation are considered to be very low and below the Statutory Guidance dose constraint of 10 µSv y^{-1} below which progressive reductions in discharges will not be pursued as long as the application of BAT can be demonstrated (Ref. 21.35).

21.8.8 Collective doses, resulting from HPC discharges, to populations of the UK, Europe and the world truncated at 500 years have been calculated (Ref. 21.46). A more informative presentation of this data is in the form of per caput doses, which provide an estimate of the average dose to individual members of a given population. The 'per caput' dose from all discharges from HPC to the UK population was calculated to be less than seven nano-sieverts per year. The Health Protection Agency has stated that discharges giving rise to per caput doses of less than a few nano-sieverts per year of discharge can be regarded as "*minuscule*" (Ref. 21.46).

21.8.9 The freshwater habitat represented the most affected based on estimated dose rates for non-human species. The species most affected was calculated to be insect larvae, which would experience a dose rate of less than 3 µGy h^{-1}. This is below the default screening value of 10 µGy h^{-1} and well below the Environment Agency biota dose screening values listed in Section 21.4.

21.8.10 The highest estimated annual dose to an individual (2 µSv y^{-1}) due to transport of radioactive materials from HPC is associated with the transport of spent fuel. This value can be compared to the dose limit for members of the pubic from the Ionising Radiations Regulations 1999 of 1,000 µSv y^{-1} which is applicable to transport operations (Ref. 21.18). It should be noted that the ISFS is proposed to be on the HPC site so this estimated dose is conservative.

21.8.11 The combined impacts of discharges from the Hinkley Point Sites, including gaseous and liquid effluents are compared against the site dose constraint of 500 µSv y^{-1}. The highest dose (17.2 µSv y^{-1}) represents less than 3.5% of the site constraint.

21.8.12 The assessments all show that, when judged against a range of stringent internationally agreed criteria on the Radiological Protection of Human and Non-human species, the assessed impacts from radioactive liquid and gaseous discharges from HPC and other impacts due to site operations such as waste storage and transport are all considered negligible without additional mitigation being required over and above that already contained in the current design. Therefore, the residual impacts remain very low and a small percentage of the relevant dose limits and constraints.

Plate 21.6: Map showing the Habitats Around HPC

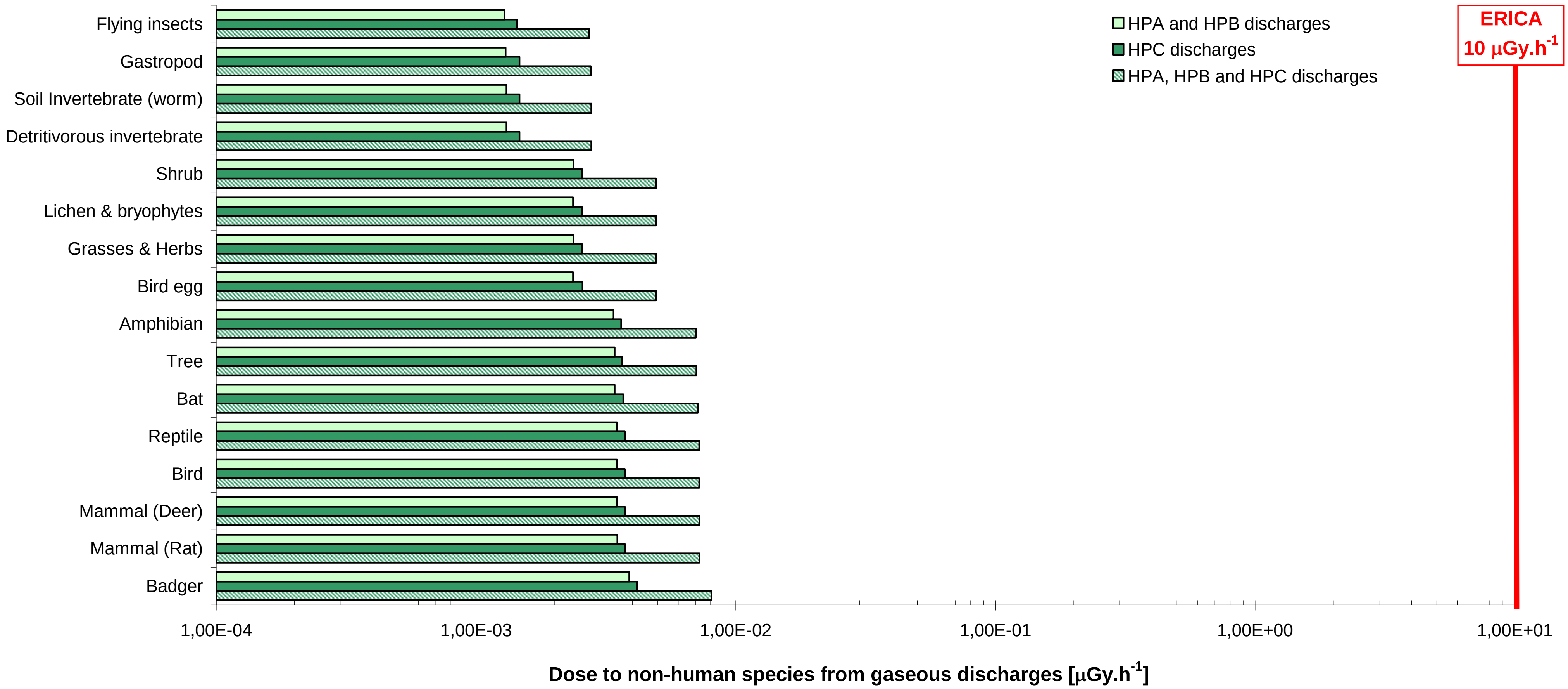
Habitat 1 – Terrestrial habitat

Habitat 2 – Marine habitat

Habitat 3 – Coastal habitat

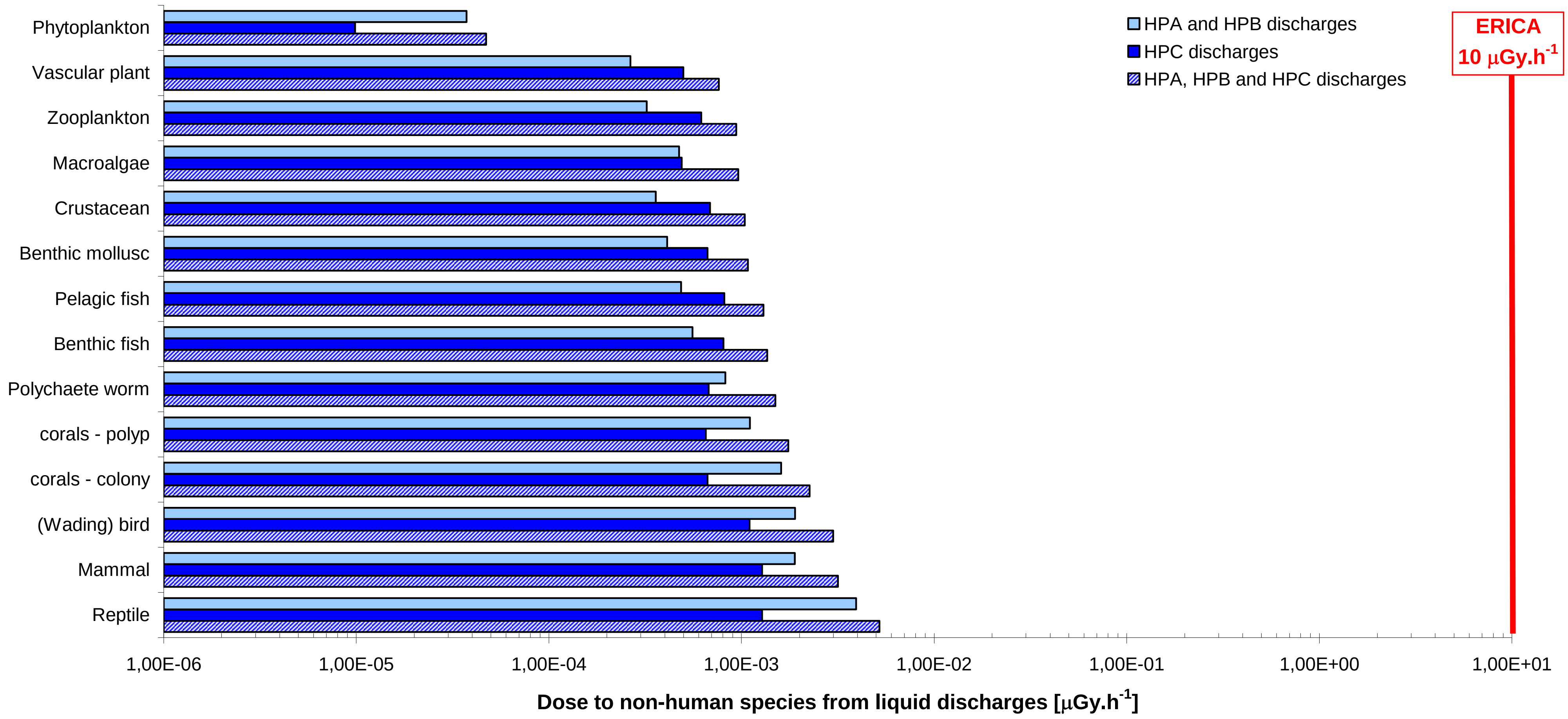
Habitat 4 – Freshwater habitat

Plate 21.7: Habitat 1 - Dose to Non-human Species Resulting from Gaseous Discharges



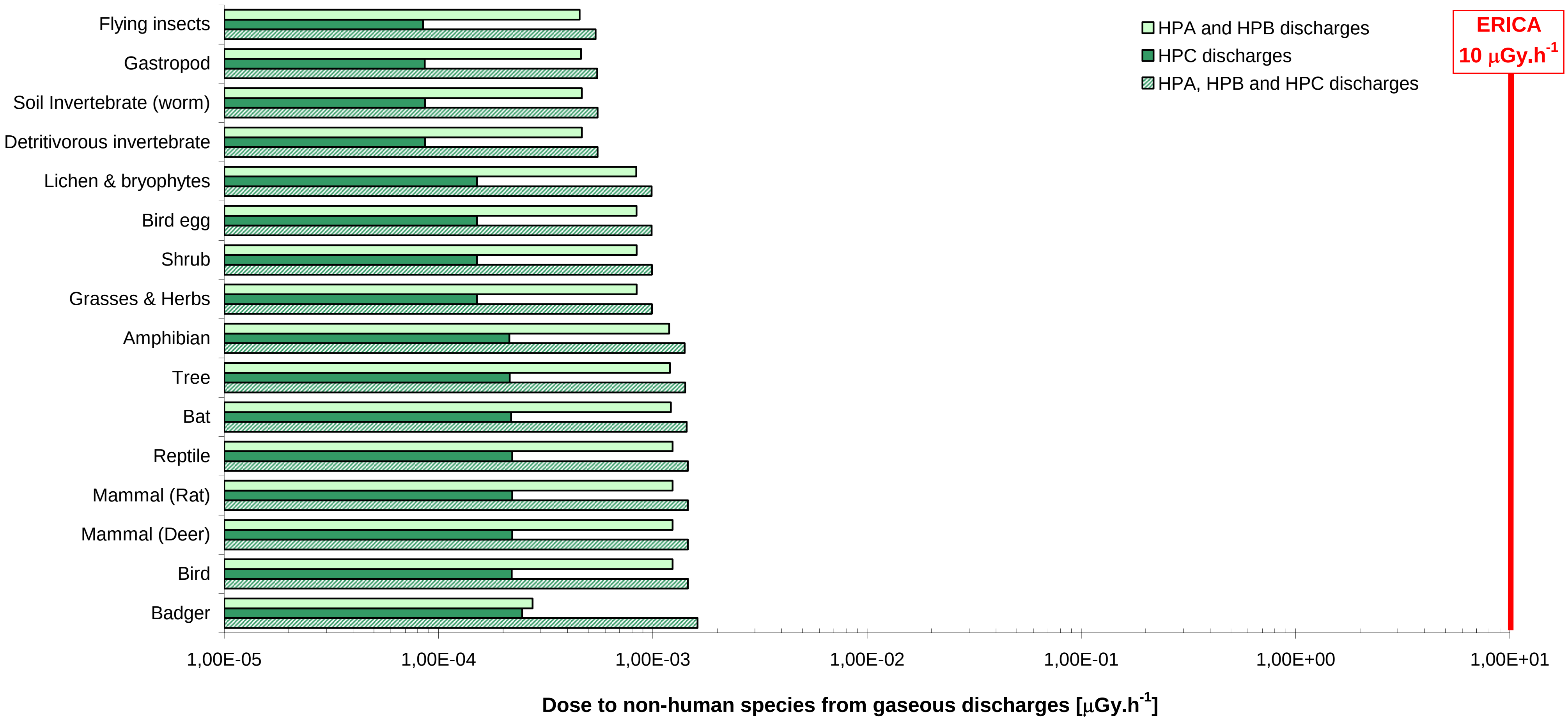
Note: A log scale is used and the Environment Agency threshold value of 40 μGy h^{-1} is beyond the ERICA screening value presented on the graph

Plate 21.8: Habitats 2 and 3 - Dose to Non-human Species Resulting from Liquid Discharges



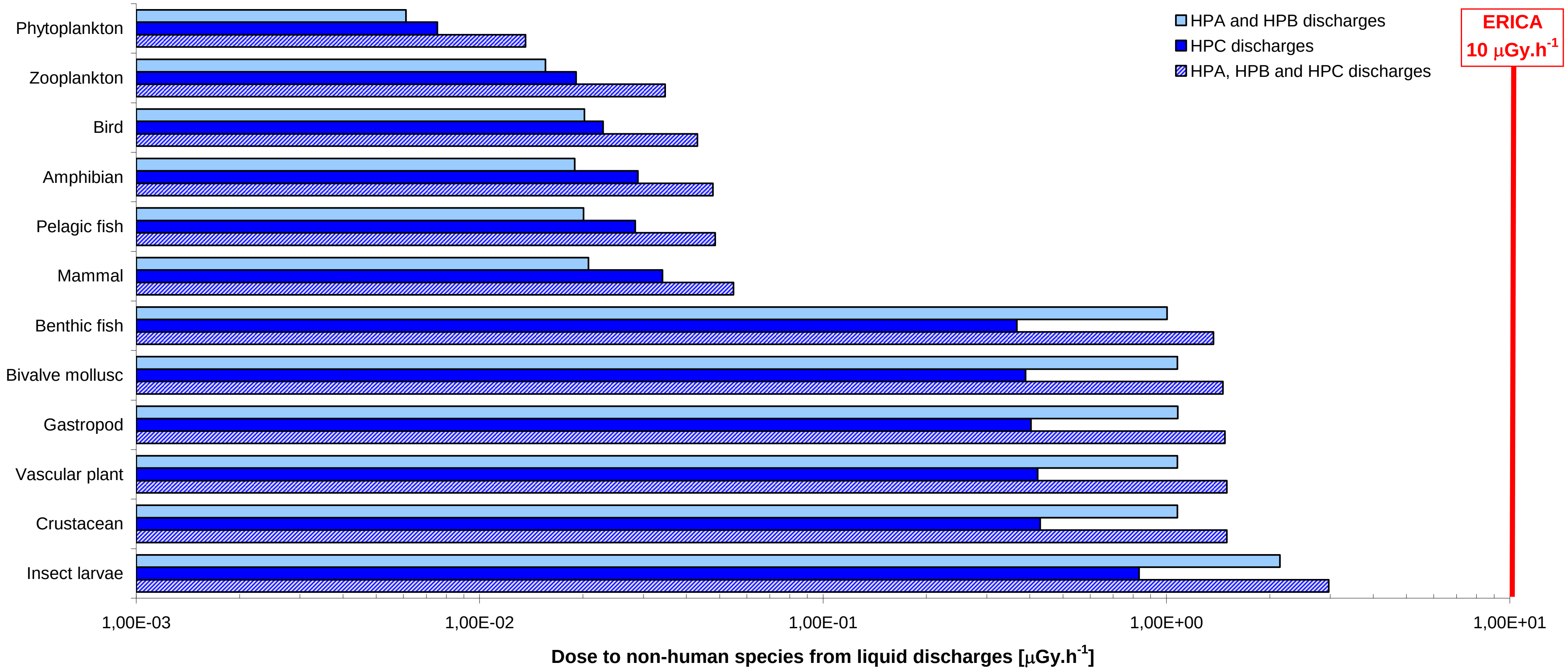
Note: A log scale is used and the Environment Agency threshold value of 40 µGy h^{-1} is beyond the ERICA screening value presented on the graph

Plate 21.9: Habitat 3 - Dose to non-human Species Resulting from Gaseous Discharges



Note: A log scale is used and the Environment Agency threshold value of 40 μGy h^{-1} is beyond the ERICA screening value presented on the graph

Plate 21.10: Habitat 4 - Dose to Non-human Species Resulting from Liquid Discharges



Note: A log scale is used and the Environment Agency threshold value of 40 μGy h^{-1} is beyond the ERICA screening value presented on the graph

Plate 21.11: Breakdown of the Prospective Cumulative Doses Due to Liquid and Gaseous Discharges from the Hinkley Point Sites to Each of the Age Groups in the Critical Group of the 'Farming Family with Marine and Gaseous Exposure' (as a Percentage of the Cumulative Dose for Each Age Group)

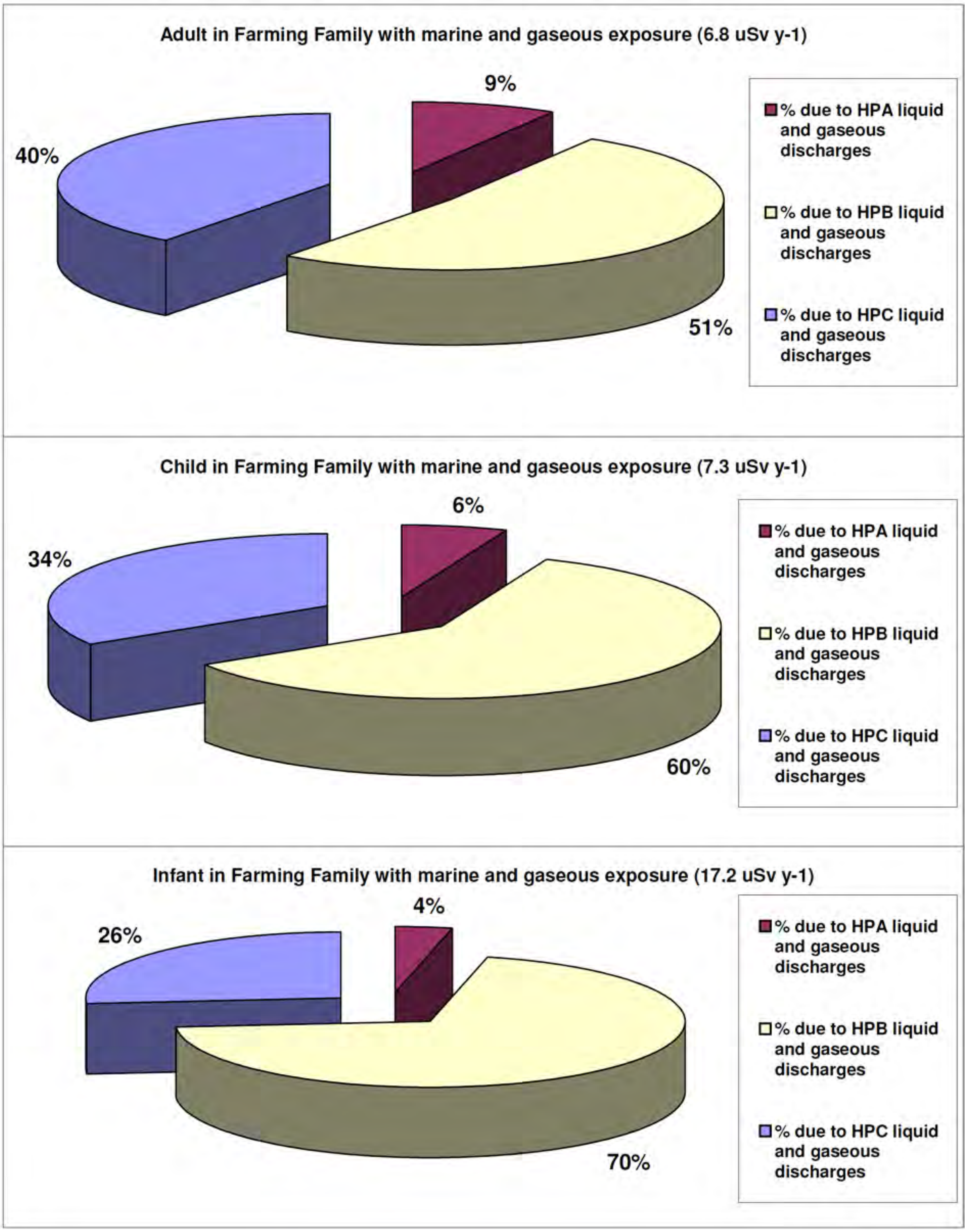
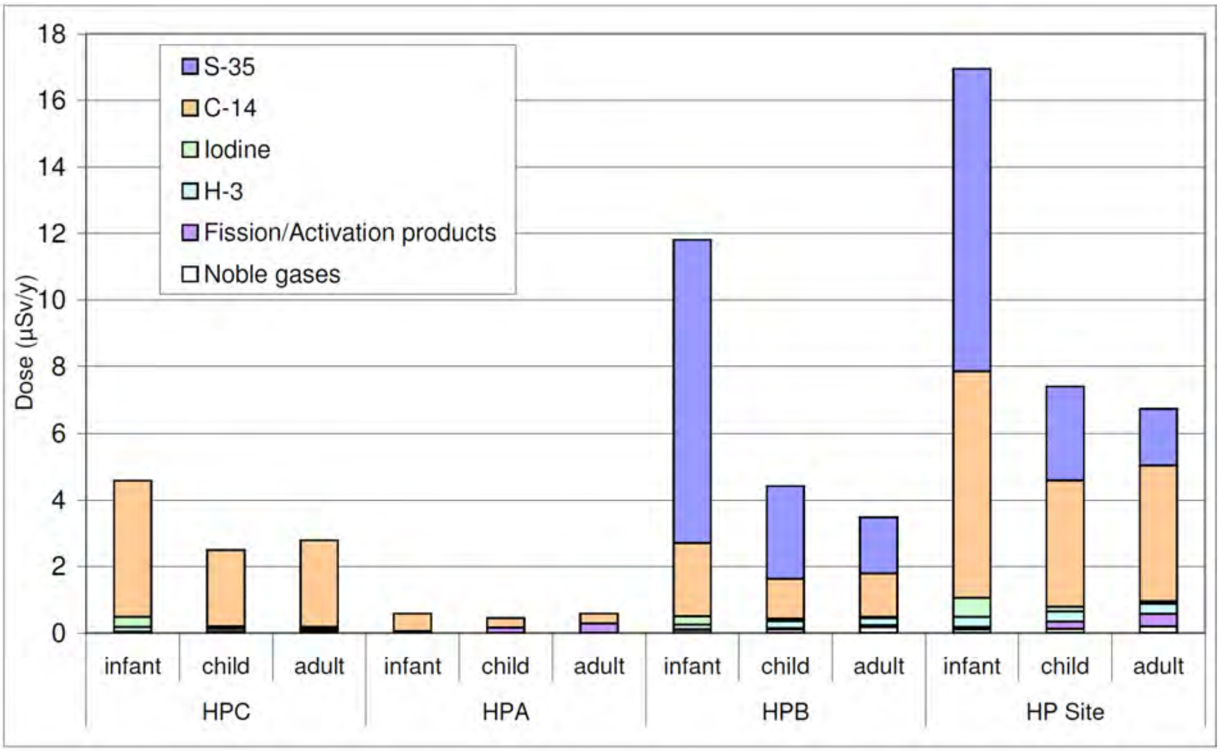


Plate 21.12: Breakdown of Annual Dose by Radionuclide to Farming Family with Marine and Gaseous Critical Group for Hinkley Point Site



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CHAPTER 22: LANDSCAPE AND VISUAL

CONTENTS

TABLES

FIGURES

APPENDICES

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22. LANDSCAPE AND VISUAL

22.1 Introduction

22.1.1 This chapter of the Environmental Statement (ES) provides an assessment of the potential landscape and visual impacts associated with the construction and operation of the proposed Hinkley Point C (HPC), the on-site campus accommodation, associated leisure facilities, temporary jetty and the National Grid substation (together referred to as the HPC proposed development). Consideration is also given to the HPC highway improvement works off-site which also form part of the project.

22.1.2 A detailed description of the proposed development is provided in **Chapter 2** of this volume. The construction and operation of HPC is described in **Chapter 3** and **Chapter 4** of this volume, respectively. A summary of issues arising from construction and operation of the HPC proposed development and associated off-site HPC highway improvement works relevant to the assessment of landscape and visual impacts is presented in Section 22.6 of this chapter. A site location plan is shown on **Figure 22.1**.

22.2 Scope and Objectives of Assessment

22.2.1 The scope of this assessment has been determined through a formal Environmental Impact Assessment (EIA) scoping process undertaken with the Infrastructure Planning Commission (IPC) and informed by consultation with statutory consultees, including English Heritage, Natural England, Exmoor National Park Authority, and West Somerset Council (WSC), Sedgemoor District Council (SDC) and Somerset County Council (SCC) as the relevant authorities. Consideration has also been given to comments from non-statutory consultees including the Quantock Hills AONB Service, local residents and members of the general public, notably in response to the Stage 1, Stage 2, Stage 2 Update and M5 Junction 24 and Highway Improvements consultations.

22.2.2 Specifically, this chapter addresses the following:

- landscape planning context for the project including a review of the key designations and the planning policies relevant to the proposed development;
- landscape character and condition of the site and its relationship with the surrounding area;
- visual prominence of the proposed development within the surrounding landscape and the identification of representative visual receptors;
- the significance of the impacts arising from the HPC proposed development on landscape character and landscape elements and features within the HPC development site boundary;
- the significance of the impacts arising from the HPC proposed development on representative visual receptors from locations within the short, middle and long distance during the day and under night time conditions; and

- the significance of impacts on landscape and representative visual receptors arising from the associated off-site highway improvement works.

22.2.3 This chapter has influenced and has been informed by terrestrial ecology and ornithology (**Chapter 20** of this volume), historic environment (**Chapter 23** of this volume), amenity and recreation (**Chapter 25** of this volume) and transport matters (**Chapter 10** of this volume) due to the strong inter-relationship between these topics with landscape and visual issues. Further topic specific baseline information is included in these chapters.

22.2.4 The assessment of landscape and visual impacts has been undertaken adopting the methodologies described in section 22.4.

22.2.5 The existing baseline conditions, against which the landscape and visual impacts of the HPC proposed development and associated off-site highway improvement works are assessed, have been determined through a desk-based assessment, field surveys and modelling, and are described in section 22.5. The assessment of landscape and visual impacts is presented in section 22.6 and assumes that proposed mitigation located within the HPC development site is embodied in the project. Section 22.7 describes the proposed landscape mitigation, including off-site landscaping and a temporary screening bund along the north-western boundary during construction. An assessment of residual impacts is presented in section 22.8. Section 22.9 provides a summary of landscape and visual impacts assessed in this chapter.

22.2.6 An assessment of the landscape and visual impacts arising from HPC off-site associated development is presented in separate ES chapters. Cumulative impacts relating to landscape and visual matters arising from the HPC proposed development in combination with other elements of the HPC project and other relevant plans and projects are identified and assessed in **Volume 11** of this ES.

22.3 Legislation, Policy and Guidance

22.3.1 Guidelines for Landscape and Visual Assessment (GLVIA) produced by the Landscape Institute (LI) and Institute of Environmental Management and Assessment (IEMA) (Ref. 22.1) states that

> *"It is important for landscape assessments to consider the ecological, historical or cultural associations that contribute to the character and importance of a landscape."*
>
> and,
>
> *"planning policies for nature conservation and landscape are generally linked through a common approach to land use… there are also numerous interrelationships between landscape and cultural heritage and it is important that these links are not overlooked."*

22.3.2 In accordance with best practice guidance, this assessment takes into account legislation and policy relevant to landscape and visual amenity, ecology and cultural heritage. Reference should also be made to **Chapter 20** of this volume (terrestrial ecology and ornithology) and **Chapter 23** of this volume (historic environment) for details on specific heritage and biodiversity policy.

22.3.3 This section reviews relevant European and national legislation and policy, as well as guidance from Natural England and published materials prepared by statutory and non-statutory bodies, such as Exmoor National Park authority and the Quantock Hills AONB Service.

22.3.4 The overall legislative and planning policy context for the HPC project is set out in **Volume 1 Chapter 4**.

a) International Legislation

i. European Landscape Convention (Ref. 22.2)

22.3.5 The European Landscape Convention (ELC), which was signed by the UK in February 2006 and became binding in 2007, is the first international convention to focus specifically on landscape issues and aims to protect, manage and plan landscapes in Europe. The ELC defines landscape as:

> *"An area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors."*

b) UK Legislation

i. National Parks and Access to the Countryside Act 1949 as amended by the Environment Act 1995 (Ref. 22.3)

22.3.6 The National Parks and Access to the Countryside Act provides for the designation of National Parks to conserve and enhance their natural beauty, wildlife and cultural heritage and promote opportunities for the understanding and enjoyment of the special qualities of those areas by the public. References in the Act to the preservation or the conservation of the natural beauty of an area are to be construed as including references to the preservation or, as the case may be, the conservation of its flora, fauna and geological and physiographical features.

22.3.7 Areas of Outstanding Natural Beauty (AONB) are designated under the provisions of the 1949 National Parks and Access to the Countryside Act, in order to secure their permanent protection against development that would damage their special qualities. AONBs are designated solely for their landscape qualities, for the purpose of conserving and enhancing their natural beauty.

ii. Countryside and Rights of Way (CRoW) Act 2000 (Ref. 22.4)

22.3.8 The CRoW Act provides a statutory framework for AONBs, provides further measures to protect the AONBs, and clarifies the role of local authorities which now includes the preparation of management plans to set out how they will care for their AONBs.

iii. Hedgerow Regulations 1997 (Ref. 22.5)

22.3.9 The Hedgerow Regulations aim to protect hedgerows, which play an important role in supporting and enhancing biodiversity, as well as defining the character of the English countryside.

22.3.10 According to the regulations, a hedgerow is important if it has existed for 30 years or more and it satisfies various wildlife, landscape or historical criteria specified in the regulations.

iv. Ancient Monuments and Archaeological Areas Act 1979 (Ref. 22.6)

22.3.11 Scheduled Monuments are designated under the Ancient Monuments and Archaeological Areas Act for archaeological sites or historic buildings that are considered to be of national importance by English Heritage. They are given protection against unauthorised change including changes to their visual setting.

c) National Planning Policy

i. Overarching National Policy Statement for Energy (EN-1) (Ref. 22.7)

22.3.12 The overarching National Policy Statement (NPS) for Energy (EN-1) sets out national policy for energy infrastructure. The policy, together with the relevant technology-specific NPS, effects decisions by the Infrastructure Planning Committee (IPC) on applications for energy developments that fall within the scope of the NPSs.

22.3.13 Part 4 of EN-1 titled 'Assessment Principles' sets out the key principles for examining and determining applications for energy infrastructure. In relation to good design, EN-1 states in paragraph 4.5.1 that *"applying 'good design' to energy projects should produce sustainable infrastructure sensitive to place, efficient in the use of natural resources and energy used in their construction and operation, matched by an appearance that demonstrates good aesthetic as far as possible"*. However, it is acknowledged that the nature of much of the infrastructure development will often limit the extent to which it can contribute to the enhancement of the quality of the area.

22.3.14 In relation to landscape and visual impacts, EN-1 specifies that *"applicants should carry out a landscape and visual assessment and report it in the ES"*, adding that it should *"include reference to any landscape character assessment and associated studies as a means of assessing landscape impacts relevant to the proposed project… [and] …also take account of any relevant policies based on these assessments in local development documents…"*. EN-1 adds that *"the applicants' assessment should include the effects during construction of the project and the effects of the completed development and its operation on landscape components and landscape character"*. It should be noted that EN-1 Specifies that *"in this context, references to landscape should be taken as covering seascape and townscape where appropriate."*

22.3.15 It acknowledges that *"Virtually all nationally significant infrastructure projects will have effects on the landscape. Projects need to be designed carefully, taking account of the potential impacts on the landscape. Having regard to siting, operational and other relevant constraints the aim should be to minimise harm to the landscape, providing reasonable mitigation where possible and appropriate."*

22.3.16 Reference is made to development within nationally designated landscape, noting in particular that:

> *"National Parks, the Broads and AONBs have been confirmed by the Government as having the highest status of protection in relation to landscape and scenic beauty. Each of these designated areas has specific statutory purposes which help ensure their continued protection and which the IPC should have regard to in its decisions. The conservation of the natural beauty of the landscape and countryside should be given*

substantial weight by the IPC in deciding on applications for development consent in these areas.

Nevertheless, the IPC may grant development consent in these areas in exceptional circumstances. The development should be demonstrated to be in the public interest and consideration of such applications should include an assessment of:

- *The need for the development, including in terms of national considerations, and the impact of consenting or not consenting it upon the local economy;*
- *the cost of, and scope for, developing elsewhere outside the designated area or meeting the need for it in some other way, taking account of the policy on the alternatives set out in Section 4.4; and*
- *any detrimental effect on the environment, the landscape and recreational opportunities, and the extent to which that could be moderated.*

The IPC should ensure that any projects consented in these designated areas should be carried out to high environmental standards, including the application of appropriate requirements where necessary."

22.3.17 It should be noted that the HPC development site is not located within an AONB designation. The nearest AONB, Quantock Hills, is located approximately 3.7km south west of the HPC development site boundary.

ii. National Policy Statement for Nuclear Power Generation (EN-6) (Ref. 22.8)

22.3.18 The National Policy Statement (NPS) for Nuclear Power Generation (EN-6), together with the overarching NPS for Energy (EN-1) provides the primary basis for decisions taken by the IPC on applications for nuclear power stations.

22.3.19 All of the NPSs have been subject to an Appraisal of Sustainability (AoS). EN-6 reports that: *"possible significant adverse effects on nationally important nature conservation sites and designated landscapes were identified by the Nuclear AoS"*, adding that *"further studies will need to be carried out, as part of the project EIA process for individual development consent applications, to determine significance of the effects and the effectiveness of any mitigation measures."*

22.3.20 EN-6 re-emphasises EN1 by noting the need for the consideration of good design. It states that the *"IPC should consider how good design can act to mitigate the impacts of nuclear power stations, such as landscape and visual impacts."*

22.3.21 Part 4 of the NPS identifies the potentially suitable sites for the development of nuclear power stations in England and Wales before the end of 2025. Hinkley Point is one of the eight sites identified.

22.3.22 All the potentially suitable sites are recognised as sharing the following landscape issues:

"The sites are generally in less populated areas that may have value for their visual amenity and as landscape resources; they are coastal/estuarine sites; and the scale of the facilities means that the scope for visual mitigation is quite limited."

22.3.23 It is recorded that there can be uncertainty over future land uses once the sites are decommissioned due to the timescales involved in the projects. The potential long term impacts on visual amenity are also recognised.

iii. Planning Policy Statement 1: Delivering Sustainable Development (PPS1) (2005) (Ref. 22.9)

22.3.24 PPS1 was published in 2005 and sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system. It advises that planning should facilitate and promote sustainable and inclusive patterns of urban and rural development by, amongst other things: protecting and enhancing the natural and historic environment; the quality and character of the countryside and existing communities; and ensuring high quality development through good and inclusive design; and the efficient use of resources (paragraph 5).

22.3.25 Paragraph 17 of PPS1 states:

> *"The Government is committed to protecting and enhancing the quality of the natural and historic environment, in both rural and urban areas. Planning policies should seek to protect and enhance the quality, character and amenity value of the countryside and urban areas as a whole. A high level of protection should be given to most valued townscapes and landscapes, wildlife habitats and natural resources. Those with national and international designations should receive the highest level of protection."*

iv. Planning Policy Statement 5: Planning for the Historic Environment (2010) (PPS5) (Ref. 22.10)

22.3.26 PPS5 sets out the role of planning in conserving and enhancing the historic environment, and establishes those elements which constitute the historic environment.

22.3.27 Landscapes of historic interest are considered to be 'heritage assets' and PPS5 makes reference to 'historic environment characterisation', the process of combining assessments of archaeological, architectural and historic landscape character to define the overall historic character of a place or landscape. PPS5 also stresses the importance of understanding of the cultural processes shaping the present landscape in coastal and marine areas.

v. Planning Policy Statement 7: Sustainable Development in Rural Areas (PPS7) (2004) (Ref. 22.11)

22.3.28 PPS7 was published in 2004 and sets out Government policy on the conservation of the natural beauty of the landscape and countryside and the Government's objectives for rural areas. The key objectives of PPS7 in the context of landscape and visual amenity are:

- *"good quality, sustainable development that respects and, where possible, enhances local distinctiveness and the intrinsic qualities of the countryside; and,*

- *continued protection of the open countryside for the benefit of all, with the highest level of protection for our most valued landscapes and environmental resources."*

22.3.29 PPS7 also states that protection of the countryside for the sake of its intrinsic character and beauty is the Government's overall aim and that all development in rural areas should be sensitive to the character of the countryside and local distinctiveness.

22.3.30 Paragraph 21 of PPS7 states:

> *"Nationally designated areas comprising National Parks, the Broads, the New Forest Heritage Area and Areas of Outstanding Natural Beauty (AONB), have been confirmed by the Government as having the highest status of protection in relation to landscape and scenic beauty. The conservation of the natural beauty of the landscape and countryside should therefore be given great weight in planning policies and development control decisions in these areas. The conservation of wildlife and the cultural heritage are important considerations in all these areas. They are a specific purpose for National Parks, where they should also be given great weight in planning policies and development control decisions. As well as reflecting these priorities, planning policies in LDDs and where appropriate, RSS, should also support suitably located and designed development necessary to facilitate the economic and social well-being of these designated areas and their communities, including the provision of adequate housing to meet identified local needs."*

22.3.31 Paragraph 22 advises that major developments (including major development proposals that raise issues of national significance) should not take place in these designated areas, except in exceptional circumstances.

vi. Planning Policy Statement 9 (PPS9): Biodiversity and Geological Conservation (2005) (Ref. 22.12)

22.3.32 PPS9 was published in 2005 and sets out planning policies on the protection of biodiversity and geological conservation through the planning system. The broad aim of the policies is to ensure that planning, construction, development and regeneration should have minimal impacts on biodiversity and enhance it wherever possible.

22.3.33 Key objectives of PPS9 include:

- *"to promote sustainable development by ensuring that biological and geological diversity are conserved and enhanced as an integral part of social, environmental and economic development, so that policies and decisions about the development and use of land integrate biodiversity and geological diversity with other considerations.*
- *conserve, enhance and restore the diversity of England's wildlife and geology by sustaining and where possible improving the quality and extent of natural habitat and geological and geomorphological sites; and to conserve, enhance and restore the diversity of England's wildlife and geology by sustaining, and where possible improving, the quality and extent of natural habitat and geological and geomorphological sites; the natural physical processes on*

which they depend; and the populations of naturally occurring species which they support."

22.3.34 Paragraph 8 states that, where a proposed development on land within or outside an SSSI is likely to have an adverse effect on an SSSI (either individually or in combination with other developments), planning permission should not normally be granted. Where an adverse effect on the site's notified special interest features is likely, an exception should only be made where the benefits of the development, at this site, clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest and any broader impacts on the national network of SSSIs.

22.3.35 Paragraph 9 states that sites of regional and local biodiversity and geological interest, which include Regionally Important Geological Sites, Local Nature Reserves and Local Sites, have a fundamental role to play in meeting overall national biodiversity targets; contributing to the quality of life and the well-being of the community; and in supporting research and education.

22.3.36 Paragraph 10 states that planning authorities should not grant planning permission for any development that would result in the loss or deterioration of ancient woodland, unless the need for, and benefits of, the development in that location outweigh the loss of the woodland habitat.

22.3.37 Paragraph 12 states that networks of natural habitats provide a valuable resource and should be protected from development, and, where possible, strengthened by or integrated within it.

22.3.38 Paragraph 16 states that planning authorities should ensure that protected species are protected from the adverse impacts of development and refuse permission where harm to the species or their habitats would result, unless the need for, and benefits of, the development clearly outweigh that harm.

vii. **Planning Policy Statement 25 Supplement: Development and Coastal Change (PPS25)** (Ref. 22.13)

22.3.39 PPS25 Supplement describes coastal change as *"physical change to the shoreline, i.e. erosion, coastal landslip, permanent inundation and coastal accretion"*. It states that the Government's aim is to ensure that coastal communities adapt to coastal change, and that policies and decisions are based on an understanding of coastal change over time. It adds that local planning authorities should therefore ensure that they have an appropriate evidence base on coastal change. Specifically, local planning authorities should *"identify areas likely to be affected by physical changes to the coast and refer to this area as the Coastal Change Management Area (CCMA)".* This should include details of the character of the coast and any relevant designations.

viii. **Planning Policy Statement: Planning for a Low Carbon Future in a Changing Climate (Consultation Paper) (March 2010)** (Ref. 22.14)

22.3.40 The draft PPS sets out a planning framework for securing progress towards meeting the UK's targets to cut greenhouse gas emissions and use more renewable and low carbon energy, and to plan for climate change.

22.3.41 The document sharpens the policy on locating renewable and low carbon energy projects and states that *"depending on their scale and impact, renewable and low carbon energy developments should be capable of being accommodated in most locations"*. It goes on to state that *"planning should ensure that adverse impacts on the environment are addressed satisfactorily but applications for cutting edge, well designed buildings should not be turned down simply because they do not look familiar".* The document sets this out in proposed policy LCF 13.4 which states that *"Local planning authorities should support innovation which secures well designed, sustainable buildings."*

ix. Consultation Paper on a New Planning Policy Statement: Planning for a Natural and Healthy Environment (Ref. 22.15)

22.3.42 In March 2010, the Government published a Consultation Paper for a new Planning Policy Statement: Planning for a Natural and Healthy Environment. The consultation period expired in June 2010.

22.3.43 At the outset, the document makes clear that in its final form, the PPS would replace paragraphs 21 to 23 in PPS7 which relate to landscape protection.

22.3.44 With specific reference to landscape protection, proposed Policy NE8.5 maintains the approach set out in Paragraph 21 of PPS7. In addition, proposed Policy NE8.5 advises that, in consideration of applications for major development proposals should include an assessment of:

(i) "the need for the development, including in terms of any national considerations, and the impact of permitting it, or refusing it, upon the local economy;

(ii) the cost of, and scope for, developing elsewhere outside the designated area, or meeting the need for it in some other way; and

(iii) any detrimental effect on the environment, the landscape and recreational opportunities, and the extent to which that could be moderated."

d) Regional Planning Policy

22.3.45 The Government's revocation of regional strategies was quashed in the High Court on 10 November 2010. However, on the same date the Government reiterated in a letter to Chief Planners its intention to revoke regional strategies through the Localism Bill. This letter was also challenged but, on 7 February 2011, the High Court held that the Government's advice to local authorities that the proposed revocation of regional strategies was to be regarded as a material consideration in their planning decisions should stand. Therefore, the regional strategies remain in place but it is for planning decision makers to decide on the weight to attach to the strategies taking into account, as a material consideration, the Government's stated intention to revoke them (see **Volume 1, Chapter 4** for a full summary of the position regarding the status of regional planning policy). Consequently, the following policies are of relevance:

i. Regional Planning Guidance 10 for the South West 2001 – 2016 (RPG10) (2001) (Ref. 22.16)

22.3.46 RPG 10 sets out the broad development strategy for the period to 2016 and beyond. With specific reference to landscape character, paragraph 4.5 explains that the Countryside Agency and English Nature have identified and mapped the distinctive "character areas" for the South West as part of the testing of a new approach to "environmental capital" being promoted by the Countryside Agency, English Heritage, English Nature and the Environment Agency.

22.3.47 Policy EN 1 relates to Landscape and Biodiversity. It states that local authorities and other agencies, in their plans, policies and proposals, should, amongst other things:

- *"provide for the strong protection and enhancement of the region's internationally and nationally important landscape areas and nature conservation sites;*
- *indicate that the protection and, where possible, enhancement of the landscape and biodiversity should be planned into new development;*
- *have regard to the significant landscape joint character areas of the region set out in this RPG (…)and aim to conserve and enhance local character;*
- *take measures to protect the character of the countryside and the environmental features that contribute towards that character, including minimisation of light pollution."*

ii. Draft Revised Regional Spatial Strategy (RSS) for the South West Incorporating the Secretary of State's Proposed Changes for Public Consultation (July 2008) (Ref. 22.17)

22.3.48 Chapter 7 deals with Enhancing Distinctive and Cultural Life. Policy EN1 states;

"The quality, character, diversity and local distinctiveness of the natural and historic environment in the South West will be protected and enhanced, and developments which support their positive management will be encouraged. Where development and changes in land use are planned which would affect these assets, Local Authorities will first seek to avoid loss of or damage to the assets, then mitigate any unavoidable damage, and compensate for loss or damage through offsetting actions. Priority will be given to preserving and enhancing sites of international or national landscape, nature conservation, geological, archaeological or historic importance. Tools such as characterisation and surveys will be used to enhance local sites, features and distinctiveness through development, including the setting of settlements and buildings within the landscape and contributing to the regeneration and restoration of the area."

iii. Somerset & Exmoor National Park Joint Structure Plan Review 1991-2011 (2000) (Ref. 22.18)

22.3.49 The Somerset & Exmoor National Park Joint Structure Plan was adopted in 2000 with relevant policies saved from 27 September 2007. All policies have been saved with the exception of Policy 53 which is unrelated to landscape and visual impacts. The Plan provides a strategic base for all land use planning within the plan area for the period up to 2011.

22.3.50 The Somerset and Exmoor National Park Joint Structure Plan contains policies which aim to protect the local area.

22.3.51 Nature Conservation (Policy 1) states;

> *"The biodiversity of Somerset and the Exmoor National Park should be maintained and enhanced. The greatest protection will be afforded to nature conservation sites of international and national importance.*
>
> *In addition, Local Plans should include policies to maintain and enhance sites and features of local nature conservation importance including landscape features which provide wildlife corridors, links or stepping stones between habitats."*

22.3.52 Exmoor National Park (Policy 2) states;

> *"In the Exmoor National Park;*
>
> - *the conservation and enhancement of the natural beauty, wildlife and cultural heritage;*
> - *the promotion of opportunities for public understanding and enjoyment of the special qualities of the area,*
>
> *should be given priority over other planning considerations. In cases of conflict between these purposes, greater weight should be attached to the first."*

22.3.53 Areas of Outstanding Natural Beauty (Policy 3) states;

> *"In Areas of Outstanding Natural Beauty the conservation of the natural beauty of the landscape should be given priority over other planning considerations….Provision should only be made for major industrial or commercial development where it is in the national interest and there is a lack of alternative sites. Particular care should be taken to ensure that any development proposed does not damage the landscape character of the area."*

22.3.54 Landscape Character (Policy 5) states;

> *"The distinctive character of the countryside of Somerset and Exmoor National Park should be safeguarded for its own sake. Particular regard should be had to the distinctive features of the countryside in landscape, cultural heritage and nature conservation terms in the provision for development."*

22.3.55 Historic Landscapes (Policy 10) states;

> *"Development proposals which affect a registered historic landscape (historic parks, gardens and battlefields) should take account of their impact on the character of that landscape."*

22.3.56 Coastal Development (Policy 15) states;

"Provision for any development along the coast, including the Exmoor Heritage Coast, should be made within towns, Rural Centres and Villages. Where development requires an undeveloped coastal location it should respect the natural beauty, biodiversity and geology of the coast and be essential in that location…."

iv. Strategy for the Severn Estuary (2001) (Ref. 22.19)

22.3.57 Whilst not forming part of the statutory development plan for the proposed development site, the Strategy for the Severn Estuary was published by the Severn Estuary Partnership in 2001 and sets out policies and proposals for action for the estuary. Chapter 12 deals with Landscape and Seascape and aims to conserve, promote and enhance and, where necessary, restore the special and distinctive character and quality of the estuary's landscape and seascape.

22.3.58 Strategy for the Severn Estuary influences the design of infrastructure and transport projects in relation to the estuary's landscape and seascape through Policy L1c, which states;

"Plan and design all new developments including infrastructure and transport so that they conserve and enhance the character of the Severn Estuary landscape and seascape across authority boundaries."

e) Local Planning Policy

22.3.59 Although the site is not located within any local landscape policy designation, several general policies related to landscape issues exist within the West Somerset District Local Plan 2006; the Exmoor National Park Local Plan 2001-2011, Sedgemoor District Local Plan 1991-2011; and North Somerset District Replacement Local Plan (RLP). Details follow below.

i. West Somerset Local Plan (2006) (Policies 'saved' from 17 April 2009) (Ref. 22.20)

22.3.60 The West Somerset Local Plan forms part of the development plan for West Somerset. The Local Plan was adopted in April 2006. The Proposals Map indicates that the site is not subject to any specific landscape designations. The site lies outside of the defined Development Boundary.

22.3.61 The following policies are considered to be potentially relevant:

22.3.62 Areas of Outstanding Natural Beauty (Policy LC/2) states;

"Development which would harm the natural beauty and character of the Quantock Hills Area of Outstanding Natural Beauty will not be permitted. Major industrial or commercial development will only be permitted where justified by a proven national interest and a lack of alternative sites."

22.3.63 Landscape Character (Policy LC/3) states:

"Where development is permitted outside development limits, particular attention will be given to the protection of the scenic quality and distinctive local character of the landscape. Development which does not respect the character of the local landscape will not be permitted."

22.3.64 Trees and Woodland Protection (Policy TW/1) states;

"Development proposals that would adversely affect woodlands, groups of trees or individual trees of significant landscape, wildlife or amenity value will only be permitted where conditions can be attached to planning permissions to protect trees and, where appropriate, to require replacement and/or additional planting."

22.3.65 Hedgerows (Policy TW/2) states;

"Development or land management proposals will be required to show that an allowance has been made for the retention and protection of existing hedgerows and hedgerow trees unless they are not considered to be of value to the area's landscape, character or wildlife."

22.3.66 Sites of Local Nature Conservation or Geological Importance (Policy NC/3) states;

"Planning permission will not be granted for development which has a significant adverse effect on local nature conservation/geological interests or integrity of landscape features, unless the importance of the development outweighs the value of the substantive interests present.*

Where development is permitted which would damage the nature conservation value of the site, such damage will be kept to a minimum. The use of conditions and/or Planning Obligations to provide appropriate compensatory measures will be considered.

**Landscape features include:*

- river, streams and ponds,

- species rich hedgerows, field margins and road verges,

- broad leafed woodlands and orchards,

- wood pasture, parkland and veteran trees present."

22.3.67 River Corridor Protection (Policy W/7) states;

"Development which would harm the landscape, nature conservation, fisheries or the recreational interest of water courses, wetlands and the surrounding landscape will only be permitted where suitable mitigation measures are undertaken to ensure that any damage is kept to a minimum and compensatory measures, including enhancement and habitat restoration, are secured."

22.3.68 Development in the Coastal Zone (Policy CO/2) states;

"Development proposals in any part of the Coastal Zone, including those areas of existing developed coast, will only be permitted where;

(i) the development and its associated activities are unlikely to have an adverse effect, either directly or indirectly on;

a. heritage features,

b. landscape character areas,

c. nature conservation interests, including sub-tidal and marine habitats, and;

d. residential amenities.

(ii) the development is unlikely to have an adverse effect on the character of the coast and maintains and where possible, enhances, improves or upgrades the environment particularly in derelict and/or despoiled coastal areas; and

(iii) the development requires a coastal location."

22.3.69 Historic Parks and Gardens (Policy LB/3) states;

"Development which would harm any part or setting of a registered historic park or garden will not be permitted."

22.3.70 New Development and Conservation Areas (Policy CA/1) states;

"Development proposals in conservation areas will be permitted only where they are compatible with the preservation or enhancement of the architectural and historic character or appearance of the conservation area. In particular, proposals should meet the following requirements:

i) The proposal must be in keeping with the scale, architectural quality and features of the area and not detract from the setting of historic or architecturally important buildings.

ii) External building materials must be appropriate to those that are traditional in the conservation area.

iii) The proposal should not detract from the existing landscape elements of the conservation area including trees, hedgerows, walls, banks, footpaths and open spaces."

ii. **Exmoor National Park Local Plan 2001-2011 (2005) (Policies 'saved' from 14 February 2008)** (Ref. 22.21)

22.3.71 Aspects of planning policy and guidance of relevance to the site and to the landscape and visual amenity are presented below, as detailed in the Exmoor National Park Local Plan.

22.3.72 Lighting (Policy LNC 2) states;

"Applications for development which include lighting will not be permitted where:

(i) The lighting scheme proposed is excessive to achieve its purpose;

(ii) There would be sky glow, light spillage from the site or unacceptable glare;

(iii) There would be an adverse impact on local amenity, landscape, wildlife or the historic environment of the National Park."

22.3.73 Landscapes Covered by Section 3 Conservation Map (Policy LNC 3) refers to Section 3 of the Wildlife and Countryside (Amendment) Act 1985 and states;

"Development proposals which adversely affect the natural beauty of areas shown on the Proposals Map as Section 3 Moor, Heath, Woodland, Cliff and Foreshore will not be permitted."

22.3.74 Important Trees, Woodlands and Hedgerows (Policy LNC 4) states;

"Development proposals that would adversely affect woodlands, groups of trees, hedgerows or individual trees of significant landscape or amenity value will not be permitted unless acceptable conditions can be attached to protect trees and, where appropriate to require replacement or additional planting."

22.3.75 Coastal Zone (Policy LNC 6) states;

"Permission for development proposals within the coastal zone defined on the Proposals Map will be restricted to those which:

(i) Are appropriate to the coastal location and do not adversely affect coastal interests;

(ii) Involve changes in use or alterations or additions to buildings, or improvements to facilities on permanently established caravan and camping sites, without substantial impact on the coastal character of the surroundings."

22.3.76 Rivers and their Corridors (Policy LNC 7) states;

"Development proposals which harm the landscape, nature conservation, fishing or recreational interest of rivers and adjacent banks and valley sides associated with their landscape and amenity value will not be permitted."

22.3.77 Sites of Local Nature Conservation Importance (Policy LNC 11) states;

"In considering proposals which affect sites of local nature conservation importance the Authority will have full regard for their scientific significance and nature conservation value…"

22.3.78 Historic Parks and Gardens (Policy CBS 11) states;

"Development which would harm the special features and qualities of historic parks or gardens, or their settings will not be permitted."

iii. Sedgemoor District Local Plan (1991-2011 Adopted Version) (2004) (Ref. 22.22)

22.3.79 The Sedgemoor District Local Plan forms part of the development plan for the proposed development site. The Local Plan was adopted in 2004 with relevant policies saved from 27 September 2007. The Inset Map (Map No. 1) indicates that the entire proposed development site is not subject to any specific landscape, heritage or biodiversity designations.

22.3.80 The relevant saved policies relating to landscape and visual impacts are as follows.

22.3.81 Policy CNE2 (Landscape Character) states;

"Development which adversely affects local landscape character or scenic quality will not be permitted. In particular:

a) siting and landscaping should take account of visibility from publicly accessible vantage points; and

b) the form, bulk and design of buildings should have proper regard to their context in respect of both the immediate setting and the defining characteristics of the wider local area.

In determining planning applications the important characteristics of landscape character areas described in the Sedgemoor Landscape Assessment and Countryside Design Summary and/or AONB Landscape Assessments will be a material consideration."

22.3.82 Policy CNE4 (Countryside Around Settlements) states;

"Areas of land which have particular importance as Green Wedge, Green Edge or Strategic Gap are defined on the Proposals Map. Whatever their individual character and function, these are predominantly open areas, mostly outside development boundaries, which retain a largely rural character and appearance. Positive land management which benefits the landscape, countryside access, amenity, nature conservation or urban area containment/enhancement functions of these areas will be encouraged and developments which would have a detrimental effect on these functions will not be permitted."

22.3.83 Policy CNE7 (Internationally Important Sites) states;

"Development which is likely to have a significant adverse effect on the conservation objectives or the integrity of a site of international importance (i. e. Ramsar sites, potential and classified Special Protection Areas, or candidate and designated Special Areas of Conservation) will not be permitted."

22.3.84 Policy CNE12 (Trees, Hedgerows and Woodlands) states;

"In considering proposals for development, the Council will seek to protect important trees and hedgerows. Planning permission may be refused where these would not be retained, or acceptably replaced. The Council will also encourage the planting and proper management of new trees and shrubs."

iv. Sedgemoor District Local Development Framework Core Strategy (Proposed Submission) (September 2010) (Ref. 22.23)

22.3.85 The Sedgemoor Core Strategy Proposed Submission was consulted on from September to November 2010. Changes prior to submission, proposed as a result of the consultation process were recently reported and endorsed by the Council's Executive Committee on 9 February 2011. This was submitted to the Secretary of State on 1 March 2011.

22.3.86 Chapter 3 outlines the overarching strategy for the plan area. Policy D4 relates to proposals for Renewable or Low Carbon Energy Generation. It states the Council will support proposals that maximise the generation of energy from renewable or low carbon sources, provided that the installation would not have significant adverse impact taking into account, amongst other factors:

"The impact of the scheme, together with any cumulative impact (including associated transmission lines, buildings and access roads), on landscape character, visual amenity, historic features and biodiversity."

22.3.87 Policy D14 (Natural Environment) deals with landscape and visual impacts more generally. It states:

"Development proposals within the Mendip Hills AONB or the Quantock Hills AONB will only be supported where they enhance or maintain the natural beauty, or the exceptional character or quality of the landscape in these areas.

Elsewhere in the District proposals should ensure that they enhance the landscape quality wherever possible or that there is no significant adverse impact on local landscape character, scenic quality and distinctive landscape features as identified in the Sedgemoor Landscape Assessment and Countryside Design Summary. In particular through:

a) siting and landscaping that takes account of visibility from publicly accessible vantage points;

b) the form, bulk and design of buildings having proper regard to their context in respect of both the immediate setting and the defining characteristics of the wider local area.

Where there are reasonable grounds to suggest that a development proposal may result in a significant adverse impact on the landscape, the Council will require planning applications to be supported by landscape impact assessments.

In exceptional circumstances, where development is necessary and could result in significant impact on the landscape, appropriate mitigation and compensation measures should be provided."

v. Supplementary Planning Guidance

22.3.88 Sedgemoor District Council and West Somerset Council have jointly prepared draft supplementary planning guidance in relation to the HPC Project. Public consultation on the Consultation Draft version of the Hinkley Point C Project Supplementary Planning Document (the draft HPC SPD) commenced on 1 March 2011 and concluded on 12 April 2011. EDF Energy has submitted representations which object to the draft HPC SPD. See **Volume 1, Chapter 4** for a full summary of the position regarding the status of the draft HPC SPD.

22.3.89 With regards to the approach to masterplanning and design of the Main Site, Box 19 in the draft HPC SPD states that the HPC project promoter will be expected, amongst other things:

- *"To undertake an assessment of the individual and cumulative visual impacts of the proposals taking into account the impacts of off-site associated development proposals and impacts during the construction stage of the project;*
- *To minimise the individual and cumulative visual impacts on the landscape and setting of designated areas, buildings and monuments, including Exmoor National Park, AONBs, Conservation Areas, Outstanding Heritage Settlements, Listed Buildings and Scheduled Ancient Monuments and where it has been demonstrated by the HPC project promoter that the impacts are unavoidable provide appropriate levels of mitigation and compensation;*
- *To ensure a partnership approach to the master-planning of the site involving local authorities and the local communities with the objective of securing a coherent and high quality design solution;*
- *To identify landscape treatments, habitat creation and public rights of way connections and improvements that integrate appropriately with the surrounding area and sufficiently mitigate and compensate for the impacts on these features at the construction, operation and decommissioning stages. Landscape and green infrastructure works and enhancements that extend beyond the power station main site boundary will be expected to mitigate and compensate the impacts of the project;*
- *Protect valuable landscape assets through careful construction practices;*
- *To prepare a landscape legacy plan (in consultation with the Council and local communities) to demonstrate how the landscape and rights of way proposals on and off site can integrate effectively with the area in the long term…" (page 36-37)'.*

22.3.90 Further planning policy context is provided in the Legislative Planning Policy Context chapter (**Volume 1 Chapter 4**) and the Introduction chapter (**Volume 1 Chapter 1**).

vi. North Somerset District Replacement Local Plan (RLP) (Ref. 22.24)

22.3.91 The North Somerset Replacement Local Plan (RLP) adopted in March 2007 is the most important local planning document as it sets out the local planning context up to 2011. It applies and implements all national and regional planning policies interpreting them into specific planning guidelines for North Somerset district. Work has also begun on the Local Development Framework (LDF) a new suit of documents which will provide local planning guidance to replace the North Somerset Local Plan.

22.3.92 The North Somerset Replacement Local Plan (RLP) is part of North Somerset's Local Development Framework. The policies in the plan remain in force until they are superseded by forthcoming Development Plan Documents.

22.3.93 Landscape Character Areas (Policy ECH/7) states;

"Within the Landscape Character Areas, development will be permitted if it will not adversely affect the particular character of the landscape."

22.3.94 Mendip Hills Area of Outstanding Natural Beauty (Policy ECH/8) states;

"(…) Major development which would affect the environment and landscape of the Mendip Hills AONB will only be permitted where:

i. there is a need for the development in terms of national considerations; and

ii. there is no adverse effect on the local economy; and

iii. there is a lack of an alternative site outside the area, having regard to the cost or means of meeting the need for it in some other way; and

iv. any harm to the environment and natural beauty of the landscape of the AONB can be kept to a minimum and the development is carried out to high environmental standards.

Wherever possible new roads should be kept away from the AONB and, where they would be likely to affect it, proposals should demonstrate the need for the road and that the route and design would do as little damage to the environment as practicable."

f) Designated Area Management Plans and Guidance

i. Quantock Hills Area of Outstanding Natural Beauty Management Plan 2009-2014 (2009) (Ref. 22.25)

22.3.95 Whilst not forming part of the statutory development plan for the HPC development site, the Quantock Hills Area of Outstanding Natural Beauty (AONB) Management Plan was published by the Quantock Hills AONB Joint Advisory Committee in 2009 and sets out policies, objectives and action points over a range of subjects, including landscape, wildlife, historic environment and cultural influences, development and planning. Of particular relevance are the following policies:

- Policy D1 – *"To protect the wild character, wildlife sites and species, cultural landscape and architectural heritage of the AONB."*
- Policy D2 – *"To ensure AONB involvement and influence in planning processes affecting the AONB."*
- Policy D3 – *"To protect the views out from the AONB through involvement in the planning process."*
- Policy D4 – *"To support the local distinctiveness in AONB settlements."*

ii. Mendip Hills Area of Outstanding Natural Beauty Management Plan 2009-2014 (Ref. 22.26)

22.3.96 The Mendip Hills AONB Management Plan was published by the Mendip Hills AONB Partnership in 2009 and sets out the special qualities of the Mendip Hills AONB; considers current issues and future trends; pressures and challenges; and suggests what needs to happen in the future to conserve and enhance the AONB.

g) Other Relevant Guidance

i. Lighting in the Countryside: Towards Good Practice (Ref. 22.27)

22.3.97 The Department for Communities and Local Government (DCLG) and the former Countryside Commission (CC) 1997 guidance on lighting, Lighting in the Countryside: Towards Good Practice provides advice on developing lighting strategies, lighting design and how to mitigate adverse impacts associated with lighting on landscape and visual amenity.

22.3.98 Guidance relevant to the landscape and visual impact assessment and landscape character assessment is referred to in section 22.4 of this chapter (methodology).

22.4 Methodology

22.4.1 The Landscape and Visual Impact Assessment (LVIA) and supporting studies and surveys were conducted for all phases of the proposed development, in accordance with the principles set out by the Landscape Institute (LI) and Institute of Environmental Management Assessment (IEMA) in the Guidelines for LVIA (GLVIA) (Ref. 22.1) and guidance on Landscape Character Assessment from the Countryside Agency (now Natural England) and Scottish Natural Heritage (Ref. 22.28).

22.4.2 Landscape and visual impact assessment (LVIA) comprises firstly the identification, understanding and description of the existing ('baseline') landscape and visual receptors (viewers of varying types) likely to be impacted by the proposed HPC development within a defined study area and secondly the identification and description of the impacts arising from the development on the landscape and the visual receptors. The assessment examines both construction phase impacts and operational phase impacts. The impacts are assessed based on an understanding of the construction and operation phases which are fully described in earlier ES chapters but summarised in this section and include all landscape mitigation works within the red line application boundary, except for a temporary screening bund along the north-western boundary during the construction phase, and off-site planting works. Landscape impacts can be both indirect (essentially visual issues that contribute to the appreciation and understanding of landscape character) or direct, physical impacts resulting from development where elements of the landscape are lost i.e. tree cover is removed or farmland is lost to development. Visual impact is an indirect impact resulting in the alteration in a view resulting from development, as seen by varying types of visual receptors. Residual Impacts are recorded in section 22.8. These record the benefits of permanent off-site planting and a temporary screening bund during the construction phase for receptors in close proximity to the HPC development site.

22.4.3 The structure of this chapter broadly comprises the following:

- description of the LVIA study area;
- baseline and assessment methodology;
- landscape baseline;
- visual baseline;
- summary of construction and operational phases;
- landscape impact assessment;
- visual impact assessment; and
- residual impact assessment.

a) LVIA Study Area

22.4.4 The LVIA study area defines the geographic extent of the landscape and visual impact assessment of the HPC proposed development and associated off-site highway improvement works.

22.4.5 The LVIA study area has been defined through a staged process which has included desk study, Zone of Theoretical Visibility (ZTV) analysis, modelling and field survey, including verification and refinement of ZTV results. Consultation has also been undertaken with a range of statutory and non-statutory consultees on the extents of the LVIA study area. The ZTV methodology is presented in **Appendix 22A**.

22.4.6 The geographic area for the assessment of landscape and visual impacts was initially set to 25km from the HPC development site. This distance was considered by the statutory consultees in the Stage 2 consultation as an appropriate basis for initial modelling and assessment.

22.4.7 Following the analysis of Bare Ground ZTVs of early iterations of the HPC proposed development, Ordnance Survey mapping at a range of scales, field surveys and consultation this initial 25km study area was refined to exclude areas from which the proposed development would not be visible or was judged not to have a potential to cause significant landscape and visual impacts due to the screening provided by landform, vegetation or urban form, distance from the HPC proposed development, or combination of some of these factors.

22.4.8 For example it was confirmed during site visits and consultation that in lowland inland areas the HPC proposed development would not be visible beyond 18km. In more elevated areas, or in exposed coastal locations with no intervening visual barriers, the maximum extents of the LVIA study area were assessed to be either 21km or 25km from the HPC proposed development. A summary of the maximum extent of the study area is described below:

- Lowland Somerset – up to 18km from the HPC development site;
- Exmoor National Park – up to 25km from the HPC development site;
- Mendip Hills AONB – up to 21km from the HPC development site; and
- Welsh coastline – up to 21km of the HPC development site.

22.4.9 The Bare Ground ZTV for the HPC proposed development and buffer zones used to define the maximum extents of the LVIA study area for different topographies are presented on **Figure 22.2**. The final LVIA study area is illustrated on **Figure 22.3**.

b) Baseline and Assessment Methodology

22.4.10 The approach to assessing and describing the impacts on landscape and visual receptors is similar to that used for other environmental topics in this ES and is based on determining impact significance through consideration of the potential magnitude of change in relation to the sensitivity of a particular receptor to change. As such the LVIA is similar to the overall assessment approach set out in **Volume 1 Chapter 7**.

22.4.11 There are, however, some differences, which largely relate to the landscape and visual impact assessment process being more complex than other environmental topics (such as water or air quality), since *"it is determined through a combination of quantitative and qualitative elements"* (Ref. 22.1). Therefore, the assessment adopts a structured and consistent approach, incorporates consultation findings and has been undertaken by experienced landscape architecture and assessment professionals.

22.4.12 The methodology used in the assessment of landscape and visual impacts draws significantly upon professional judgment to accurately establish an understanding of baseline conditions, the sensitivity of landscape and visual receptors the magnitude of impacts arising from the proposed development and the significance of impacts arising.

22.4.13 The methodology for this assessment, as described below, was subject to consultation with statutory and non-statutory consultees.

22.4.14 There are four key stages in the assessment process:

- Stage 1: Baseline data collection and analysis.
- Stage 2: Assessment of the sensitivity of landscape and visual receptors.
- Stage 3: Assessment of the magnitude and nature of impacts.
- Stage 4: Assessment of the significance of impacts on landscape and representative visual receptors.

i. Stage 1: Baseline Data Collection and Analysis

22.4.15 This stage establishes the baseline conditions for the LVIA study area and identifies the relevant landscape and visual receptors. Key activities during the baseline data collection and analysis stage included:

- preparation of a ZTV; a theoretical area from which part or all of the proposed HPC proposed development is potentially visible, based on evolving project design;
- preparation of draft photomontages from several locations to illustrate the anticipated view of the operational scheme and including maturing vegetation associated with the landscape strategy to inform evolving project design iterations;
- desk study to identify potential representative viewpoints and photomontage locations;
- desk study of national landscape character within the LVIA study area to understand the broad landscape character context for the project;

- desk study of local (district and designated landscape) character assessments to gain a detailed understanding of the landscape character context of the LVIA study area;
- field survey to review the selection of representative viewpoints to gain a broad understanding of the visual context of the LVIA study area;
- field work to verify the desk study of national and local landscape character assessments and to gain a detailed understanding of the landscape character of the HPC development site and its immediate landscape context, including analysis of landscape elements and features for the HPC development site; and
- consultation with key statutory and non-statutory consultees to review the findings of initial desk study and field work and to agree representative viewpoints, and baseline descriptions of landscape character and visual context.

22.4.16 Representative viewpoints have been selected on the basis of locations that represent a receptor type (such as a group of residential properties). To ensure that selected viewpoints represent the 'worst-case scenario' view for a given receptor, viewpoints were selected which provide the clearest views of the proposed development, for example because of their proximity to the proposed development or the absence of visual barriers between the viewpoint and the proposed development. All representative viewpoints have been agreed during consultation. The majority of viewpoints are publicly accessible, except Principal Viewpoints 10 and 17, which are located on private farmland, and Principal Viewpoints 7 and 23, which are located on private land around historic residences seasonally open to public.

22.4.17 In this LVIA a distinction is made between 'Principal' and 'Secondary' Viewpoints to indicate viewpoints for which Visually Verifiable Images (VVI) were prepared (Principal Viewpoints) and those that have restricted views of the proposed development and for which VVIs were not considered appropriate (Secondary Viewpoints) due to a range of factors such as the long distance from the viewpoint to the site, elevation or landscape elements/features obscuring the views.

22.4.18 A total of 42 Principal and 6 Secondary Viewpoints were selected and agreed with statutory and non-statutory consultees. Initial baseline photographs illustrating views from all viewpoints were taken using a Nikon D100 digital camera, set to the equivalent of a 35mm focal length, which is the equivalent of 50mm film camera lens (equivalent of human eye). Where viewpoints consisted of more than one frame, the relevant frames were merged together using Photovista software (version 2.0).

22.4.19 Photographs for all agreed Principal Viewpoints were retaken with a high resolution camera between February and April 2011. The method for recording high resolution photography, stitching full resolution panoramas and creating VVIs is set out in **Appendix 22B**.

22.4.20 For the purpose of the assessment of lighting impacts dusk views were recorded for 13 viewpoints covering selected and agreed locations up to approximately 7km from the HPC development site. The viewpoints were selected based on their accessibility at dusk, potential visibility of lighting proposals and their distribution across the study area. The dusk views locations were agreed with Statutory and non-statutory consultees in April 2011. The methodology for recording dusk views is available in **Appendix 22B**.

22.4.21 The viewpoint panoramas were scaled according to the Advice Note 01/11 from the Landscape Institute, Photography and Photomontage in Landscape and Visual Impact Assessment (Ref. 22.29). The panoramas on the viewpoint sheets have been scaled to be viewed at a distance of 400mm. Further details on the photographic scaling method are available in **Appendix 22B**.

22.4.22 Where possible, the selected photographs were taken in winter and show the 'worst-case scenario' (views without foliage). For some views, where vegetation does not obscure views of the proposed HPC development site, or it has limited screening effect, views with foliage were considered sufficient. In relation to the Quantock Hills AONB, summer views were preferred by the consultees (notably the Quantock Hills AONB Service), due to the better visibility of the HPC development site and the more representative character of the photographs due to higher number of visual receptors likely to experience such views during summer months.

22.4.23 Representative viewpoints have been classified according to their distance from the HPC development site. Short distance viewpoints are located up to 1.5km from the site, medium distance viewpoints are between 1.5km - 5km from the site and viewpoints beyond 5km from the site are classified as long distance views.

ii. Stage 2a: Receptor Sensitivity – Landscape

22.4.24 The determination of landscape sensitivity is an important part of the landscape and visual impact assessment process. Sensitivity combined with the potential magnitude of impact allows assessment of the overall significance of the landscape impacts to be made.

22.4.25 According to GLVIA (Ref. 22.1), the sensitivity of the landscape resource is described as *"The degree to which a particular landscape type or area can accommodate change arising from a particular development without detrimental effects on its character (…)".* The overall sensitivity of the existing landscape resource will vary with:

- *"existing land use;*
- *the pattern and scale of the landscape;*
- *visual enclosure/ openness of the views, and distribution of visual receptors;*
- *the scope for mitigation, which would be in character with the existing landscape;*
- *the value placed on the landscape."*

22.4.26 In addition to the above list of considerations, GLVIA also considers that sensitivity of the landscape resource is based on evaluation of factors such as quality, value, contribution to landscape character and degree to which elements can be replaced or substituted.

22.4.27 Evaluation of the value or importance of a landscape often refers to policy or designations as an indicator. Importance also relates to the contribution of the landscape element/feature to the character or views within the local area and is a factor of its scenic quality, condition, sense of place, visibility, accessibility and special qualities such as remoteness. Not all characteristics are uniformly spread throughout designated landscapes so the importance of the proposed development site is considered within the designated area.

22.4.28 For assessment purposes, the sensitivity of a landscape receptor is based on the application of the above criteria, informed by field surveys undertaken by landscape professionals, professional judgement of the assessor and consultation with statutory and non-statutory consultees.

22.4.29 **Table 22.1** shows the potential gradations of sensitivity of landscape receptors (high, medium, low or very low).

Table 22.1: Guidelines for the Assessment of Landscape Sensitivity

Sensitivity	Description
High	A landscape of particularly distinctive character and scenic quality. Nationally and regionally designated landscape for its scenic quality and character.
Medium	A landscape of moderately distinctive character and scenic quality. Locally designated landscape for its scenic quality and character.
Low	A landscape of no distinctive character and scenic quality. A landscape not subject to any form of landscape designation.
Very low	A landscape that is damaged, neglected or poor character and lacking scenic quality. A landscape not subject to any form of landscape designation.

22.4.30 By way of an example, a landscape that is nationally designated, such as an AONB, is regarded as being the most sensitive to change. A landscape that is relatively intact, of some scenic quality, and locally designated would be judged to be of medium sensitivity. A landscape that is neglected and damaged, or lacking scenic quality, such as a brownfield site, might be judged to be of low or very low sensitivity.

iii. Stage 2b: Receptor Sensitivity – Visual

22.4.31 Visual sensitivity is established in relation to visual receptors. Visual receptors are interest or viewer groups that may experience an effect arising from the proposed development. According to GLVIA (Ref. 22.1), the sensitivity of visual receptors depends on:

- *"The location and context of the viewpoint;*
- *The expectations and occupation or activity of the receptor;*
- *The importance of the view (which may be determined with respect to its popularity or numbers of people affected, its appearance in guidebooks, on tourist maps, and in the facilities provided for its enjoyment and references to it in literature or art)."*

22.4.32 **Table 22.2** shows the potential gradations of sensitivity of visual receptors (high, medium, low or very low).

Table 22.2: Guidelines for the Assessment of Visual Receptor Sensitivity

Sensitivity	Description
High	Viewers with a proprietary interest, specific interest in the view and prolonged viewing opportunities. Examples include: Occupiers of residential properties. Visitors to tourist attractions. Recreational receptors using recreational facilities such as National Cycle Routes, National Trails, and designated long distance footpaths. Recreational receptors using PRoW or viewpoints in nationally or locally designated landscapes.
Medium	Viewers with a moderate interest in their surroundings such as : Users of schools. Users of outdoor recreational facilities where landscape appreciation is unlikely to be a primary motive. Local viewpoints. Users of local PRoW.
Low	Viewers with a passing interest in their surroundings such as: Road or other transport users.
Very low	Viewers with no interest in their surroundings such as: People at their place of work.

22.4.33 By way of an example residential receptors are generally considered to be the most sensitive receptor group owing to their propriety interest and their prolonged exposure. Recreational receptors such as people engaged in outdoor sports are considered of medium sensitivity although recreational receptors whose attention or interest is focused on the landscape may also be considered to be highly sensitive.

22.4.34 The least sensitive group are those with no interest in their surroundings or that are already affected by similar types of visual impact to that arising from the proposed development or have a passing interest in the surroundings, such as motorists on a busy motorway.

22.4.35 It should be noted that for each of the representative visual receptors used in the assessment, a range of visual receptor types may be represented. In all cases the highest sensitivity is taken forward to the assessment of significance.

22.4.36 For assessment purposes, the sensitivity of representative visual receptors is based on the application of the above criteria, informed by field surveys undertaken by landscape professionals, professional judgement of the assessor and consultation with statutory and non-statutory consultees.

iv. Stage 3: Magnitude of Impacts

22.4.37 According to GLVIA (Ref. 22.1), the magnitude of impacts is described as a *"combination of the scale, extent and duration of an effect."* The magnitude of landscape and visual impacts are judged using the criteria set out below.

v. Stage 3a : Magnitude of Landscape Impacts

22.4.38 The magnitude of landscape impacts is defined as high, medium, low or very low depending on the following factors:

- scale or degree of change to the existing landscape resource;
- nature and duration of the change caused by the proposed development (for example beneficial or adverse); and
- timescale or phasing of the proposed development.

22.4.39 Guidelines for the assessment of magnitude of landscape impacts are presented in **Table 22.3**:

Table 22.3: Guidelines for the Assessment of Magnitude of Landscape Impacts

Magnitude	Description
High	Total or widespread loss or major alteration to key landscape elements/characteristics.
Medium	Partial loss or alteration to one or more key landscape elements/characteristics.
Low	Limited loss or alteration to one or more key landscape elements/characteristics.
Very low	Extremely limited loss or alteration to one or more key landscape elements/characteristics.

vi. Stage 3b: Magnitude of Visual Impacts

22.4.40 The magnitude of visual impacts is defined as high, medium, low or very low and depends upon the following factors:

- the scale of change or proportion of the existing view that would change as a result of the proposed development;
- the loss or addition of features or elements within the view;
- the degree of contrast or integration of the proposed development with the existing or remaining landscape elements and characteristics within the view;
- the nature and duration of the impact and whether it is temporary or permanent, continuous or intermittent;
- the angle of the view in relation to the main activity of the receptor; and
- the distance of the viewpoint from the proposed development.

22.4.41 Guidelines for the assessment of magnitude of visual impacts are presented in **Table 22.4**:

Table 22.4: Guidelines for the Assessment of Magnitude of Visual Impacts

Magnitude	Description
High	Complete change or widespread alteration to the existing view.
Medium	Noticeable but localised alteration to the existing view.
Low	Partial and very localised alteration the existing view.
Very low	Barely perceptible change to the existing view. It may be difficult to differentiate the proposed development from its surroundings.

vii.Nature and Duration of Impacts

22.4.42 The nature of impacts contributes to the assessment of magnitude of landscape and visual impacts.

22.4.43 The nature of impacts can be adverse, beneficial or neutral. The impact is assessed as neutral in situations where little or no change is predicted, or it is impossible to objectively establish whether the change would be adverse or beneficial.

22.4.44 With regard to the duration of landscape and visual impacts, short to medium-term impacts are normally considered to be temporary and associated with the construction of the proposed development, and long-term impacts are normally associated with a fully occupied and operational scheme. Permanent impacts are those which result in an irreversible change to baseline conditions or will last for the foreseeable future.

22.4.45 The duration of landscape and visual impacts assessed in this chapter takes account of possible project delays and is typically categorised as follows:

- long-term – 15 years plus;
- medium-term – 5 to 15 years;
- short-term – 0 to 5 years.

22.4.46 Landscape impacts can be both indirect (essentially visual issues that contribute to the appreciation and understanding of landscape character) or direct, physical impacts resulting from development where elements of the landscape are lost i.e. tree cover is removed or farmland is lost to development, or new elements and features, such as woodland areas or buildings, are introduced. Visual impact is an indirect impact resulting in the alteration in a view resulting from development, as seen by varying types of viewers.

22.4.47 Section 9 of this chapter provides a summary of impacts and their classification as temporary (short-term or medium-term) or permanent (long-term).

viii. Stage 4: Assessment of Significance

22.4.48 The potential significance of landscape and visual impacts is determined by assessing the magnitude of the identified impacts against the sensitivity of the landscape and visual receptors affected. The significance matrix presented in **Volume 1 Chapter 7** provides a guide to decision-making but is not a substitute for professional judgement and interpretation, particularly when sensitivity or impact magnitude levels are not clear or are borderline between categories.

22.4.49 **Table 22.5** provides a brief definition of the significance criteria which are specific to landscape and visual impact assessment and are in accordance with the overall EIA sensitivity criteria outline in **Volume 1 Chapter 7**.

Table 22.5: Significance Criteria

Level of Significance	Description
Major	Very important or substantial change in landscape and visual conditions. Impacts may be adverse or beneficial.
Moderate	Noteworthy or medium change in landscape and visual conditions. Impacts may be adverse and beneficial.
Minor	Inconsiderable or small change in landscape and visual conditions. Impacts may be adverse, neutral or beneficial.
Negligible	No discernable change in landscape and visual conditions. Impact is likely to have a negligible (neutral) influence, irrespective of other impacts.

22.4.50 By way of an example, major landscape and visual impact may occur where a large scale development is proposed within a nationally designated landscape leading to widespread loss or alteration to one or more key landscape elements/characteristics. In visual terms, a major impact may arise where large number of residential receptors would experience complete alteration to the existing view.

22.4.51 With reference to the EIA Methodology (see **Volume 1 Chapter 7**), predicted impacts of major and moderate significance equate to a significant impact in planning terms.

ix. Illustration of the HPC Proposed Development

22.4.52 As described above, the extent to which the HPC proposed development is visible in the surrounding landscape has been established through a combination of ZTV modelling, desktop analysis, and field survey. Forty eight viewpoints were agreed with consultees to be representative of views within the LVIA study area and as an appropriate basis on which to assess and describe visual impacts arising from the HPC proposed development on a diverse range of receptors at locations in the short, middle and long distance from the HPC development site.

22.4.53 Photograph panels (full list presented on **Figure 22.9b**) illustrate the existing view from each of the representative viewpoints and, where appropriate, indicate the location of the HPC development site in the view as well as other major landscape features to help orientate the viewer. Forty two of the representative viewpoint locations have been agreed with consultees as appropriate for the preparation of photo-realistic photomontages to illustrate the nature of visual effects arising from the HPC development during its operational phase.

22.4.54 The photomontages, referred to throughout the ES as Visually Verifiable Images (VVIs), illustrate the HPC proposed development at year 15 of the operational phase and as such include all proposed HPC structures, associated infrastructure such as access roads and lighting and mitigation proposals developed iteratively as part of the design process such as landform and screen planting. In addition to the 42 VVIs illustrating day time views, 13 additional VVIs have been prepared to illustrate the HPC proposed development at night. Additional VVIs from 11 Principal Viewpoints have also been prepared to illustrate the HPC proposed development in combination with National Grid proposals (see **Volume 11 Chapter 6**).

22.4.55 The methodology for the preparation of the VVIs (see **Appendix 22B**) states that the surveying techniques used in the preparation of the VVIs have recorded information based on Ordnance Survey National Grid with a relative accuracy of 10-50mm. It should be noted, whilst position, height and scale are objectively accurate, subjective judgement must be used when lighting is being assessed in VVI imagery. The lighting used in the preparation of the dusk VVI's has been constructed and placed based on manufacturers specifications and industry guidelines however technology is not sufficiently advanced to produce definitive reproduction of lighting and therefore a definitive and objectively verified agreement on lighting is not possible.

22.4.56 The computer can accurately assess the relative contrast between the faces of a building at a particular time. The computer can also render approximate material definitions. However, not every aspect of what is seen visually on screen is able to be simulated using an automatic or wholly objective process. Reflected light, local lighting conditions, detailed material definitions, and climatic conditions including moisture content of the air both across the scene as a whole and locally cannot be accurately assessed or simulated by current computer technology. In these cases it is necessary to refer to the scene for visual clues in order to set the render of the proposed development into the photograph.

22.4.57 Some elements of the HPC proposed development are yet to be finalised, and as such several parameters have been established and used as a basis to model and render the proposed development in the VVIs. By way of an example, parameters are specified for the building heights that are modelled, and the materials, finishes and colours that are used to render the buildings in the VVI views. **Appendix 22B** also describes the parameters used to model the landform and planting proposed as part of the landscape strategy, taking into account assumptions regarding how the selected species will grow over the period from planting to year 15 of operation. It should be noted that vegetation growth is modelled only for planting proposed as part of the landscape restoration plan within the HPC development site. Existing planting visible in the VVIs has not been amended in the VVIs to illustrate 15 years of additional growth.

22.4.58 The effects of natural lighting were also modelled into the VVIs to replicate the lighting conditions in which the original photograph was taken. For the dusk VVIs, the effects of proposed lighting were modelled in accordance with the methodology described in **Appendix 22B**.

22.4.59 Whilst every effort has been made to ensure the accuracy of the VVIs within the parameters defined and described, several factors are not, and in many instances cannot be, modelled into static photo-realistic montages of the type presented in the ES. For example, the dynamic effects of lighting (such the shifting patterns of light and shade created by clouds moving across the view) and atmospheric conditions (created by mist, rain and snow) on the main HPC structures are not illustrated. Similarly, movement within the site and in the surrounding landscape, perhaps from vehicles on roads evident in the view, is not illustrated. Similarly, the VVIs do not illustrate changes to elements in the view that are outside the HPC development site, such as the introduction of new structures or planting arising from other developments; changes to land management regimes; or the removal of features in the existing view such as buildings or woodlands. In addition, the VVIs illustrate static views of a field of view centred upon the HPC application site, and as such they cannot replicate the effects of the movement of the viewer or the true nature of the view which in reality will include an awareness of the wider landscape.

22.4.60 In addition, the VVIs do not seek to portray a subjective representation of the proposed development. It is acknowledged that individual viewers will each have their own particular emotional response to the change in view arising from the HPC proposed development that is illustrated. However, and as with the assessment of landscape and visual impacts described, the preparation of VVIs is an objective process based on best practice methodologies.

22.4.61 Therefore, and whilst representing an accurate objective representation of the proposed HPC development, the VVIs must be regarded as representative and illustrative. They are not intended to be a definitive illustration of how the project will appear at year 15 of operation or seek to influence the viewer's emotional or subjective reaction to the proposals.

x. Residual Impact Assessment

22.4.62 The initial assessment of landscape and visual impacts assumes that the proposed mitigation within the HPC development site boundary is embodied within the HPC scheme.

22.4.63 The assessment of the residual impacts takes account of the proposed off-site mitigation measures and is undertaken using the same assessment methodology as outlined above.

xi. Cumulative Impacts

22.4.64 The assessment of site-specific additive and interactive impacts on landscape and visual receptors as a result of the HPC proposed development is included in the assessment of impacts in this LVIA. The methodology for assessing these impacts is described in **Volume 1 Chapter 7**.

22.4.65 Project-wide cumulative impacts and in-combination impacts with other proposed or reasonably foreseeable development or projects are assessed in **Volume 11**.

b) Consultation

22.4.66 The HPC consultation process is outlined in **Volume 1 Chapter 7**. Comments from formal stages of consultation (Stage 1, Stage 2, Stage 2 Update and M25 Junction 24 and Highway Improvements) have been taken into account within the assessment (see **Consultation Report**).

22.4.67 Consultation undertaken outside the Stage 1, Stage 2 and Stage 2 Update and M25 Junction 24 and Highway Improvements consultation (informal consultation) was also carried out and included meetings and correspondence exchanged with a variety of organisations to discuss the extents of study area, landscape and visual baseline, landscape and visual impacts including lighting, development footprint and design, and mitigation proposals.

22.4.68 Informal consultation has been carried out with the following organisations and consultees:

- Local residents;
- Natural England;
- Exmoor National Park Authority;

- Somerset County Council (SCC);
- West Somerset District Council (WSC);
- Sedgemoor District Council (SDC);
- Quantock Hills AONB Service;
- English Heritage; and
- Fairfield Estate.

c) Limitations, Constraints and Assumptions

22.4.69 The principal assumptions and limitations for the LVIA are described below:

- The baseline assessment is set for spring 2011 and is focused on landscape conditions prior to any major HPC works on the HPC development site (including the proposed HPC preliminary works, comprising the site preparation works and the temporary jetty).
- The landscape character baseline was informed by landscape character desk studies and existing Landscape Character Assessments, whose findings were verified and, where necessary, extended during field surveys carried out by qualified landscape professionals.
- Landscape and visual surveys that contribute to the assessment were undertaken between December 2008 and May 2011.
- The assessment of impacts has been undertaken for the following phases of the HPC proposed development:
  - construction of the HPC (including all phases of the on-site accommodation campus and leisure facilities, temporary jetty and site preparation works, which are entirely located within the HPC development site);
  - operation of the HPC at year 1 (including fully implemented landscape strategy);
  - operation of the HPC at year 15 (including fully implemented and maturing landscape strategy); and
  - Highway Improvements were assessed during all phases of the HPC proposed development according to the HPC project programme.
- All photographs used for VVIs within this ES were taken between February and April 2011.
- The assessment of construction impacts is based on construction parameters described in **Chapter 3** of this volume. The assessment is based on likely construction activities and takes account of the potential exceptional conditions, such as temporary tall crane operations.
- The assessment of operational impacts on landscape and visual receptors is based on the parameters of the project described in **Chapter 2** of this volume and includes an allowance for the proposed height of the buildings and structures (illustrated on **Figure 2.3** in **Chapter 2** of this volume) to increase by an additional 3m above stated roof heights to permit additional roof plant or machinery to be secured. Visually Verifiable Images (VVIs) are based on building height parameters without the 3m additional height allowance.

- The landscape restoration plan involves extensive bulk earthworks, excavation, earth placement and modelling. At this stage the final detail of the formation levels across the landscape restoration area is not known, but illustrative information is provided in the landscape restoration plan (see **Figure 22.59**), setting out the likely finished ground levels. Details regarding the finished ground levels will be submitted as part of the detailed landscape scheme, submitted pursuant to a requirement in the DCO.
- The impact assessment has therefore been based on the likely ground levels across the site and has factored into the assessment potential changes to ground levels that may arise in the design development process, allowing for a potential variation in the stated heights of +1m to +1.5m has been assumed. Such variations have been assessed and it is considered that such change across the site would not give rise to any additional significant impact on landscape or visual receptors than that already identified. The effectiveness of the proposed screening earthworks and planting mitigation proposed and illustrated in the VVIs will not be materially altered.
- The mitigation of landscape and visual impacts has been considered from an early stage in the project. As such, consideration of landscape and visual impacts comprising both the construction and operational phases has been an important part of the design process, including architectural and landscape design, and development of the lighting strategy. Further details of the iterative design process are provided within the description of the HPC proposed development (see **Chapter 2** of this volume), and the alternatives chapter (see **Chapter 6** of this volume), which describes the alternative design options which have been considered with respect to the potential environmental impact.
- The assessment of the lighting impacts of the proposed development on visual amenity is based on construction and operational lighting strategies and health and safety requirements. The lighting strategy is considered inherent mitigation within the design of the proposed development and as such is not part of further or additional mitigation measures. The HPC Construction Lighting Strategy is appended to the **Construction Method Statement** and **HPC Operational Lighting Strategy** is appended to **Chapter 2** of this volume.
- The principles of mitigation adopted for this EIA are consistent with the guidance on landscape mitigation provided within the consultation document EIA: A Guide to Good Practice and Procedures produced by the Department for Communities and Local Government (DCLG) (Ref. 22.30).

22.5 Baseline Environmental Characteristics

a) Introduction

22.5.1 This section describes the landscape and visual baseline environmental conditions for the HPC proposed development.

b) Study Area Description

22.5.2 The HPC development site is located to the west of and adjacent to the existing Hinkley Point Power Station Complex. It occupies farmland extending westwards up to Benhole Lane, and southwards to Holford Stream and the village of Shurton. The on-shore part of the HPC development site is bounded to the north by Bridgwater

Bay, from which it is separated by a low cliff. The site then extends into the Bridgwater Bay to accommodate off-shore construction activities. The on-shore part of the HPC development site is bisected by Green Lane, a local ridge running east-west up to a maximum elevation of approximately 35m AOD. A detailed description of the HPC development site is presented in **Chapter 1** of this volume.

22.5.3 The LVIA study area is shown on **Figure 22.3**. The maximum extents of the LVIA study area are as follows:

- Lowland Somerset – up to 18km from the HPC development site;
- Exmoor National Park – up to 25km from the HPC development site;
- Mendip Hills AONB – up to 21km from the HPC development site; and
- Welsh coastline – up to 21km of the HPC development site.

c) Environmental Designations

i. International and National Designations

22.5.4 There are no national or international landscape designations within the HPC development site.

22.5.5 However, there are several important international or national landscape and environmental designations within the LVIA study area which are illustrated on **Figure 22.4**. These designations are:

- Exmoor National Park;
- Quantock Hills and Mendip Hills AONB;
- The Severn Estuary Ramsar site;
- The Severn Estuary Special Protection Area (SPA);
- The Severn Estuary Special Area of Conservation (SAC);
- The Bridgwater Bay Site of Special Scientific Interest (SSSI), Blue Anchor to Lilstock Coast SSSI, and the Quantocks SSSI;
- The Bridgwater Bay National Nature Reserve (NNR);
- Scheduled Monuments;
- Registered Parks and Gardens; and
- Area of outstanding scenic interest.

22.5.6 Exmoor National Park is situated within the counties of Somerset (71% of the park) and Devon. The boundary of the National Park is located approximately 14km to the west of the HPC development site.

22.5.7 The Quantock Hills AONB was designated in 1956 under the National Parks and Access to the Countryside Act 1949 and was the first AONB designated in England. It is approximately 9,900ha in area and at its closest is located approximately 3.7km away from the HPC development site. It falls within the boundary of three local planning authorities, namely: WSC, SDC and Taunton Deane Borough Council (TDBC). The Mendip Hills AONB lies approximately 19.5km north-east of the HPC development site.

22.5.8 The Bridgwater Bay NNR is approximately 5km north of the town of Bridgwater and comprises the lower reaches of the River Parrett and its estuary where it flows into the Bristol Channel. Along the coast the site extends north to the town of Burnham on Sea and as far west as the village of Lilstock. The area is also designated as the Bridgwater Bay SSSI, the Severn Estuary SPA and part of the area is in the process of being designated as a SAC. The area comprises a succession of habitats ranging through extensive intertidal mudflats, saltmarsh, shingle beach and grazing marsh intersected by a complex network of freshwater and brackish ditches. The ditches and ponds contain a diverse invertebrate fauna including six nationally rare species and eighteen nationally scarce species. The site is an integral part of the Severn Estuary system and is ecologically linked to the Somerset Levels which provide alternative winter feeding grounds for waders and wildfowl.

22.5.9 A Scheduled Monument (Wick Barrow, commonly known as Pixies Mound), dating from the Neolithic and Bronze Age, is located immediately to the east of the HPC development site. The visual impact on Pixies Mound is considered in this assessment. The full list of Scheduled Monuments and the assessment of impact of the HPC proposed development on their setting are included in **Chapter 23** of this volume (historic environment).

22.5.10 There are a number of Registered Parks and Gardens within 10km of the HPC development site. Two are located within the ZTV, namely; Fairfield and St Audries. Both are of historic value and are included by English Heritage in the national Register of Parks and Gardens of special historic interest in England. The full list of Registered Parks and Gardens and the impact of the HPC proposed development on their setting is assessed in **Chapter 23** of this volume (historic environment).

22.5.11 Areas of outstanding scenic interest are described by Natural England as landscape designations aimed to protect landscapes of outstanding, scenic, historic and scientific interest; although they are not a statutory landscape designation as such. An area of outstanding scenic interest covering the historic Fairfield Estate is located adjacent to the HPC development site and extends farther to the west. Two other areas of outstanding scenic interest are located to the west of Fairfield Estate. Areas of outstanding scenic interest located within the LVIA study area are shown on **Figure 22.4**.

ii. Regional and Local Designations

22.5.12 Regional and local designations within 5km of the HPC development site are shown on **Figure 22.4a**.

22.5.13 There are two Conservation Areas within 5km of the HPC development site; Stogursey and Nether Stowey. Baseline descriptions and assessments of the impact of the HPC proposed development on their setting can be found in **Chapter 23** of this volume (historic environment).

22.5.14 The nearest Green Wedge designation is located approximately 11km to the north-east of the HPC development site, adjacent to the coastal settlements between Burnham-on-sea and Brean Down. There are no Green Wedge designations within 5km of the HPC development site.

22.5.15 There is a County Wildlife Site (CWS) within the HPC development site (Hinkley County Wildlife Site). The full list of relevant CWS within the LVIA study area and an assessment of the impact of the HPC development site on these sites are provided in **Chapter 20** of this volume. County Wildlife Sites are shown on **Figure 22.4a**.

d) Landscape Character Baseline

i. Introduction

22.5.16 The assessment of landscape character is an objective process that provides factual information about a particular locality. It does not itself attribute a place with an account of its relative quality, sensitivity or capacity to accommodate particular types of development, and nor does it prescribe whether particular development or landscape change would be appropriate or inappropriate. However, an assessment of landscape character can be used as a basis on which to attribute value, sensitivity and/or capacity at a range of spatial scales - such as at the county, district and site scales of assessment. An understanding of landscape character, and the elements and features that contribute to character can also inform the development of landscape strategies and the iterative design process, in which mitigation proposals are developed in tandem with the design of the HPC proposed development.

22.5.17 In England, a hierarchy exists from the broad scale national character assessment at the top tier, through regional and county scale assessments to those at the district/ local scale. At the most detailed level, site specific landscape character assessments are undertaken, often to provide an accurate and appropriate description of baseline conditions to help inform the siting and design of new development and to provide a basis on which to assess the direct and indirect impacts of new development and changes to land management regimes. Each level in the assessment hierarchy should, in principle, add detail to the layer above, with the broader scale assessment providing a context and framework for more detailed assessments.

22.5.18 Analysis of landscape character at the national and regional scale of assessment is presented for the full LVIA study area, and as such includes reference to broad scale assessments for England and Wales (see **Figure 22.5**). Analysis of local landscape character assessment is presented for the LVIA study area in England and includes reference to seascape character assessment for the coastal element from the coastline up to the low water mark (see **Figures 22.6** and **22.6a**). Site scale assessment has been undertaken for the site and its immediate landscape context within the Quantock Vale local landscape character area (see **Figure 22.7**). An assessment of landscape elements and features is presented for the HPC development site only (see **Figure 22.8**).

22.5.19 The assessment of impacts on landscape character is undertaken at the local and site scales of assessment. An assessment of the impacts of the HPC proposed development on landscape elements and features is also presented for the HPC development site.

22.5.20 Several studies are of relevance to understanding the character of the landscape in the vicinity of the project within the LVIA study area.

22.5.21 In England the national landscape character assessment provides an important overview of landscape character and context within which to understand the HPC development site and its wider setting, extending to the full extent of the LVIA study area and including all locations in which highway improvements associated with the

HPC project are planned. Reference is also made to the draft Landscape Character Map for Wales (Ref. 22.31) which presents character assessment information for the entirety of Wales at a scale similar to National Character Assessment of England.

22.5.22 Local scale landscape character assessments, prepared by local planning authorities, National Park Authorities and AONB Units/Partnerships in England present a more detailed description of landscape character to that contained in the national landscape character assessment in England. It should be stressed that landscape assessments undertaken at the local scale of assessment are often for wide geographic areas, and do not necessarily deal with a specific issue in a particular location. As such their findings can only be used as a basis for understanding landscape character at a broad scale. As such desk study and field survey has been undertaken by LVIA chapter authors to confirm the findings of existing landscape assessments and to attribute sensitivity to the various landscape character areas described for the purposes of undertaking the LVIA. The findings of the local landscape character assessment, and judgments regarding sensitivity of the landscape character types/areas forms the basis of assessing the impacts arising from the HPC proposed development and associated highways works on local landscape character in this assessment.

22.5.23 In addition, a site scale landscape character assessment has been undertaken to describe the HPC development site and its immediate landscape setting and ascribe landscape sensitivity at this detailed scale of assessment. As noted in section 22.4 (methodology) the condition prior to any preliminary works within the HPC development site is taken as the basis of the descriptions of site scale landscape character areas. An assessment has also been undertaken of the key elements and features that combine to create the landscape character of the HPC development site, both to describe in greater detail baseline landscape conditions and also as a basis to assess the impacts of the HPC development site scale landscape character.

ii. Landscape Baseline Summary

22.5.24 An assessment of landscape character from national to site scale is presented in the pages that follow. The analysis identifies the HPC development site as lying within the rolling coastal lowland mixed farming landscape of the Vale of Taunton and Quantock fringes which contrasts with neighbouring upland areas of the Mendips, Exmoor and Quantock Hills, the lower lying Somerset Levels and Moors and the coastal and marine landscape of Bridgewater Bay and the Bristol Channel.

22.5.25 The rolling agricultural landscape in which the HPC development site lies is not designated for its landscape value at a national level. However, the Quantock Hills, located approximately 3.7km from the HPC development site is designated as an AONB and the upland areas of the Mendips and Exmoor, located towards the fringes of the LVIA study area are designated as an AONB and National Park, respectively. The coastal elements of the HPC development site form part of more extensive international and national biodiversity and wildlife designations.

22.5.26 In close proximity to the HPC development site local variations in landscape character are assessed and described. The analysis emphases variations in landform, land cover patterns and land use, and highlights sites and areas that are locally designated for their heritage, landscape and wildlife value and interest. The analysis confirms that the HPC development site is not subject to any form of local landscape designation, but records that areas within the site and in close proximity to it are designated, notably as County Wildlife Site and area of outstanding scenic interest. Stogursey, a nearby village, contains a Conservation Area and several local settlements include Listed Buildings.

22.5.27 The site scale landscape assessment recorded localised variations in character and the elements and features that contribute to the character of the HPC development site.

iii. National Landscape Character

England

22.5.28 At the national scale of assessment, significant work was undertaken in the mid-to-late 1990's by the Countryside Agency and English Nature (together now Natural England) to map and describe the broad variations in character that can be identified across England. The assessment identifies 159 Joint Character Areas (known as National Character Areas) and the findings are presented in eight regional volumes. With reference to Volume 8: South West (Ref. 22.32) all or part of six National Character Areas lie within the LVIA study area (see **Figure 22.5**).

22.5.29 The HPC development site falls within National Character Area (NCA) 146 – Vale of Taunton and Quantock Fringes. The landscape is described as a broad sweep of pastoral lowland landscape which contrasts to the steep moorland-topped character of the Bredon and Quantock Hills to the west and the open character of the clay levels to the east.

22.5.30 The landscape is characterised by irregular, medium sized fields bounded by thick hedgerows, commonly on top of banks. Narrow winding lanes link substantial farmsteads and hamlets, where red sandstone and less commonly, cob are characteristic building materials.

22.5.31 Woodland is described as sparse and the distribution of hedgerow trees variable. Orchards are noted as being a once prominent feature of the Vale but that the older orchards are now in decline.

22.5.32 Within the character area, considerable variety is evident. In the low lying Tone valley the landscape is flat and open displaying something of the character of the nearby Levels. Beyond this, the Vale is described as a patchwork of arable, pasture, market gardening and orchards. Beyond the lower lying parts of the vale, the land rises towards the high moorlands where there are the more steeply undulating hills and valleys of the high vale. Along the coast, to the north of the A39, further local variations are evident. Here the landscape is described as a belt of rolling, open windswept countryside with a few scattered trees and small villages. Field patterns are generally rectilinear and the landscape is broken by blocks of low-lying wet pasture where meandering streams meet the coast. Parts of the coast are described as remote and rather bleak, with the existing Hinkley Point Power Station noted as a prominent feature in the east but with fine views past Steep Holm and Flat Holm to the Welsh coast.

22.5.33 With regard to the observable changes to the countryside, hedgerow removal and a decline in hedgerow management are cited. Small woodlands, described as essential to the character of this sparsely wooded landscape have also been lost, as have hedgerow trees, notably as a result of Dutch Elm Disease. Major development in recent decades is also noted. This has introduced new elements into the landscape such as mineral workings, industrial development and major transport and electricity transmission infrastructure. Hinkley Point is described as a "*very prominent*" feature in the landscape and it is noted that expansion could "*make this impact worse.*" (Ref. 22.32).

22.5.34 The assessment presents broad strategies for shaping the future landscape. It notes that the rural and agricultural character of the landscape, and especially the pattern of irregular fields and thick hedgerows with oak trees, is important and that the retention and appropriate management of hedgerows, hedgerow trees and small copses and woods should be addressed. Additional strategies include the retention, management and replanting of traditional orchards, smaller new buildings in rural locations reflecting the influence of the red sandstones and maintaining the contrast between different parts of the character area i.e. the river floodplains, low vale and high vale.

22.5.35 By way of a summary, the key characteristics of the Vale of Taunton and Quantock Fringes NCA include (Ref. 22.32):

- *"Lowland farmland qualities in sharp contrast to surrounding upland landscapes.*
- *Lowland mixed farming landscape, with dense hedges, sparse woodland and frequent settlement.*
- *Contrast between floodplain, low clay vale and higher sandstone vale edge.*
- *Scattered settlement of farmsteads and hamlets linked by winding lanes.*
- *Scattered villages.*
- *Red sandstone buildings and prominent Perpendicular church towers.*
- *Cider apple orchards.*
- *Variable hedgerow tree cover, with some areas of abundant hedgerow oaks.*
- *Willows on floodplains.*
- *Open and windswept coast with low cliffs."*

22.5.36 Approximately 1km to the east of the HPC development site extends National Character Area 142 – Somerset Levels and Moors. Its characteristics are combined with National Character Area 143 – Mid Somerset Hills, which extends approximately 12km to the east of the HPC development site and beyond.

22.5.37 The landscape is described as a broad area of low-lying farmland and wetland surrounded and divided up by low hills and ridges. The NCA describes the landscape as comprising five distinct elements: hills and islands; the peat moors that lie between them, the clay Levels towards the coast; the dunes and tidal flats of the coast itself; and the sand banks or 'burtles' marking the position of former river channels.

22.5.38 The hills are described as being generally well wooded, with good tree and hedgerow cover, which softens the often frequent settlement. From the hills the assessment notes that expansive views across the Levels and Moors are possible. The Moors lie within the inland basins formed by the hills. Many parts are largely treeless and are dominated by the planned pattern of the rhynes. Near the islands and ridges there is more tree and shrub cover, notably of pollarded willows, marking a transition to a landscape of hedges, farmsteads, villages and orchards as the land rises. While peat extraction has influenced local landscape character, the abiding character of the Moors is centred on a pastoral wetland landscape of long views across a foreground of rhynes, pollards and occasional withy beds. The Levels are a low belt of marine clay which runs parallel to the coast. With its intermittent areas of sinuous lanes and irregular fields, it is an older landscape than the reclaimed moors and more densely populated. The Levels abut a coastline of extensive mudflats around the Parrett estuary and the edge of Bridgwater Bay where sand dunes extend northwards to Brean Down and where caravan parks and camp sites are prominent features.

22.5.39 Despite the distinctions made between these component parts, the landscape character area is described as having a strong unity and a distinctive character. Indeed, a great deal of its charm and interest is described by the writer Hawkins as being because of its paradoxical character; "*at once more wild and primitive and yet more artificial than any other part of England*."

22.5.40 Key characteristics of the Somerset Levels and Moors/Mid Somerset Hills include (Ref. 22.32):

- *"Flat, open landscape of wet pasture, arable and wetland divided up by wet ditches or 'rhynes'.*
- *Absence of dispersed farmsteads or any buildings on levels and moors. Nucleated settlements on ridges/islands.*
- *Surrounded, and divided up, by low hills, ridges and islands which form distinctive skylines.*
- *Peat working and nature reserves contrasting with the rectilinear planned landscape of the Moors.*
- *Dramatic and prominent hills such as Brent Knoll, the Isle of Avalon and Barrow Mump, rising above the Levels and Moors.*
- *Sparse tree cover on Levels and Moors contrasting with woodland, hedges and orchards of surrounding hills.*
- *Sparsely populated Moors but settlements common on hills, ridges and islands.*
- *Historic landscape strongly evident in features ranging from prehistoric trackways and lake villages, to post-medieval enclosures and peat working.*
- *International nature conservation significance for wetland, waders and waterfowl.*
- *Narrow dune belt fringing Bridgwater Bay.*
- *Raised rivers and levees, with main roads and causeways flanked by houses. Flooding in winter over large areas."*

22.5.41 Approximately 5km to the south-west of the HPC development site rises the Quantock Hills National Character Area (NCA 144). The Quantock Hills is described as an open moorland and heath covered ridge, from which wide views (reputedly over nine counties) are possible. The eastern slopes are described as gently undulating and farmed, with a mixture of hedged pasture and arable land. This contrasts to the steeper western slopes which are deeply dissected by thickly wooded combes below the springline. The open and exposed summits are described as being devoid of settlement and possessing an air of solitude and wilderness, imparting a feeling of space and remoteness.

22.5.42 Key characteristics of the Quantock Hills include (Ref. 22.32):

- *"Central high, heathland ridge, with some beech clumps.*
- *Irregular field patterns and farmsteads in sheltered fringes.*
- *Steep wooded valleys and lower slopes, commonly with former deer parks. Beech copses and lines are characteristic.*
- *Red sandstone and shales used in older buildings and giving colour to the soils.*
- *High archaeological interest of Bronze Age monuments such as burial mounds."*

22.5.43 Approximately 14km to the west of the HPC development site is the Exmoor National Character Area (NCA 145). Exmoor is described as an extensive upland landscape displaying strong contrasts between open moorland, sheltered hollows, steep valleys and wooded slopes. The assessment notes that from the rolling moorlands at its centre, there are wide views across a largely treeless landscape. It goes on to describe the whale-back ridges and steep combes forming a "*spectacular coastline*".

22.5.44 The central moorlands are described as possessing a remote upland character and being largely devoid of settlement. Towards the outer edges of the moor and the Brendon Hills heather moorland is common, but the central areas of Exmoor are often cloaked in purple moor grass. The moorland edge is characterised by rectangular fields dating to the 19^{th} century. In more sheltered areas there is an older landscape of scattered farmsteads, hedged fields and sunken lanes.

22.5.45 Key characteristics of Exmoor include (Ref. 22.32):

- *"A diverse upland landscape, rising abruptly out of the surrounding lowlands and ending in a high and spectacular cliffed coastline with coastal heath at the edge of the Bristol Channel.*
- *Central high, treeless heather and grass moorlands used for rough grazing.*
- *Extensive 19th century moorland-edge enclosures and farms with beech-topped hedgebanks and beech windbreaks.*
- *Steep, wooded inland valleys and steep, coastal combes.*
- *Regular, straight-sided fields usually enclosed by earth banks and stone walls.*
- *Villages and farmsteads nestle in sheltered valley bottoms.*
- *Wooded lower slopes in some places, some with former deer parks.*
- *Slates and sandstones used in older buildings.*
- *Complex and visually outstanding coastline of headlands, steep cliffs and coves.*

- *High archaeological interest of Bronze Age monuments such as hill-forts."*

22.5.46 Approximately 17km to the north east of the HPC development site is the Mendip Hills National Character Area (NCA 141). The NCA is described as rising abruptly out of the flat landscape of the Somerset Levels and Moors to the west and combing classic features of a karst landscape, including cave and river systems with complex ritual, industrial and agricultural landscapes extending in time from the prehistoric period to modern quarrying.

22.5.47 The central feature of the Mendip Hills is described as a gently undulating limestone plateau with an outstanding assemblage of prehistoric features on which sits a rectilinear pattern of 18th century fields. Contrasting to the plateau are four outcrops of Old Red Sandstone. Here heathland and acid grassland mark a sharp contrast to the remainder of the landscape which is mainly agriculturally improved pasture. Settlement is mainly in the form of scattered farmsteads, often with clusters of wind-shaped trees around them. Trees are otherwise described as being scarce.

22.5.48 Compact villages are noted at the foot of the steep slopes that surround the plateau, with the slopes above displaying a mosaic of woodland and scrub, small fields and the remnants of sheep walks. To the west of the plateau, the land breaks up into groups of individual hills narrowing to a prominent ridge at Brean Down, beyond which the limestone islands of Steep Holm and Flat Holm emerge from the Bristol Channel.

22.5.49 The key characteristics of the Mendip Hills include (Ref. 22.32):

- *"A chain of prominent hills extending inland from the cast and rising up sharply from surrounding lowlands.*
- *An open, largely treeless, limestone plateau with karst features, cave systems, dry stone walls and sparse settlement.*
- *Dramatic gorges, cliffs and escarpment slopes around the plateau.*
- *A sharp contrast between the open plateau and steep escarpment slopes of the karst landscape and the more complex, gentler landforms in the east.*
- *Many industrial archaeological sites reflecting the lead, coal and cloth industries.*
- *Perpendicular church towers.*
- *Country houses in the east with wooded parks.*
- *Buildings in local stone with pantile roofs: stones include grey limestone, reddish dolomitic limestone and grey or honey-coloured oolitic limestone.*
- *Outstanding prehistoric ritual landscapes."*

Wales

22.5.50 At the national scale of assessment in Wales, the Countryside Council for Wales (CCW) has developed a draft 'Landscape Character Map' (Ref. 22.31) to map and describe the broad variations in character that can be identified across the country. The draft assessment identifies 48 regional scale landscape character areas (RLCA); each one possessing a distinct sense of place. It is noted that within each area different parts will have their own identity as well, and as such reference is made to CCWs LANDMAP landscape information system.

22.5.51 With reference to draft character area descriptions supplied by CCW, part of two regional scale character areas lie within the LVIA study area (refer to **Figure 22.5**).

22.5.52 Approximately 18.5km to the north of the HPC development site is the Cardiff and Newport Regional Character Area (RLCA 35).

22.5.53 This intensively urbanised area is dominated by Cardiff and Newport and occupies the lowland margins to the south-east of the South Wales coalfield. The landscape us underlain by a varied geology of mudstones, sandstones and occasional limestone outcrops. A number of major rivers cut through the area, and through glacial moraine features.

22.5.54 The sense of place is dominated by built up areas, notably Cardiff, Newport and the towns of Cwmbran, Penarth and Barry. The rural landscape between these built up areas is typically a patchwork of medium sized, hedged pastoral fields with broadleaved woodlands, sometimes penetrating urban areas.

22.5.55 The M4 and other transport infrastructure are noted as dominating parts of the landscape. The assessment also makes reference to the oil refinery near Sully as standing prominent on the skyline of the surrounding agricultural landscape. Despite the influence of urban areas, the assessment records that the open rural landscape between the urban areas is under pressure but is tranquil in areas away from major transport corridors.

22.5.56 The town of Barry is noted as being best known for its pleasure beach. The assessment adds that its docks are being redeveloped and that the town retains an industrial character with its large chemical works which draw the eye at night with its lit structures.

22.5.57 The assessment also notes that the landscape and coast between Pennarth and Barry is partly urban fringe in character and includes the Cosmeston Lakes Country Park. The coast is described as having features of interest including cliffs, coves and wave platforms and includes the distinctive Sully Island and Lavernock Point with its views to Flatholm and the Somerset Coast.

22.5.58 Approximately 19km to the north-west of the HPC development site is the Vale of Glamorgan Regional Character Area (RLCA 36).

22.5.59 This is a described as a distinctive lowland landscape, largely comprising a rolling Blue Lias limestone plateau. Older Carboniferous Limestone outcrops from areas of higher ground and Triassic mudstones define the eastern area. The Piedmont ice deposited glacial till across the landscape contributing to its undulating topography.

22.5.60 A variety of land uses define the area, including dairying, sheep rearing, arable, pony paddocks and pig rearing. A mixture of field patterns and sizes is evident, enclosed by hedges or hedge-banks, with frequent hedgerow trees. Limestone walls define land above the cliffs in the west. Frequent woodland clumps, field trees, riparian woodlands and small plantations characterise the eastern area.

22.5.61 In the centre of the Vale compact and historic settlements with limited modern development reinforce the area's distinctive sense of place. However, the assessment also records that many of the Vales villages have expanded with modern housing detracting from their historic character and that a cement works are visually prominent features of the south coast.

22.5.62 The coasts are described as affording a number of attractive beaches. The assessment also records that the rural and historic character of the Vale engenders a strong sense of enclosure, tranquillity, intimacy and timelessness and that long and attractive views are possible from the coast across the Bristol Channel to Somerset.

iv. Local Landscape Character

22.5.63 Many planning authorities, AONB Units and National Park Authorities in England have undertaken assessments of their administrative or designated areas in order to contribute a greater level of detail and local relevance to the national scale character assessment.

22.5.64 In order to understand local landscape character and to provide a basis for assessing the impact of the project on landscape character, several existing studies have been reviewed and their findings verified:

- West Somerset Landscape Character Assessment 1999 adopted in 2006 as part of the West Somerset Local Plan (Ref. 22.33);
- The Sedgemoor District Landscape Assessment and Countryside Design Summary 2003 (Ref. 22.34);
- North Somerset Landscape Character Assessment 2005 (Ref. 22.35);
- Landscape Assessment of the Mendip Hills AONB 1999 (Ref. 22.36);
- Somerset and Exmoor Historic Landscape Characterisation Project 1999-2000 (Ref. 22.37);
- Landscape Character Assessment of the Borough of Taunton Deane 2008 (Ref. 22.38); and
- The Quantock Hills Landscape (Ref. 22.39).

22.5.65 These landscape character assessments have been undertaken at different times, draw on different best practice guidance and in some cases have been undertaken for overlapping geographies. As such it was necessary to draw their findings together to establish a composite map and description of local landscape character for the LVIA study area.

22.5.66 To supplement information contained in published landscape character assessments for terrestrial areas, the LVIA also maps and describes five seascape character areas within the LVIA study area, extending to the low water mark.

22.5.67 The assessment of local seascape character draws on relevant information from the West Somerset Landscape Assessment (Ref. 21.33) and Sedgemoor Landscape Character Assessment (Ref. 21.34) supplemented with field survey by qualified landscape professionals. Reference has also been made to the Bridgwater Bay to Bideford Bay Shoreline Management Plan (Ref. 21.40).

22.5.68 As illustrated on **Figures 22.6** and **22.6a**, parts of nine local landscape character areas (LLCAs) and 5 local seascape character areas (LSCAs) lie within the study area for local landscape character. Descriptions of all relevant LLCAs and LSCAs follow.

Quantock Vale LLCA

22.5.69 The HPC development site is located within the Quantock Vale local landscape character area, which comprises four distinct sub areas; Eastern Lowlands, Coast, Wick Moor and Coast; and Wall Common and Coast. The principal source for the following description is the West Somerset Landscape Character Assessment.

22.5.70 The Quantock Vale local landscape character area is a flowing lowland landscape of valleys and gentle hills although the Quantock ridge is noted as being a dominant feature to the south-west. In common with most of the district, the landform is overlain by an essentially agricultural landscape of small fields, hedges, hedgerow trees and small woodlands. Stogursey is the only village of significant size but there are several small settlements and numerous farms. The lowlands define this character area, but two small areas of marsh and coast are locally distinctive.

22.5.71 The Eastern Lowlands sub area, in which the existing Hinkley Point Power Station Complex and HPC development site are located, is an extensive tract of low rolling hills where variations in landform and soils do not appear to have had a significant influence on vegetation and land use patterns. Medium sized deciduous woodlands and copses are noted as being scattered throughout the area and reference is also made to mixed species hedgerows and hedgerow trees as a key characteristic.

22.5.72 Within this long settled area, the only village of any size is Stogursey. All other settlements are small, nucleated villages and hamlets and farms. The existing Hinkley Point Power Station Complex is described as a notable modern development, but that it is not as visually dominant from within the area as might be expected, although it is acknowledged that it is a significant feature in views of the area from the Quantock Hills. Overhead lines are described as locally dominant features.

22.5.73 The coastal element of the Eastern Lowlands sub area is described as an erodible cliffed coastline with the cliffs fronted by a wave cut, intertidal rock platform; both of which are noted as being of geological and geomorphological interest. Other areas, such as land slips are also described as being of biodiversity interest. In comparison to other areas of the coast, the coastal element of the Eastern Lowlands landscape character sub area is described as containing virtually no settlement or tourist development.

22.5.74 The Wick Moor and Coast sub area is a finger of coastal marsh immediately to the east of Hinkley Point. The area is predominantly used as grazing marsh in the summer and some scrub is evident along the lines of drainage ditches. Subject to flooding, the marsh is of high nature conservation value. A submarine forest is also noted as being of importance for marine archaeology. Lying below 10m Above Ordnance Datum (AOD) the area is described as open and bleak. The existing Hinkley Point Power Station Complex is described as being visually dominant on this landscape.

22.5.75 Wall Common and Coast shares characteristics with the Wick Moor and Coast sub area. However, reference is also made to a series of low cobble embankments separating fields from the sea and a strip of salt marsh to the seaward side. The coast is noted as being of high nature conservation value.

22.5.76 The landscape character sensitivity of the Quantock Vale local landscape character area is judged to be **medium**. Landscape character is currently influenced by the existing Hinkley Point Power Station Complex which has varying visual prominence dependent on location and the influence of localised characteristics such as landform and vegetation. The majority of the character area is not designated at the national or local authority scale for its landscape or biodiversity value. However, some areas, notably in the west of the character area beyond the HPC development site boundary are designated as an area of outstanding scenic interest. Only a very small part of its western fringe is designated as AONB. The landscape character area also contains areas designated for their nature conservation interest, notably along the coastline.

22.5.77 Further descriptions of Quantock Vale sub character areas and the assessment of their sensitivity are provided below in a separate, more detailed analysis of Quantock Vale landscape character.

Doniford Stream and Quantock Fringe LLCA

22.5.78 The principal sources for the following description are the West Somerset Landscape Character Assessment (Ref. 22.33) and The Quantock Hills Landscape (Ref. 22.39).

22.5.79 Along the northern boundary of the Quantock Hills AONB, the main ridge is fringed by productive farmland that sweeps down to the coastline affording open views across Bridgewater Bay. The steeper foothill slopes remain under pastoral land uses, whereas where gentler gradients occur near the coast, larger, rectangular hedged fields are characteristic. Evidence suggests these have been cultivated for many hundreds of years, and they retain arable weeds in the field margins that are usually associated with traditional land management. This relatively low lying narrow band of land has long been an important communication route and now carries the A39. Its strategic importance and the productivity of the land led in the Middle Ages to the development of two estate villages at East Quantoxhead and Kilve.

22.5.80 To the west, and largely outside the AONB boundary lies the Doniford valley. The landscape is characterised by a similar pattern of hedged fields albeit with more extensive areas of woodland and frequent copses. The valley has a distinct linear quality being enclosed by elevated landform; to the east by the Quantock ridge and to the west by the Brendon Hills. The western slopes of the Quantock ridge, below the wooded scarp, are characterised by an apron of enclosed pastoral landscape. Streams issuing from the steep combes continue in shallow depressions creating wetland flushes with damp grassland and patches of willow and alder. This fringe is dominated by the rising landform of the hills and several villages, including Bicknoller sit along the spring line at the foot of the scarp.

22.5.81 The coastal edge of the AONB is considered to be of international geological importance. Here low cliffs of interbedded limestone and mudstone are being gradually eroded by the sea to reveal the foreshore landscape and the fossil remains of many animals. Despite some tourist development, the AONB coastline retains an exposed, wild character that contrasts to the productive, enclosed inland scenery of the northern Quantock foothills.

22.5.82 The sensitivity of the Doniford Stream and Quantock Fringe landscape character is assessed as **medium**. Although the coastal part of this LLCA is of higher sensitivity due to its location within an AONB, the existing Hinkley Point Power Station Complex has a very low prominence within this area due to topography and distance. The majority of the character area is not designated at the national or local authority scale for its landscape or scenic interest or biodiversity value.

Central Quantocks LLCA

22.5.83 The principal sources for the following description are the West Somerset Landscape Character Assessment (Ref. 22.33) and The Quantock Hills Landscape (Ref. 22.39).

22.5.84 The Central Quantocks comprises a high plateau underlain by Devonian sandstones known as the Hangman Grits. The plateau rises into smooth, rounded summits cut by deep combes, creating the characteristic landform of repeating ridges and valleys. Woodland, at one time common, now only remains on the steep combe sides and on some of the eastern hill flanks. The loss of woodland on the summits led to the degradation of hilltop soils and they now support a heathland cover that is managed as common land of great ecological value.

22.5.85 The open summits and combes with heathland is one of the most distinctive landscape types in the AONB. It is a rolling landscape where the elevation, exposure and long views engender a sense of wilderness, isolation and solitude. The low heathland vegetation reveals the distinctive landform and permits long views beyond the hills and down through the combes. The plateau has a long history of human use. It formed part of a Bronze Age ritual landscape and the remains of barrow cemeteries can be found on many high summits, ridges and spurs. Dowsborough Hill is also significant as the site of an Iron Age hillfort with views over the surrounding lowlands. The existing Hinkley Point Power Station Complex is a visible feature in panoramic views to the east.

22.5.86 The open combes dissect this upland plateau. They lead gently from the foothills to the summits where they open out to reveal unexpected views and panoramas, framed by landform. The effect is made more dramatic by the juxtaposition of enclosed sheltered valleys and open exposed summits.

22.5.87 On the eastern flanks of the northern portion of the Quantock Ridge, deep wooded combes are characteristic. Here the steep valley sides are clothed with western oak woodland which merges with the moorland at the head of the combes and on their upper slopes. Here the trees are severely wind pruned and sculpted by strong westerly winds. The valleys are threaded with well-used paths up onto the hilltops where the woodland falls away to reveal panoramic views.

22.5.88 On the western edge of the ridge is a wooded scarp which falls steeply from the upland plateau down to the rich agricultural land of the Quantock Vale. The steep slope and smooth crest are distinctive features in views to the hills. The slopes are generally well wooded with broadleaved copses, forestry plantations and medieval and designed parklands. Lines of beech often cut sharply across the contours and are a particularly dominant feature where they descend down the spurs.

22.5.89 The sensitivity of the Central Quantocks landscape character is assessed as **high** due to its location within the Quantock Hills AONB. The open, elevated summits of

NOT PROTECTIVELY MARKED

the Central Quantocks have very distinctive landscape characteristics, high scenic value, and provide long distance views in all directions.

Quantock Hills LLCA

22.5.90 The principal sources for the following description are the Sedgemoor District Landscape Assessment and Countryside Design Summary 2003 (Ref. 22.34) and The Quantock Hills Landscape (Ref. 22.39).

22.5.91 The southern part of the AONB is generally underlain by younger, softer rocks which have been weathered to create lower, rounded undulating hills that carry a mantle of enclosed farmland. The surrounding farmland is made up of a patchwork of small pasture fields with mature hedgerows and some larger arable fields. The landscape is described as small scale and domestic with settlement clustered in small hamlets villages and farmsteads. The landscape includes long gentle combes draining eastwards which combine with the undulating topography to create an interior landscape of complexity and variety.

22.5.92 The open southern summits are isolated from the main block of heathland. They are rounded and open and rise up from the surrounding enclosed agricultural landscape echoing the more expansive heathland summits of the northern plateau, albeit lacking the same qualities of remoteness and wilderness. The sense of openness is also diminished, notably because of the fringe of developing woodland and scrub. The existing Hinkley Point Power Station Complex is a visible feature in panoramic views to the east.

22.5.93 Between the open southern summits is a landscape of rolling hills and fringes. The landscape is characterised by soft rounded hills and long, low ridges rolling gently down to the Vale of Taunton Deane and the Somerset Levels. These green foothills are enclosed by a patchwork of mature hedgerows. The fields are mainly permanent pasture, although some areas have been converted to arable production, notably on the long ridges running south eastwards. Where intact field patterns survive, they are of considerable historic interest and in places reflecting Iron Age patterns or phases of Saxon and medieval expansion. Some parts of the higher land have been converted to coniferous plantations and are recorded as having had a significant visual impact within this intimate pastoral landscape.

22.5.94 Long combes drain the hills eastwards. They have gentler gradients than those to the west and are covered by a patchwork of hedged pastures created by medieval and earlier enclosures. Some steeper valley sides have retained woodland and small patches of semi improved grassland. Many combes contain narrow lanes winding up the valleys, sometimes bordered by stone faced hedgebanks bound by the roots of beech trees. Villages shelter in the combes although farms are dispersed along the valleys.

22.5.95 The sensitivity of the Quantock Hills landscape character is considered to be **high** due to its strongly distinctive character and scenic quality. The combination of landform and topography means that these landscapes are particularly vulnerable to change as they are frequently seen in views within and across the AONB, both from the hilltop summits and the many lanes that cross the area.

Central West Somerset LLCA

22.5.96 The principal source for the following description is the West Somerset Landscape Character Assessment (Ref. 22.33).

22.5.97 Central West Somerset is an area of rolling or undulating hills, rarely over 100m AOD, divided by numerous streams and rivers in generally narrow but not exceptionally steep valleys. The hills of Exmoor and the Quantocks visually enclose this area yet the sea to the north creates openness to the view.

22.5.98 Essentially this is an ancient agricultural landscape of small fields, hedges, hedgerow trees and small woodlands but it also contains the main settlements of the district as well as numerous farms, hamlets and villages. The enclosure provided by the surrounding hills and the sea gives this area a cohesion which is difficult to divide. Therefore, this area is considered as two simple sub areas, namely Carhampton to Quantock Coastal Hills and The Coast (Blue Anchor to St Audries).

22.5.99 Carhampton to Quantock Coastal Hills sub area is characterised by a distinctive field pattern form which it is possible to read to medieval influence on landscape. Hillsides contain numerous tree groups and copses and some medium sized woodlands, which create a localised sense of enclosure often combined with undulating topography. This complex pattern is enriched by numerous hedges and hedgerow trees and small settlements, hamlets and farms.

22.5.100 The Coast (Blue Anchor to St Audries) sub area is characterised as an erodible cliffed coastline with wave cut, intertidal rock platform fronting the cliff. Both are of considerable interest for their geological and geomorphological features. The sub area also contains some nationally important examples of coastal flora. The development of caravan sites has led to some localised visual impact on the character of the coastline.

22.5.101 The sensitivity of the Central West Somerset landscape character is assessed as **medium** being of moderately distinctive character and scenic quality. Landscape character is currently influenced by modern development and the majority of the character area is not designated at the national scale for its landscape value. However, some areas are designated as an area of outstanding scenic interest. The landscape character area also contains areas designated for their nature conservation interest, notably along the coastline.

Lowland Hills LLCA

22.5.102 The principal source for the following description is the Sedgemoor District Landscape Assessment and Countryside Design Summary 2003 (Ref. 22.34).

22.5.103 The Lowland Hills rise out of the low and wet landscape of the Levels and Moors and are a series of hills and isolated knolls. The hills historically provided dry land for village settlements and agriculture. Settlement patterns vary between hills from significant, large villages through to a dispersed pattern of hamlets and farmsteads. Use of local stone, dominantly lias limestone, as a building material is common. Hedgerows are the most significant vegetation and vary from being unmanaged and outgrown with many mature trees to lower flailed forms. The area includes land of similar key characteristics lying within parts of two National Landscape Character

Areas; 146 Vale of Taunton and Quantock Fringes and 142/143 Somerset Levels and Moors/Mid Somerset Hills.

22.5.104 The sub areas within this landscape character area of particular relevance to the proposed development site are Quantock Foothills, Stockland Hills, Polden Hills and Isolated Hills.

22.5.105 Quantock Foothills sub area is characterised by low, broad, rolling, hills forming a transition to the steeply folded AONB. The undulating topography contains an ancient network of lanes and field patterns and a scatter of settlements and farms punctuates the landscape. It contains numerous small deciduous woodlands and some remnant parkland landscapes. However, it is a predominantly farmed landscape, with field boundaries demarcated by hedgerows with hedgerow trees, such as ash (*Fraxinus excelsior*) and oak (*Quercus robur*). The area is drained by a number of small streams and brooks, many of which run to the River Parrett. The M5 and overhead lines are described as a notable feature within this sub area.

22.5.106 The Stockland Hills sub area is similar to Quantock Foothills in that it is characterised by low, broad, rolling hills which form a transition between the steeply folded AONB and the wetlands of the Levels and Moors landscape character area but the Stockland Hills are more diverse and smaller in scale. This area has also a strong relationship with the coastal and estuarine areas. Small hills, such as Cannington Park Hill Fort, are present in the area. The area contains a patchwork of larger arable and small pasture fields, unmanaged hedgerows and small woodlands. Settlement in this area includes the old port of Combwich and a small settlement of Stockland Bristol.

22.5.107 The Polden Hills sub area is a long low ridge of variable topography which cuts across the levels, with steeper slope and hillocks to the south and shallower gradients to the north. To the west the area is characterised by small scale agricultural land with hedgerows and trees, particularly ash and oak, and frequent small orchards. A string of loosely rectilinear settlements dating from medieval and Saxon Periods exists along north side of ridge, where there is a sense of unspoilt, peaceful rural charm.

22.5.108 The Isolated Hills sub area is characterised by isolated hills rising out of the levels, visually dominant landmarks and landscape components similar to those of Polden or Wedmore Hills, but with blocks of woodland on steeper slopes. These hills were a natural location for early settlement which has developed on some of them. A sense of rural isolation prevails and long views over surrounding areas can be experienced in this area.

22.5.109 The sensitivity of the Lowland Hills landscape character is assessed as **medium** being of moderately distinctive character and scenic quality. The character area is not designated at the national scale for its landscape value. However, some areas are designated for their nature conservation interest, notably along River Parrett.

Levels and Moors LLCA

22.5.110 The principal source for the following description is the Sedgemoor District Landscape Assessment and Countryside Design Summary 2003 (Ref. 22.34).

22.5.111 The Somerset Levels and Moors are a vast area of drained wetland with limited tree cover and a strong sense of openness. The Moors are an area of summer pastures criss-crossed with a geometric pattern of rhynes, long straight access droves and distinctive pollarded willows (*Salix spp.*) or hawthorn (*Crataegus monogyna*) hedgerows. The Levels and Moors landscape contains several distinctive sub areas. These are described below.

22.5.112 The Levels sub area is characterised by lowland areas on largely flat landscape with irregular field pattern defined by a combination of drainage channels, hedgerows and hedgerow trees. The areas close to the coast are generally open and windswept. Hedgerows are widespread throughout the Levels except in the open coastal areas. Despite the area being the location of urban areas, coastal holiday sites and the M5 motorway, much of the countryside retains a strong sense of remoteness and unspoilt rural character.

22.5.113 The Estuarine Levels sub area has similar characteristics to Levels sub area, but is less developed and more tranquil than the Levels and has a strong relationship with the coastal and estuarine areas. The area around the River Parrett contains a number of environmental designations of international and national importance.

22.5.114 The sensitivity of the Levels and Moors landscape character is assessed as **high** being a landscape of highly distinctive character and scenic quality and an important component of a distinctive Somerset landscape. Much of the western part of this LLCA has a highly remote, rural character and as such is particularly vulnerable to change.

LLCA Limestone Ridges and Combes

22.5.115 The principal source for the following description is the North Somerset Landscape Character Assessment (Ref. 22.35).

22.5.116 Limestone Ridges and Combes are characterised by steep escarpment slopes forming a distinctive and visible topographic feature rising above and creating the backdrop to the low lying areas of the North Somerset District. This LLCA is known for an outstanding collection of historic monuments, earthworks (hillforts) along the scarp top and local legends associated with the gorges/cleeves. The slopes are wooded, with large-scale mixed and deciduous plantations and extensive areas of ancient woodland. Spring line settlement is concentrated along road following the foot of the escarpment ridge. Hidden, deep wooded combes/gorges extend into the scarp slopes providing important historic routeways and now steep, winding rural lanes. This intimate, enclosed wooded landscape is counterbalanced by occasional dramatic and views out to the surrounding lowlands. The field pattern is a mosaic of medieval and post medieval enclosure.

22.5.117 The Mendip Ridge sub area is of particular relevance to this assessment as it provides long distance views towards the west and the existing Hinkley Point Power Station Complex. It is characterised by steep scarp slopes clothed in broad leaved and mixed woodland forming distinctive backdrop to the surrounding low lying areas. Its dramatic combes form routes for winding rural roads often with exposed geology of grey Limestone. The summits are typically grassland plateaus while lower slopes contain pastures in fields bounded by hedgerows. Settlement is sparse with a few scattered stone farmsteads on the plateau and villages centred on historic stone churches on lower slopes. This sub area is known for its rich heritage of historic landscape features, notably the Bronze Age hill fort on Banwell Hill.

22.5.118 The sensitivity of the Limestone Ridges and Combes landscape character area is assessed as **high** being a landscape of strongly distinctive character and scenic quality located within the Mendip Hills AONB.

LLCA Mendips

22.5.119 The principal source for the following description is the Sedgemoor District Landscape Assessment and Countryside Design Summary 2003 (Ref. 22.34).

22.5.120 The Mendip Hills rise from the steep scarp slope on the northern edge of the Sedgemoor District, dominating views from much of the lowland areas and the Isle of Wedmore. The south face of the Mendip Hills presents a dramatic landscape, rising from the low and flat landscape of the Levels, through a narrow band of fertile farmland and settlements, to the steep scarp face with deciduous woodland, enclosed pastures, open heath and downland and a relatively bare plateau skyline. The area contains many pre-historic features and intact medieval patterns. Much of the plateau is a landscape of large fields contained by drystone walls, the unenclosed heathland and downland of Wavering Down, Crook Peak and Brean Down retain a more natural character.

22.5.121 The sub areas within this landscape character area of particular relevance to the proposed development site are Scarp slope, West Mendip Summits and Cheddar Gorge, and Brean Down.

22.5.122 The Scarp slope, West Mendip Summits and Cheddar Gorge sub area rises steeply to a height of 190m to 250m AOD. The relatively steep hillside land is cloaked by a mixture of open downland, heath, deciduous woodland and pasture. Unenclosed heath and downland is the dominant feature of the western part of this zone, giving a distinctly upland character and dramatic contrast with the pastoral Levels landscape it overlooks. The bare skyline includes the distinctive profile of Crook Peak.

22.5.123 The Brean Down sub area is an outlier of the Mendips standing isolated at the mouth of River Axe. It rises to over 90m AOD and has steep cliffs on all sides. Rising abruptly above the estuary and the Levels it is an imposing landmark. It is characterised by the open grassland with panoramic views and is a popular destination for local residents and visitors to the area.

22.5.124 The sensitivity of the Mendips local landscape character area is considered to be **high** being a landscape of strongly distinctive character and scenic quality located within the Mendip Hills AONB with a strong historic influence, including rich historic landscape. Its elevated topography provides dramatic views towards Bridgwater Bay and further towards the Quantocks and Exmoor.

Blue Anchor to St Audries Bay LSCA

22.5.125 The Blue Anchor to St Audries Local Seascape Character Area (LSCA) falls within the Central West Somerset LLCA defined by West Somerset Landscape Character Assessment. The principal sources for the following description are the West Somerset Landscape Character Assessment (Ref. 22.33) and The Bridgwater Bay to Bideford Bay Shoreline Management Plan (Ref. 22.40).

22.5.126 The LSCA is described as an erodible cliffed coastline with the cliffs fronted by a wave cut, intertidal rock platform; both of which are noted as being of geological and geomorphological interest and designated as SSSI. Other areas, such as land slips are also described as being of biodiversity interest. In comparison to other areas of the coast, this LSCA contains only sporadic developments, such as the small harbour of Watchet and a variety of holiday camps, separated by areas of woodland and agricultural land, which is a dominant feature east of Blue Anchor.

22.5.127 The predominantly residential town of Watchet was once a commercial port, however industry which supported it has declined and the harbour is now confined to leisure use. Watchet has a station on the West Somerset Railway, which brings thousands of tourists each year. The railway and the coast road run close to the coast east of Watchet. Beyond this lies Doniford, which has a holiday village and caravan park, surrounded by agricultural land, and St Audries Bay, where there is a cliff top chalet park.

22.5.128 The LSCA contains areas of higher landscape value and part is designated as an area of outstanding scenic interest. An eastern part of this LSCA is adjacent to the Quantock Hills AONB. The existing Hinkley Point Power Station Complex has very low prominence when viewed from the majority of this character area due to the alignment of the coastline and topography.

22.5.129 The landscape character sensitivity of the Blue Anchor to St Audries local seascape character area is judged to be **high** due to its distinctive landscape character and a part of the LSCA being designated as an area of outstanding scenic interest.

St Audries Bay to Hinkley Point LSCA

22.5.130 St Audries Bay to Hinkley Point LSCA, as defined within the West Somerset Landscape Character Assessment. The principal sources for the following description are the West Somerset Landscape Character Assessment (Ref. 22.33) and The Bridgwater Bay to Bideford Bay Shoreline Management Plan (Ref. 22.40).

22.5.131 St Audries Bay to Hinkley Point is essentially a continuation of the coast from Blue Anchor Bay to St Audries. It falls within the Quantock Vale LLCA and is also described as an erodible cliffed coastline fronted by wave cut, intertidal rock platforms of geological and geomorphological interest, designated as SSSI. The LSCA has continuous undeveloped land along the coast, used primarily for agriculture and differs from the Blue Anchor to St Audries section in that there is virtually no settlement or tourist development. The settlements of East Quantoxhead, Kilve, and Lilstock are set slightly back from the coast which remains largely undeveloped. To the east of Lilstock the majority of the coast is of international nature conservation importance, and is also designated as a NNR. There are small areas at Kilve and Lilstock liable to flooding, giving way to a low coastal slope towards Hinkley Point.

22.5.132 Between St Audries and Quantocks Head, the coastline forms part of the Quantock Hills AONB designation and is also designated as an area of outstanding scenic value. The HPC development site lies within the eastern part of this LSCA and is a dominant feature on this otherwise undeveloped part of the Somerset coastline.

22.5.133 The landscape character sensitivity of the Blue Anchor to St Audries LSCA is judged to be **high** due to its distinctive landscape character in particular around East

Quantockshead and large part of the LSCA being designated as an area of outstanding scenic interest.

Hinkley Point to River Parrett LSCA

22.5.134 The principal sources for the following description are the West Somerset Landscape Character Assessment (Ref. 22.33), Sedgemoor District Landscape Assessment and Countryside Design Summary 2003 (Ref. 22.34) and The Bridgwater Bay to Bideford Bay Shoreline Management Plan (Ref. 22.40).

22.5.135 Hinkley Point to River Parrett LSCA falls within the Quantock Vale Landscape Character Area as defined in the West Somerset Landscape Character Assessment and the Levels and Moors Landscape Character Area (Estuarine Levels sub area) as defined in the Sedgemoor Landscape Character Assessment.

22.5.136 The entire LSCA lies adjacent to the predominantly flat landscape of eastern Quantock Vale and coastal Levels and Moors and the entire intertidal area is of international nature conservation importance for migrant bird populations. No landscape designations of international or national importance exist within this area. Stolford and Steart are the only settlements along the coastline within this area, which otherwise has a largely undeveloped character.

22.5.137 The existing Hinkley Point Power Station Complex is a visually dominant feature when viewed from this flat, open landscape. Agriculture continues to dominate the coast east of the existing Hinkley Point Power Station Complex and cliffs are absent on this part of the coastline.

22.5.138 The landscape character sensitivity of the Hinkley Point to River Parrett LSCA is judged to be **medium** due to its moderately distinctive landscape character. Furthermore, no national landscape designations are present in this area.

Burnham-on-Sea to Brean Down LSCA

22.5.139 Burnham-on-Sea to Brean Down LSCA falls within the Levels and Moors Landscape Character Area. The principal sources for the following description are the Sedgemoor District Landscape Assessment and Countryside Design Summary 2003 (Ref. 22.34) and The Bridgwater Bay to Bideford Bay Shoreline Management Plan (Ref. 22.40).

22.5.140 This LSCA is characterised by broad open landscape of sand dunes, mud flats and river estuaries. The dunes have created a slightly higher strip of land along which the coastal settlements have developed and there is almost uninterrupted development along this part of the coastline, which is characterised by a mixture of residential, commercial, tourism and leisure interests. Burnham-on-Sea is the largest development on this west facing stretch of coastline. To the north, and adjacent to Berrow flats, are the tourist developments of Berrow and Brean.

22.5.141 The estuarine flats are an important, designated area for nature conservation. The dunes and long flat sandy beaches are a popular tourist destination. Caravan sites, some coastal residential development and a golf course are a linear development along the coastline in the northern part of the area, while the southern part of the LSCA is dominated by the urban area of Burnham-on-Sea with its historic seafront buildings and a pier.

22.5.142 The landscape character sensitivity of the Burnham-on-Sea to Brean Down LSCA is judged to be **medium** due to its moderately distinctive landscape character and the influence of Burnham-on-Sea and other settlements, including a number of caravan sites. No national landscape designations are located in this area.

Brean Down LSCA

22.5.143 Brean Down LSCA falls within the Mendips Landscape Character Area. The principal sources for the following description are the Sedgemoor District Landscape Assessment and Countryside Design Summary 2003 (Ref. 22.34) and The Bridgwater Bay to Bideford Bay Shoreline Management Plan (Ref. 22.40).

22.5.144 Brean Down is a prominent, undeveloped headland and an outlier of the Mendips standing isolated at the mouth of River Axe. It is an area of high nature conservation and amenity value. It rises to over 90m AOD and has steep cliffs on all sides. It is characterised by open grassland with panoramic views and is a popular destination for residents and visitors. A nineteenth century fort is located at its seaward point.

22.5.145 The landscape character sensitivity of the Brean Down LSCA is judged to be **high** due to its highly distinctive character and scenic quality. Although it is not designated as an AONB or any other national designation, it falls within the Mendips LLCA, and is a very popular tourist destination due to open views of Bridgwater Bay and towards Quantocks and Exmoor.

v. Site Scale Landscape Character

22.5.146 At a local level, the West Somerset Landscape Assessment (Ref. 22.33) encompasses the HPC development site and the surrounding area. The study further refines the local character areas into more detailed sub character areas (see **Figure 22.7**). The HPC development site falls within the Quantock Vale Landscape Character Area, further divided into four local sub character areas, namely; Eastern Lowlands; The Coast (St. Audries to Hinkley Point); Wick Moor and Coast and Wall Common and Coast.

22.5.147 According to the original description of the Wick Moor and Coast Area from the West Somerset Landscape Character Assessment (Ref. 22.33), the middle part of the HPC development site (Holford Stream Valley) would fall within the Wick Moor and Coast sub character area. Following consultation with Natural England and detailed landscape characterisation studies on site, the boundary of this area was refined and its new boundary redrafted to follow the Wick Moor Drove. It has been concluded (and agreed with Natural England) that the landscape character of the Holford Stream Valley (to the south of Green Lane and within the HPC development site) is characteristic of the Eastern Lowlands sub area. This adjustment has been taken into account in this assessment. The landscape character areas shown on **Figure 22.7** illustrate the adjusted boundary between Wick Moor and Coast, and Eastern Lowlands.

22.5.148 Also, due to the large size of the Eastern Lowlands sub character area compared to the other three Quantock Vale sub areas a further sub-division of Eastern Lowlands into four smaller landscape sub character areas has been undertaken. This sub-division is for descriptive purposes for this LVIA and is not intended as a full Landscape Character Assessment of the Eastern Lowlands Area.

22.5.149 The Countryside Agency's (now Natural England) guidance (Ref. 22.28) on landscape character assessment recommends that landscapes are initially characterised and that judgements about the nature and value of these landscapes are then based on this characterisation process. The guidance recommends that the characterisation process should be based on an assessment of natural factors, cultural social factors and aesthetic and perceptual factors. This approach has been used to identify the following site scale landscape character areas.

22.5.150 The four additional sub character areas of the Eastern Lowlands are: Coastal - Lilstock, Rolling Farmland East - Stogursey, Fairfield and Quantock Fringes - Dodington (see **Figure 22.7**).

22.5.151 As a result of this characterisation process, the LVIA identifies six site scale landscape character sub areas of the Quantock Vale, which are carried forward to the assessment of landscape impacts, namely:

- Wick Moor and Coast;
- Wall Common and Coast;
- Coastal – Lilstock;
- Rolling Farmland East – Stogursey;
- Fairfield; and
- Fairfield and Quantock Fringes – Dodington.

22.5.152 The character areas which are excluded from the assessment are Eastern Lowlands (now covered by four more detailed sub areas) and the Coast (St. Audries to Hinkley Point), which overlaps with the St. Audries to Hinkley Point Local Seascape Character Area identified above.

22.5.153 A description of the relevant sub character areas and the assessment of their sensitivity is provided below.

Wick Moor and Coast

22.5.154 The principal source for the following description is the West Somerset Landscape Character Assessment (Ref. 22.33) and field work undertaken as part of the LVIA.

22.5.155 The Wick Moor and Coast sub area is a finger of coastal marsh immediately to the east of Hinkley Point. The land is below 10m AOD and covered with recent alluvial deposits.

22.5.156 The area is predominantly used as grazing marsh in the summer and some scrub is evident along the lines of drainage ditches. Subject to flooding, the marsh is of high nature conservation value, designated as SAC, Ramsar Site, SPA and SSSI. A submarine forest is also noted as being of importance for marine archaeology. Lying below 10m AOD the area is described as open and bleak. Hinkley Point is described as being visually dominant on this landscape. However, due to a lack of development, open views across Bridgwater Bay (to the east), high nature conservation interest and effective screening of the existing Hinkley Point Power Station Complex, this area of landscape is highly valued by the local residents.

22.5.157 The character of this sub character area is strongly influenced by the Bridgwater Bay and the coast. Due to topography and vegetation surrounding the existing Hinkley Point Power Station Complex, the area is visually and physically separated at its western edge from the rural landscape within the Coastal-Lilstock sub character area and to the south. This separation results in a prevailing intimate character and strong relationship with Bridgwater Bay.

22.5.158 The sensitivity of the Wick Moor and Coast character area is assessed as **high** due to the area being designated for its nature conservation interest and its high recreational and amenity value.

Wall Common and Coast

22.5.159 The principal source for the following description is the West Somerset Landscape Character Assessment (Ref. 22.33) and field work undertaken as part of the LVIA.

22.5.160 Wall Common and Coast shares characteristics with the Wick Moor and Coast sub area. The land within Wick Moor is located below 10m AOD and covered with recent alluvial deposits, sands and gravels. Humic alluvial gleyed soils cover these deposits and it is drained by a complex rectilinear pattern of drainage ditches that divide the common into pasture fields. The area is open and bleak, it is used as grazing marsh in the summer and some scrubby vegetation has developed along the line of drainage ditches.

22.5.161 Towards the coast there are low cobble embankments separating fields from the sea and a strip of salt marsh to the seaward side. Similar to Wick Moor and Coast, the coast is noted as being of high nature conservation value, designated as SAC, Ramsar Site, SPA and SSSI. It also forms part of Stert Flats National Nature Reserve.

22.5.162 Two farms are located in the area on rising land toward the Stolford ridge which separates this lowland from Wick Moor to the west.

22.5.163 The sensitivity of the Wall Common and Coast landscape character area is assessed as **medium** due to some recreational and amenity value and its coastline falling within broader nature conservation designations.

Coastal – Lilstock

22.5.164 The principal source for the following description is an assessment of landscape character undertaken as part of this LVIA.

22.5.165 This area lies within the Eastern Lowlands character area to the west of the existing Hinkley Point Power Station Complex and extends approximately 1-1.5km inland from the coastline. The villages of Knighton, Burton, and the adjacent local road indicate the southern boundary of this area in the east and in the west the boundary is defined by the edge of the Quantock Fringes where the land begins to rise towards the Quantock Hills. Levels are typically between 10m and 50m AOD. Land immediately to the south of Lilstock is below 10m AOD. It is a relatively open area of rolling farmland, with few settlements and limited tree cover. It is designated as an area of outstanding scenic interest. The existing Hinkley Point Power Station Complex is a prominent landmark visible along the adjacent coastline however, it becomes less dominant to the west of Lilstock, where rolling topography and vegetation provide a degree of screening from the west. The Quantock Hills form a striking backdrop to the south-west.

22.5.166 Inland, views of the coast are limited due to the coastal cliff. This rolling pastoral landscape of large regular fields is divided by an angular pattern of thick hedgerows and small windswept copses and woodland brakes or shelter belts. The large square field pattern is characteristic of a planned 18th-19th century landscape. Hedgerows are intact and well managed and contain elm (*Ulmus minor*), hawthorn, spindle (*Euonymus europaeus*), blackthorn (*Prunus spinosa*), field maple (*Acer campestre*), dogwood (*Cornus spp.*) and wild privet (*Ligustrum vulgare*) with few hedgerow trees. Shelterbelts contain the same shrub species with larger ash, field maple and oak trees.

22.5.167 Settlement consists of villages set on elevated land to the west with prominent church spires or scattered farm buildings. The predominant building style is generally painted render, pantile, slate or thatch roofs and grey/blue lias stone garden walls. Soils are calcareous sub-soils over underlying Jurassic Lower (Blue) Lias.

22.5.168 The sensitivity of the landscape character area is assessed as **high** due to its nature conservation interest and its designation as an area of outstanding scenic interest.

Rolling Farmland East – Stogursey

22.5.169 The principal source for the following description is an assessment of landscape character undertaken as part of this LVIA.

22.5.170 This is a typically undulating rolling farmland, which flattens out to meet the coastline, and rises gently towards the Stockland Hills in the south and the Quantock Fringes in the west. Land is mainly between 10 and 50m AOD with a few hills rising to 80m in the central and southern part of the area. There are coastal views mainly from northern parts of the area, where the existing Hinkley Point Power Station Complex and the pylons leading to it are prominent landmarks punctuating the skyline. The Quantock Hills dominate views to the south-west.

22.5.171 There is a balance of open grazing fields contrasting with numerous dense copses. Field boundaries are clearly defined by thick hedgerows on raised hedge-banks and ditches forming angular fields. Hedgerows are generally well maintained, dense and species rich including blackthorn, hawthorn, field maple, guelder rose (*Viburnum opulus*) with bramble (*Rubus fruticosus*), iris (*Iris foetidissima*), ivy (*Hedera helix*) and honeysuckle (*Lonicera periclymenum*) ground flora. Hedgerow trees are not characteristic in some areas, which may be explained by the high incidence of English elm.

22.5.172 Rural settlements of Stogursey, Knighton, Burton, Shurton, Stolford and scattered small farms and local roads are characteristic for this area. As a result this area is less tranquil than the Coastal – Lilstock area. Buildings are mainly rendered with red clay pantiles and grey/blue stone walls.

22.5.173 Underlying geology consists of Lower Lias to the north and Mercia mudstones to the south, overlain with calcareous sub-soil and clay sub-soil respectively.

22.5.174 The sensitivity of the landscape character area is assessed as **medium** due to its moderately distinctive character.

Fairfield

22.5.175 The principal source for the following description is an assessment of landscape character undertaken as part of this LVIA.

22.5.176 This area forms part of a planted landscape surrounding Fairfield House (Grade II* Listed Building) and includes the Great Plantation, Fairfield Historic Park and Garden, Fairfield Wood and adjacent farmland. Landform rises from 30m AOD in the east to over 70m AOD in the west. Local views are limited by blocks of woodland. However, there are long distance views towards the coastline.

22.5.177 Fairfield is a mixture of designed parkland with blocks of woodland set in gently rolling farmland made up of medium fields of open pasture and orchards contrasting with some fields of switchgrass (*Panicum virgatum*) grown for biomass. Thick hedgerows of hawthorn, elm and field maple are planted on hedge-banks with ash, oak, horse chestnut (*Aesculus hippocastanum*) and Scots pine (*Pinus sylvestris*) hedgerow trees and mature parkland trees around Fairfield House. There are no villages in this area but a number of farmhouses are evident. Calcareous sub-soils lie on Lower Lias in the north and brown earth loamy clay enriched soils cover Mercia Mudstones in the south.

22.5.178 The sensitivity of the landscape character area is assessed as **high** due to its designation as an area of outstanding scenic interest, and heritage value associated with the Fairfield House and the Fairfield Historic Park and Garden.

The Quantock Fringes – Dodington

22.5.179 The principal source for the following description is an assessment of landscape character undertaken as part of this LVIA.

22.5.180 This character area is located between the Fairfield area and the Quantock Hills AONB. The A39 road forms the western and southern boundaries. The topography rises gently from 70m AOD in the east to 140m AOD in the south-west and long distance views across the Eastern Lowlands towards the sea and the existing Hinkley Point Power Station Complex are possible for elevated locations. This area has attractive views of the Quantock Hills, however, farm buildings and pylons are present within views.

22.5.181 Gently rolling farmland with large angular fields defined by high hedgerows contrast with the steep heavily wooded Quantock Hills above. Land use is a mixture of arable and grazing pasture, Hedgerows are made up of elm, field maple, hazel (*Corylus avellana*), wild privet with ash, oak, sweet chestnut (*Castanea sativa*), Scots pine and sycamore (*Acer pseudoplatanus*) hedgerow trees. The small settlements of Holford, Stringston and Dodington and scattered farms are mainly stone built with red pantile roofs. Soils are brown earth loamy with little clay or clay enriched soils overlying Mercia Mudstones. The area retains a rural character although the A39 and pylons impose an urbanising influence locally.

22.5.182 The sensitivity of the landscape character area is assessed as **high** due to its designation as an area of outstanding scenic interest.

22.5.183 The summary of all relevant local landscape character areas assessed in this chapter is provided in **Table 22.7** at the end of landscape baseline.

vi. Landscape Elements and Features

22.5.184 A site scale landscape character assessment has been undertaken to describe the HPC development site and its immediate landscape setting up to approximately 50m from the HPC development site boundary (on-shore) and ascribe landscape sensitivity to key landscape elements and features that contribute to landscape character.

Landform

22.5.185 The northern part of the HPC development site is located on the coastal slope with a cliff edge at its northern boundary. A prominent ridge of Green Lane bisects the site in an east-west direction and reaches 35m AOD at its highest point.

22.5.186 This ridge is an important local landmark and is visible from a number of locations around the site. It screens views of the northern part of the site and the coast from local villages and footpaths. To the south of Green Lane a shallow valley is formed along Holford Stream. The southern valley slopes fall towards reach Bum Brook which runs along the southern boundary of the site.

22.5.187 The sensitivity of the landform is assessed as **medium**. Landform features are not judged to be of national importance. However, Green Lane ridge is locally valued for its amenity value and screening capabilities.

Land Use/Settlement

22.5.188 The HPC development site is surrounded mainly by farmland, which is the principal land use within the site. The field pattern is irregular and the fields are predominantly small to medium becoming more regular and larger further to the west. Historically and culturally it is possible to read the medieval pattern of the landscape. The majority of the fields within the site boundary were enclosed within the 17th to 18th century.

22.5.189 The local built form consists mainly of small, two storey cottages, agricultural buildings of a simple form, and nucleated hamlets and farms. Four barns are located within the HPC development site. There is a strong emphasis on the use on local materials. Roofs are made of thatch, slate or pantiles. Buildings are mainly rendered and painted and walls are red sandstone or grey/blue Lias. The existing Hinkley Point Power Station Complex is a prominent local land use. Villages and hamlets around the HPC development site, such as Wick, Shurton, Burton or Knighton are small and centred on farmhouses within the village contributing to the agricultural character of the surrounding area.

22.5.190 Electricity pylons form a prominent feature in the low-lying landscape to the east.

22.5.191 The sensitivity of land use/settlement is considered to be **medium** due to its character being typical of the Quantock Vale local landscape character area. There are no nationally important land uses or settlements and buildings of exceptional landscape value within the HPC development site or its immediate surroundings.

Landcover and Vegetation

22.5.192 The HPC development site contains small to medium agricultural fields divided by hedgerows and hedgerow trees on boundaries. Pollarded willow along the field boundaries are a common feature as are elm, hawthorn, field maple and blackthorn on hedge-banks with ash, oak and sycamore hedgerow trees. Bramble, ivy, iris and honeysuckle make up the ground flora. Some small pockets of predominantly deciduous woodlands and copses and shelter belts or breaks of similar species are located within and around the HPC development site along field boundaries. Three large fields of semi-improved grassland and one field of semi-improved calcareous grassland are located in the north-eastern corner of the site. A strip of calcareous grassland is adjacent to the coastal cliff. Other large areas of grassland include semi-improved calcareous grassland covering the fields along the Holford Stream. There are small copses of woodland within and around the HPC development site.

22.5.193 A recently planted woodland, Bishop's Wood, is located on the southern slope of the Holford Stream valley. The site contains a number of hedgerows, some of which have important local ecological and amenity value. The most significant of these features is the hedgerow along Green Lane, which has important landscape amenity value due to its prominent location on the highest ridge within the site, and Benhole Lane along the western site boundary.

22.5.194 The existing landscape plan including landcover and vegetation within the HPC development site and its surroundings is shown on **Figure 22.8**.

22.5.195 **Table 22.6** shows the existing landscape elements coverage within the HPC development site (all figures are approximate).

Table 22.6: Existing Landscape Elements Coverage within the HPC Development Site

Areas and Linear Features	Measurement
Broad-leaved woodland	3.5 ha
Plantation woodland	3.5 ha
Scrub (including scrub/hedges)	1.1 ha
Calcareous Grassland (including Bishop's Wood)	3.5 ha
Improved Grassland	30.6 ha
Species-poor semi-improved grassland	16.1 ha
Semi-improved grassland/ Species rich hay meadow	n/a
Arable	97.6 ha
Agricultural Land	n/a
Wetland (including ponds)	<0.01 ha
Native Species-rich Hedgerow	7.74 km
Species-poor Hedgerow	3.4 km
Watercourses (excluding Bum Brook and including Holford Valley ditches)	2.02 km

22.5.196 The sensitivity of the landcover and vegetation on the site and close to its boundaries has been assessed as **medium** due to its local amenity value and biodiversity interest.

Watercourses/water bodies

22.5.197 The landscape in the immediate vicinity of the site contains numerous drains and ditches typical of an agricultural landscape. The most significant watercourses within and in the vicinity of the HPC development site is Holford Stream, which is not of significant landscape value and Bum Brook, which is highly valued locally for its amenity and the planting along its banks. Bum Brook is also located in the immediate vicinity of several residential properties of Shurton. No other significant watercourses are present in the immediate vicinity of the HPC development site. The existing landscape plan including watercourses and water bodies within the HPC development site and its surroundings is shown on **Figure 22.8**.

22.5.198 The sensitivity of the watercourses/water bodies is considered to be **medium** due to the presence of Bum Brook, which is locally valued for its amenity.

Public Rights of Way

22.5.199 There is a large network of Public Rights of Way (PRoW) crossing the HPC development site and in its immediate vicinity, including the West Somerset Coast Path National Trail which runs along the top of the low cliff line. All footpaths were walked during the field assessment. For more details on the existing PRoW see **Chapter 25** of this volume. The existing PRoW network within the HPC development site and its surroundings is shown on **Figure 22.8**.

22.5.200 The sensitivity of the PRoW within and in the immediate vicinity of the site has been assessed as **high** due to the presence of nationally important West Somerset Coast Path within the HPC development site.

22.5.201 Summary of landscape receptors and their sensitivity is provided in **Table 22.7**.

Table 22.7: Summary of Landscape Receptors

ID	Receptor	Sensitivity
	Local Landscape Character	
1	Quantock Vale LLCA	Medium
2	Doniford Stream and Quantock Fringe LLCA	Medium
3	Central Quantocks LLCA	High
4	Quantock Hills LLCA	High
5	Central West Somerset LLCA	Medium
6	Lowland Hills LLCA	Medium
7	Levels and Moors LLCA	High
8	Limestone Ridges and Combes LLCA	High
9	Mendips LLCA	High
10	Blue Anchor to St Audries LSCA	High
11	St Audries Bay to Hinkley Point LSCA	High
12	Hinkley Point to River Parrett LSCA	Medium
13	Burnham-on-Sea to Brean Down LSCA	Medium
14	Brean Down LSCA	High

ID	Receptor	Sensitivity
	Site Scale Landscape Character	
15	Wick Moor and Coast	High
16	Wall Common and Coast	Medium
17	Coastal – Lilstock	High
18	Rolling Farmland East – Stogursey	Medium
19	Fairfield	High
20	The Quantock Fringes – Dodington	High
	Landscape Elements and Features	
21	Landform	Medium
22	Land Use/Settlement	Medium
23	Landcover/Vegetation	Medium
24	Watercourses/water bodies	Medium
25	Public Rights of Way	High

e) Visual Baseline

i. Introduction

22.5.202 To confirm the theoretical visibility of the HPC proposed development a Zone of Theoretical Visibility (ZTV) analysis has been undertaken. The Bare Ground ZTV does not take into account the extensive screening effects of woodland, settlements or urban area and therefore represents a 'worst case scenario' in regard to the potential visibility of the HPC proposed development. As a result, there may be residential properties, roads, tracks and footpaths in the vicinity of the HPC development site and in the wider setting which, although shown as falling within the ZTV, in reality will have no views to the site or development.

22.5.203 A combination of desktop study, Bare Ground ZTV analysis, field survey and consultation has confirmed a range of visual receptors within the LVIA study area with the potential to be affected by the proposed development. They include residents, users of PRoW and other publicly accessible land including visitors to Exmoor National Park, Quantock Hills AONB and Mendip Hills AONB, users of schools, motorists and people at their place of work.

22.5.204 These receptors are represented by a series of viewpoints. A representative Viewpoint Location Plan including a ZTV is shown on **Figure 22.9** (wide area) and **Figure 22.9a** (local area).

ii. Visual Baseline Summary

22.5.205 The visual baseline records views towards the development site from a total of 48 viewpoints (42 Principal Viewpoints and 6 Secondary Viewpoints) agreed with consultees and extending throughout the study area. All viewpoints are assessed; however, Secondary Viewpoints are not supported by photomontages due to limited views of the HPC development site and the distance from the development site. These viewpoints can be broadly subdivided into short, medium and long distance views. The following viewpoints illustrated on **Figure 22.9** and **Figure 22.9a** are highlighted for summary purposes, as broadly representative;

- Short range – Principal Viewpoints 1 (west), 11 (south) and 16 (east);
- Medium range – Principal Viewpoint 4 (west), 18 (south) and 19 (east); and
- Long Range – 26 (west), 29 (south west) and 33 (south).

22.5.206 Views from the north are open and panoramic, and available predominantly from the Welsh coast. The South Wales coastline across the Bridgwater Bay, approximately 19km to the north of the HPC development site at its narrowest point, has very limited views of the site even under clear weather conditions.

22.5.207 Views from the east are available predominantly from the coastline (Hinkley Point to Weston-super-Mare) and areas of higher topography, including Brent Knoll and Puriton Hill, as well as Mendip Hills AONB (Bleadon Hill and Crook Peak). The ZTV to the east of the site was reviewed during field work and the majority of the lower lying areas within the LVIA study area were found not to have views of the HPC development site and the existing Hinkley Point Power Station Complex due to intervening vegetation, urban areas and landform. The areas located up to approximately 5km from the HPC development site provide views of the tallest structures within the existing Hinkley Point Power Station Complex.

22.5.208 Views from the south and south west are generally located on the low hills located around the HPC development site and the prominent ridgeline of the Quantocks, with undisturbed but distant views of the HPC development site from areas of highest elevation. The Quantock Hills AONB obscures any views to the site from south-west of the AONB itself.

22.5.209 To the west of the HPC development site, views are available predominantly from the coastline and some higher areas located in the eastern part of the Exmoor National Park, however, these views are very limited due to long distance from the HPC development site.

iii. Viewpoint Descriptions

22.5.210 Viewpoint descriptions and the assessment of their sensitivity are provided below. The schedule of Figures showing baseline views and photomontages is provided on **Figure 22.9b**.

22.5.211 High resolution baseline photographs at full scale and VVIs showing the HPC proposed development at year 15 of the operational phase are provided for all Principal Viewpoints.

22.5.212 Dusk views were recorded for agreed 13 viewpoints to fully understand the night time baseline conditions. Site visits were also carried out in October 2010, when light glow from the existing Hinkley Point Power Station was assessed. These additional night time views are included in the **HPC Construction Lighting Strategy** appended to **Construction Method Statement** and the **HPC Operational Lighting Strateg y** appended to **Chapter 2** of this volume, and informed the assessment of baseline conditions and night time views.

22.5.213 VVIs showing the HPC proposed development have been prepared for all Principal Viewpoints. The assessment of cumulative impacts of the HPC proposed development and the NG proposals is included in **Volume 11** of this ES.

22.5.214 Viewpoint and camera details, such as OS rid reference, date and time of a photograph, field of view, lens, elevation and distance from the HPC development site and the nearest reactor dome, are provided on viewpoint sheets.

Principal Viewpoint 1 – PRoW No. WL23/110 west of Benhole Lane

22.5.215 This viewpoint is sited on a local track (PRoW No. WL 23/110) and is representative of the view for walkers on the small ridge located to the west of the HPC development site and other local PRoW located on elevated topography immediately to the west of the site. It is situated within the Quantock Vale (Coastal - Lilstock) Local Landscape Character Area and is also located within the area of outstanding scenic interest.

22.5.216 This short distance view is open and consists of an expanse of sky, farmland and the sea with some coastal vegetation in the foreground and middle ground. The tallest structures within the existing Hinkley Point Power Station Complex punctuate the skyline while its lower buildings are screened by belts of mature vegetation.

22.5.217 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a prominent and highly valued local ridge which is a popular local destination and is one of the most prominent local historic landscape features in the vicinity of the site. See **Figure 22.10** and **Figure 22.10a**.

Principal Viewpoint 2 – West Somerset Coast Path, PRoW No. WL 23/95

22.5.218 This short distance viewpoint is located on the West Somerset Coast Path National Trail (PRoW No. WL 23/95) and situated within the Quantock Vale (Coastal - Lilstock) Local Landscape Character Area. It is also located within the area of outstanding scenic interest. It represents views experienced by walkers.

22.5.219 The HPC development site and significant areas of farmland on gently undulating topography are visible in the foreground. The tallest structures within the existing Hinkley Point Power Station Complex punctuate the skyline in views eastwards. Small shrubs partially screen the views of the sea. The coastal path provides open views of Bridgwater Bay and coastal rock platforms.

22.5.220 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a nationally important footpath. See **Figure 22.11** and **Figure 22.11a**.

Principal Viewpoint 3 – West Somerset Coast Path, Lilstock, PRoW No. WL 24/10

22.5.221 This medium distance viewpoint is situated adjacent to the West Somerset Coast Path (PRoW No. WL 24/10) to the north of Lilstock and within the area of outstanding scenic interest, and represents views available for walkers. The viewpoint is situated within the Quantock Vale (Coastal - Lilstock) Local Landscape Character Area.

22.5.222 The existing view is open and consists of an expanse of sky and the seascape of Bridgwater Bay with shingle beach and coastal shrub visible in the foreground. The existing Hinkley Point Power Station Complex is visible as a simple and distinctive landmark punctuating the skyline. The ground level of the HPC development site is screened by the cliff.

22.5.223 There is no lighting in the foreground and middle ground and the coastline is generally characterised by dark skies at night. Some localised lighting is visible across Bridgwater Bay on the coastline between Burnham-on-Sea and Brean. Lighting associated with the existing Hinkley Point Power Station Complex is visible, in particular under low cloud cover or mist.

22.5.224 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a nationally important footpath, which provides open views of Bridgwater Bay. See **Figure 22.12** and **Figure 22.12a**.

Principal Viewpoint 4 – PRoW No. WL 24/8

22.5.225 This medium distance viewpoint is located on PRoW No. WL 24/8, to the west of the site, within an area of outstanding scenic interest and represents views experienced by walkers. It is situated within the Quantock Vale (Coastal - Lilstock) Local Landscape Character Area.

22.5.226 The view predominantly comprises large areas of agricultural land (arable) on gently undulating topography with isolated areas of shrubs and trees. Trimmed hedgerows are located on field boundaries and offer no screening to the existing Hinkley Point Power Station Complex, whose tallest structures are visible in the distance. The HPC development site and lower development within the Complex are screened by intervening landform.

22.5.227 The sensitivity of visual receptors at this viewpoint has been rated as medium due to its location on a locally important footpath. See **Figure 22.13** and **Figure 22.13a**.

Principal Viewpoint 5 – Higher Hill, PRoW No. 24/3

22.5.228 This medium distance viewpoint is located on PRoW No. 24/3 on Higher Hill to the west of the site and within an area of outstanding scenic interest and Doniford Stream and Quantock Fringe Local Landscape Character Area.

22.5.229 It represents views experienced by walkers. Due to its hilltop location (approximately 108m AOD) and few intervening elements, open views of Bridgwater Bay and the HPC development site and its surroundings are available from this viewpoint. Green Lane and Holford Stream valley are visible below the existing Hinkley Point Power Station Complex. The view is dominated by agricultural fields with trimmed hedgerows on boundaries and large expanse of sky. Low lying farmland of the Quantock Vale (Eastern Lowlands) Local Landscape Character Area is visible in the distance.

22.5.230 The sensitivity of visual receptors at this viewpoint has been rated as medium due to its location on a locally important footpath. See **Figure 22.14** and **Figure 22.14a**.

Principal Viewpoint 6 – PRoW No. WL 24/11 near the edge of the Great Plantation

22.5.231 This medium distance viewpoint is sited on a PRoW No. WL 24/11 near the Great Plantation to the south-west of the site and is representative of the view for walkers.

It is located within the Quantock Vale (Fairfield) Local Landscape Character Area and within the area of outstanding scenic interest.

22.5.232 The view is contained on one side by the Fairfield Estate's Great Plantation woodland, and trees and shrubs are visible. Lower lying development associated with the existing Hinkley Point Power Station Complex is obscured by topography; however, the tallest structures of the Complex punctuate the skyline. The tree-lined Green Lane ridge running across the HPC development site forms the skyline just to the west of the existing HPA buildings and offers good screening of the coastline to the west of the existing Hinkley Point Power Station Complex up to the level of approximately 35m AOD.

22.5.233 The sensitivity of visual receptors at this viewpoint has been rated as medium due to its location on a locally important footpath. See **Figure 22.15** and **Figure 22.15a**.

Principal Viewpoint 7 – Fairfield House Driveway

22.5.234 This medium distance viewpoint is located on the driveway to Fairfield House, a Grade II* Listed Building to the south-west of the site. It is located within the Quantock Vale (Fairfield) Local Landscape Character Area and within an area of outstanding scenic interest. It is representative of the view experienced by residents and visitors to Fairfield House.

22.5.235 The view is dominated by agricultural grassland with some trees and man-made influences such as telegraph poles and fences in the foreground. A mix of hedgerows and tree blocks can be seen in the middle distance and the existing Hinkley Point Power Station Complex is clearly visible against the skyline. Small patches of woodland, unmanaged hedgerows and some small residential buildings obscure views towards the Bridgwater Bay and the HPC development site.

22.5.236 There is no lighting in the foreground and middle ground (in the parkland area). Lighting of the both HPA and HPB stations is visible above the vegetated ridge in the middle ground. Looking further towards Bridgwater Bay, distant lighting from the coastal settlements. The complex is also a source of significant light glow, which becomes more noticeable, in particular under low cloud cover or mist.

22.5.237 The sensitivity of visual receptors at this viewpoint has been rated as high due to Fairfield House being a residence and a popular tourist attraction. See **Figure 22.16** and **Figure 22.16a**.

Principal Viewpoint 8 – Knighton Farm, PRoW No. WL 23/46

22.5.238 This short distance viewpoint is located on a PRoW No. WL 23/46 adjacent to Knighton Farm, which is located on the eastern edge of Knighton. It is located within the Quantock Vale (Rolling Farmland East - Stogursey) Local Landscape Character Area and within the area of outstanding scenic interest.

22.5.239 This view is experienced by walkers and residents of Knighton Farm and shows agricultural land gently ascending towards the local ridge to the west of the HPC development site. The ridge provides screening of the lower development within the Hinkley Point Power Station Complex and only the tallest structures are visible and punctuate the skyline. Small blocks of woodland and hedgerows contribute to screening. A stone wall along the footpath is visible in the foreground.

22.5.240 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location to adjacent residential properties, whose residents experience similar views. See **Figure 22.17** and **Figure 22.17a**.

Principal Viewpoint 9 – Burton

22.5.241 This short distance viewpoint is located on a local road to the south-west of the site in the vicinity of PRoW No. WL 23/47 (north of the road) and WL 23/25 (south of the road). The viewpoint is located within the Quantock Vale (Rolling Farmland East - Stogursey) Local Landscape Character Area on the edge of the area of outstanding scenic interest.

22.5.242 This view is experienced by walkers and motorists and shows agricultural land gently ascending towards the local ridge to the west of the HPC development site and Green Lane. The existing landform provides screening of lower level development within the existing Hinkley Point Power Station Complex and only the tallest structures are visible punctuating the skyline. Small blocks of woodland and hedgerows contribute to screening.

22.5.243 The existing Hinkley Point Power Station Complex is the only light source within the view. Although lower level lighting is screened by vegetation, there is light spill onto the HPA reactor building and HPB is a notable source of light itself. The complex is also a source of light glow, which becomes more noticeable, in particular under low cloud cover or mist.

22.5.244 The sensitivity of visual receptors at this viewpoint has been rated as medium due to its location on a local road but also in the vicinity of a PRoW of local importance. See **Figure 22.18** and **Figure 22.18a**.

Principal Viewpoint 10 – Shurton West, Local Farm near PRoW No. WL 23/48

22.5.245 This short distance viewpoint is located within a local farm in the immediate vicinity of PRoW No. WL 23/48 at the western edge of Shurton, looking north-east towards the site. The viewpoint is located within the Quantock Vale (Rolling Farmland East - Stogursey) Local Landscape Character Area.

22.5.246 It represents views experienced by the residents of the residential properties and farms in western part of Shurton and was selected following consultation with the local residents. Unlike several other views from this part of Shurton it provides relatively open views towards the southern sections of the site due to a wide gap in vegetation along the Bum Brook which demarcates the southern boundary of the site. It is therefore considered as the 'worst case scenario' for visual impacts from the western parts of Shurton. Other properties at this part of the village are located within a similar distance from the proposed HPC development site but receive limited views of the site due to mature riparian vegetation along the Bum Brook and planting in residents' gardens.

22.5.247 However lighting of the existing Hinkley Point Power Station Complex is not visible at dusk, light glow from the Complex becomes more noticeable under low cloud cover or mist.

22.5.248 Taller buildings within the existing Hinkley Point Power Station Complex are visible above the small ridge to the north of Bum Brook. This small, unvegetated ridge is a distinctive local landscape feature, highly valued by the local residents of Shurton, Knighton and Burton and provides good screening of the development area. Sections of a tree line along Green Lane punctuate the skyline.

22.5.249 The sensitivity of visual receptors at this viewpoint has been rated as high because it is representative of views from residential properties. See **Figure 22.19** and **Figure 22.19a**.

Principal Viewpoint 11 – Shurton East, PRoW No. WL 23/56

22.5.250 This short distance viewpoint is located on the PRoW No. WL 23/56 located within the village of Shurton next to the pumping station to the south of the HPC development site. The viewpoint is located within the Quantock Vale (Rolling Farmland East - Stogursey) Local Landscape Character Area.

22.5.251 It represents views experienced by walkers and local residents, who receive similar views in the vicinity of the viewpoint. This view was selected following consultation with the local residents. Unlike several other views from this part of Shurton it provides relatively open views towards the HPC development site due to a wide gap in vegetation along the Bum Brook which demarcates the southern boundary of the HPC development site. It is therefore considered as the ‘worst case scenario’ for visual impacts from the eastern parts of Shurton. Properties within the eastern parts of the village are located at a similar distance from the site but receive limited views of the site due to mature riparian vegetation along the Bum Brook and planting in residents’ gardens.

22.5.252 The view encompasses large areas of farmland, hedgerows and hedgerow trees. The lower levels of the HPC development site are obscured by the topography, however, the existing Hinkley Point Power Station Complex buildings, due to their height (65 metres), punctuate the skyline and are a prominent landmark within the view.

22.5.253 The existing Hinkley Point Power Station Complex is the only light source within the view. Although lower level lighting is screened by landform and vegetation, there is light spill onto the HPA reactor building and HPB is a notable source of light itself. The existing Complex is also a source of light glow, which becomes more noticeable, in particular under low cloud cover or mist.

22.5.254 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a locally important footpath and because it is representative of views from residential properties. See **Figure 22.20** and **Figure 22.20a**.

Principal Viewpoint 12 – Local road to the south of the site (near Gunter’s Grove)

22.5.255 This short distance viewpoint is located to the south of the site on a local road near Gunter’s Grove farm and represents the view experienced by motorists. Located within the Quantock Vale (Rolling Farmland East - Stogursey) Local Landscape Character Area, the viewpoint is not situated within any landscape designation.

22.5.256 An open area of coastal marsh at Wick Moor is visible in middle distance with scrubby vegetation and individual trees partially screening views towards the site. The Green Lane ridge and the adjacent southern slopes within the HPC development site are visible from this viewpoint. The existing Hinkley Point Power Station Complex and low level ancillary buildings are visible.

22.5.257 The existing Hinkley Point Power Station Complex is the only light source within the view. Road, car park and other low level lighting is visible. There is light spill onto the HPA reactor building and HPB is a notable source of light itself. The existing Complex is also a source of light glow, which becomes more noticeable under low cloud cover or mist.

22.5.258 The sensitivity of visual receptors at this viewpoint has been rated as low due to its location on a local road. See **Figure 22.21** and **Figure 22.21a**.

Principal Viewpoint 13 – PRoW No. WL 23/57, West of Wick

22.5.259 The short distance viewpoint is located on a local track (PRoW No. WL 23/57), west of Wick and a local farmhouse, looking north-west towards the site through Wick Moor. The viewpoint is located within the Quantock Vale (Rolling Farmland East - Stogursey) Local Landscape Character Area.

22.5.260 It is representative of the view for experienced by walkers. The view is open and dominated by a large agricultural field in the foreground with hedgerows along field boundaries, which provide screening within the flat landscape. The existing Hinkley Point Power Station Complex is visible in the distance but its lower buildings are partially screened by planting around it.

22.5.261 The sensitivity of visual receptors at this viewpoint has been rated as medium due to its location on a locally important footpath. See **Figure 22.22** and **Figure 22.22a**.

Principal Viewpoint 14 – Pixies Mound (Wick Barrow)

22.5.262 This short distance viewpoint is located on a footpath adjacent to Pixies Mound (Wick Barrow) Scheduled Ancient Monument looking west towards the site. The viewpoint is located within the Quantock Vale (Coastal - Lilstock) Local Landscape Character Area.

22.5.263 It is representative of the view experienced by visitors to Hinkley Point and walkers around Pixies Mound. The view is dominated by grassland with tree plantation screening the existing Hinkley Point Power Station Complex. The access road (Wick Moor Drove) to the existing power station cuts through the grassland in the view. The majority of the skyline is dominated by the vegetation within the HPC development site, including small blocks of woodland, hedgerows and individual trees. Lamp posts and fencing poles are distinctive vertical elements within the view.

22.5.264 The sensitivity of visual receptors at this viewpoint has been rated as high due to the historic importance of Pixies Mound and the viewpoint representing the views experienced by visitors to the heritage site. See **Figure 22.23** and **Figure 22.23a**.

Principal Viewpoint 15 - PRoW No. WL 23/61

22.5.265 This short distance viewpoint is located on PRoW No. WL 23/61 to the east of the Hinkley Point Power Station Complex. The viewpoint is located within the Quantock

Vale (Wick Moor and Coast) Local Landscape Character Area and is noted for several national and international nature conservation designations.

22.5.266 A ditch, grazing fields and shrubs are visible in the foreground. The HPC development site is screened by a belt of woodland planted around the perimeter of the existing Hinkley Point Power Station Complex.

22.5.267 The sensitivity of visual receptors at this viewpoint has been rated as high. The PRoW falls within an area popular among the local residents for its wildlife and landscape value. See **Figure 22.24** and **Figure 22.24a**.

Principal Viewpoint 16 – Wick, PRoW No. WL 23/61

22.5.268 The short distance viewpoint is located at the gate on a local track (PRoW No. WL 23/61) in the vicinity of the hamlet of Wick, looking north-west towards the site through Wick Moor. The viewpoint is located within the Quantock Vale (Rolling Farmland East - Stogursey) Local Landscape Character Area and is representative of the view experienced by walkers.

22.5.269 Although more open view through Wick Moor is available at the end of the track (further to the north), this location was selected due to its proximity to the hamlet. The track is almost entirely enclosed by a hedgerow running along its western edge. However, some gaps in this hedgerow (as illustrated by the selected viewpoint location) show the best available view. The existing Hinkley Point Power Station Complex is partially screened by hedgerows and small blocks of woodland.

22.5.270 A hedgerow in the foreground screens lighting from the existing Hinkley Point Power Station Complex, although there is some light spill onto the HPA reactor building. Under low cloud cover or mist and later at night, the existing Complex is also a source of light glow.

22.5.271 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a locally important footpath and proximity to residential properties in and around the hamlet of Wick. See **Figure 22.25** and **Figure 22.25a**.

Principal Viewpoint 17 – Farrington Hill Lane (Farringdon Farm)

22.5.272 This short distance viewpoint is located near Farrington Farm and represents views experienced by walkers along Farringdon Hill Lane. The viewpoint is not located within any landscape designation and is located within the Quantock Vale (Rolling Farmland East - Stogursey) Landscape Character Area.

22.5.273 It is representative of views experienced by walkers in the countryside, locally, including PRoW overlooking the site and farmland immediately to the north of Stogursey located approximately 1.5km to the south of the site. The view is dominated by farmland, hedgerows along field boundaries and hedgerow trees. The existing Hinkley Point Power Station Complex buildings punctuate the skyline. The Green Lane ridge and its southern slopes within the HPC development site are visible.

22.5.274 The sensitivity of visual receptors at this viewpoint has been rated as medium due to its location adjacent to locally important footpath and because it is representative of views experienced by users of locally important PRoW. See **Figure 22.26** and **Figure 22.26a**.

Principal Viewpoint 18 – Residential area at Stogursey, Burgage Road/Lime Street

22.5.275 This short distance viewpoint is located on a footpath along Lime Street (junction with Burgage Road) in the northern part of Stogursey, which is located within the Quantock Vale (Rolling Farmland East - Stogursey) Local Landscape Character Area.

22.5.276 The view is experienced by residents, pedestrians and motorists. The low level development within the existing Hinkley Point Power Station Complex and the farmland around it are obscured by high hedgerows and built form within the view. First floor views of the HPC development site are possible from properties on the edge of the village. Only the tallest structures within the existing Complex are partially visible above the vegetation from the road.

22.5.277 Lighting along Lime Street is visible and spills onto the adjacent buildings, which are a source of light themselves. Lighting of the existing Hinkley Point Power Station Complex is screened by vegetation in views from the road but is likely to be visible from properties. Light glow from HPA and HPB is evident but less noticeable due to due to road lighting in the foreground.

22.5.278 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a frequently used footpath of local importance and its location within a residential area. See **Figure 22.27** and **Figure 22.27a**.

Principal Viewpoint 19 – Stolford, West Somerset Coast Path, PRoW No. WL 23/95

22.5.279 This medium distance viewpoint is located on the West Somerset Coast Path (PRoW no WL 23/95) to the north of Stolford, within the Quantock Vale (Wall Common and Coast) Local Landscape Character Area and represents views experienced by walkers and residents of the western edge of Stolford.

22.5.280 The existing Hinkley Point Power Station Complex buildings and the associated overhead lines are dominant features within the view and punctuate the skyline. Small clumps of trees are visible around the existing Complex. The hilltops of the northern Quantock Hills AONB are visible in the long distance as a backdrop to some electricity pylons. Small parts of the HPC development site adjacent to the eastern sections of Green Lane are visible; however, the majority of the HPC development site is screened by intervening elements and vegetation.

22.5.281 The existing Hinkley Point Power Station Complex is the only notable source of light within the view. Lighting from HPA is evident in this dark sky area. Lighting along Welsh coastline is barely noticeable. The existing Hinkley Point Power Station Complex is also a source of light glow, which becomes more noticeable in this dark sky area, in particular under low cloud cover or mist.

22.5.282 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a nationally important footpath, within ecological designations of international and national importance and its proximity to residential properties with similar views. See **Figure 22.28** and **Figure 22.28a**.

Principal Viewpoint 20 – Stockland Bristol, PRoW No. BW 32/3

22.5.283 This medium distance viewpoint is located on the edge of Stockland Bristol, on PRoW No. BW 32/3 and in the vicinity of PRoW No. BW 32/2, within the Lowland Hills Local Landscape Character Area. It is representative of views experienced by walkers and residents of properties located on the western edge of the village.

22.5.284 The existing Hinkley Point Power Station Complex and the associated overhead lines are visible in the distance. A large number of electricity pylons which punctuate the skyline combined with the Complex have an urbanising influence on this rural area. Green Lane ridge is visible in the far distance however the majority of the site is obscured by intervening landscape features, notably as landform and tree cover.

22.5.285 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on footpath of local importance and in the immediate vicinity of residential properties. See **Figure 22.29** and **Figure 22.29a**.

Principal Viewpoint 21 – Quantock Hills AONB, PRoW No. WL 24/1

22.5.286 This medium distance viewpoint is located on a PRoW No. WL 24/1 located to the north of Kilve which is located within the Quantock Hills AONB. It is sited within an area of outstanding scenic interest and Doniford Stream and Quantock Fringe Local Landscape Character Area. The viewpoint is representative of the view experienced by walkers and residents of Kilton.

22.5.287 This viewpoint was selected during a site visit with the Statutory Consultees (Natural England) as the most representative of the local landscape character and also likely to be used by the public. There are other views of the Hinkley Point Power Station Complex along the coastline from East Quantoxhead to Kilve Pill, however due to the elevation of these viewpoints, the nature of the development and surrounding topography, no views of the HPC development site would be available. Similar and sometimes more open views towards the existing Hinkley Point Power Station Complex also exist from lay-bys and gaps in hedgerows along Hilltop Lane but they are not as representative of a local landscape character. No direct views of the site are available for the residents of Kilton due to screening provided by vegetation and rolling topography to the east of Kilton, which are visible within the view.

22.5.288 The viewpoint has open views across farmland with hedgerow boundaries and a few trees. Local houses and farm buildings, wooden fencing, telegraph poles and small clumps of trees are visible in the foreground. The existing Hinkley Point Power Station Complex buildings are partially visible in the distance as they punctuate the skyline, however lower level development within the existing Complex is screened by landform.

22.5.289 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location in the nationally designated landscape on a footpath of local importance. See **Figure 22.30** and **Figure 22.30a**.

Principal Viewpoint 22 – East Quantoxhead, PRoW No. WL 8/30

22.5.290 This long distance viewpoint is located on a PRoW No. WL 8/30 which lies within the Quantock Hills AONB, to the north-east of the Court House. The viewpoint is located towards the western fringes of the Quantock Vale (Coastal - Lilstock) Local Landscape Character Area and designated as an area of outstanding scenic interest.

22.5.291 The viewpoint is representative of the view experienced by walkers and was selected during a site visit with the statutory consultees (Natural England and English Heritage). This typical view of the coastal edge of the Quantock Hills AONB is open and characterised by farmland on gently undulating topography with small patches of woodland and dense unmanaged hedgerows bounding large rectangular fields. The existing Hinkley Point Power Station Complex is partially screened by landform and vegetation and only the tallest structures within the Complex punctuate the skyline. The HPC development site is completely screened by the existing landform.

22.5.292 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location in the nationally designated landscape on a footpath of local importance. See **Figure 22.31** and **Figure 22.31a**.

Principal Viewpoint 23 – East Quantoxhead, Court House Gardens

22.5.293 This long distance viewpoint is located in the gardens of Court House, a listed building within the Quantock Hills AONB that is seasonally open to public. It is representative of the view experienced by walkers and visitors to Court House. The viewpoint is located within the western fringes of the Quantock Vale (Coastal - Lilstock) Landscape Character Area and within the area of outstanding scenic interest.

22.5.294 This viewpoint is located in close proximity to Principal Viewpoint 22 but it was selected by the Statutory Consultees due to its higher elevation providing the best possible views into the site from the surrounding area and its historic importance. The existing Hinkley Point Power Station Complex is generally well screened by the undulating topography of the Eastern Lowlands and coastal vegetation. The HPC development site is completely screened by the existing landform.

22.5.295 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location at Court House (of high historic importance) which is also a popular tourist attraction within the nationally designated landscape of the Quantock Hills AONB. See **Figure 22.32** and **Figure 22.32a**

Principal Viewpoint 24 – Entrance to Dodington House

22.5.296 This medium distance viewpoint is located at the entrance to Dodington House, a Listed Building within the Fairfield Estate. The viewpoint is representative of the view experienced by residents and visitors to Dodington House and is located within the Quantock Vale (Quantock Fringes - Dodington) Landscape Character Area and the area of outstanding scenic interest.

22.5.297 The view encompasses a driveway in front of Dodington House surrounded by ornamental tree planting which provide a degree of enclosure. In the medium distance large blocks of woodland obscure views across the Eastern Lowlands. The existing Hinkley Point Power Station Complex is partially screened by vegetation in the middle ground lying behind the barn in the foreground.

22.5.298 The sensitivity of visual receptors at this viewpoint has been rated as high due to residential character of the location but also its heritage importance. See **Figure 22.33** and **Figure 22.33a**

Principal Viewpoint 25 – Nether Stowey, Stogursey Lane

22.5.299 This medium distance viewpoint is located on a footpath adjacent to the residential area at Stogursey Lane in Nether Stowey and is representative of the view experienced by pedestrians. The viewpoint is located within the Lowland Hills Local Landscape Character Area.

22.5.300 Located on the edge of Nether Stowey and elevated ground the viewpoint offers views across Lowland Hills and Eastern Lowlands towards the Hinkley Point Power Station Complex, which is a distinctive landmark in the far distance. The landscape within the view is characterised by lowland hills with several small blocks of woodland and fields bounded by hedges. Garden planting and trimmed hedges in the foreground are evident within the view. The eastern part of the Green Lane ridge within the HPC development site is partially visible in the distance.

22.5.301 The sensitivity of visual receptors at this viewpoint has been rated as medium due to its location on a public footpath of local importance. See **Figure 22.34** and **Figure 22.34a**

Principal Viewpoint 26 – Quantock Hills AONB, Beacon Hill

22.5.302 This long distance viewpoint is located on the summit of Beacon Hill in the northern part of the Quantock Hills AONB, within the Central Quantocks Local Landscape Character Area. It represents views experienced by walkers.

22.5.303 The viewpoint provides an open view of a large scale landscape with few built elements and overlooks the Quantock Vale Landscape Character Area and the existing Hinkley Point Power Station Complex. The view is dominated by heathland vegetation covering Beacon Hill in the foreground, Quantock Vale farmland and large areas of sea and sky. Due to its high elevation this viewpoint provides long and almost uninterrupted views of the HPC development site.

22.5.304 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a very popular destination within the nationally designated landscape. . See **Figure 22.35** and **Figure 22.35a**.

Principal Viewpoint 27 – A39, Holford Lay-by

22.5.305 This long distance viewpoint is located approximately 5.5km to the south-west of the site in lay-by on the A39 towards north-eastern edge part of the Quantock Hills AONB, within the Central Quantocks Local Landscape Character Area. The Green Lane ridge and the southern part of the HPC development site are partially visible in the distance.

22.5.306 The lay-by is used by motorists on the A39 but also horse riders and visitors to the northern fringes of the Quantock Hills AONB. Beyond views of the A39 in the foreground, this viewpoint provides views of undisturbed countryside with a few farmhouses located in the middle distance. Several patches of woodland partially screen views towards the coastline. The existing Hinkley Point Power Station Complex is visible in the centre of the view.

22.5.307 There is no lighting in the foreground and middle ground and the Quantock Vale appears as generally dark area. Lighting from settlements on the coastline between Burnham-on-Sea and Brean is visible across Bridgwater Bay. Lighting of the existing Hinkley Point Power Station Complex is visible above the vegetation. The existing Complex is also a source of light glow, which becomes more noticeable in this dark sky area, in particular under low cloud cover or mist.

22.5.308 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location within a popular lay-by within a nationally designated landscape. See **Figure 22.36** and **Figure 22.36a**.

Principal Viewpoint 28 – Quantock Hills AONB, PRoW No. WL 10/9

22.5.309 This long distance viewpoint is located within the Quantock Hills AONB on a PRoW No. WL 10/9 between Woodland Hill and Dowsborough and represents views experienced by walkers. It is located within the Central Quantocks Local Landscape Character Area.

22.5.310 The taller buildings of the Hinkley Point Power Station Complex are a visible feature in the distance. The viewpoint overlooks the rolling lowland landscape of Quantock Vale with a distinctive and regular field pattern, hedges, woodland blocks, and small settlements and farms. In the very far distance, Steep Holm and Brean Down are visible. Due to the elevation of this viewpoint, farmland within the HPC development site is visible but its prominence is limited due to the distance and its location set within the wider complex panorama, which includes numerous features including settlement, woodland and the existing HPA and HPB stations. The local ridge of Green Lane screens the northern parts of the HPC development site.

22.5.311 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a popular footpath within the nationally designated landscape. See **Figure 22.37** and **Figure 22.37a**.

Principal Viewpoint 29 – Quantock Hills AONB, Walford's Gibbet

22.5.312 Located on PRoW No. WL 10/20, on the central eastern edge of the Quantock Hills AONB, this long distance viewpoint provides undisturbed views of countryside around the existing Hinkley Point Power Station Complex, which is visible in the centre of the view. The viewpoint is located within the Central Quantocks Local Landscape Character Area and representative of views experienced by walkers on public footpaths. The HPC development site is visible but its prominence is limited due to distance and its location set within the wider complex panorama which includes numerous features including settlement, woodland and the existing HPA and HPB stations.

22.5.313 There is no lighting in the foreground and middle ground and the Quantock Vale appears as generally dark area, although some limited spot lighting is visible. Lighting from settlements on the coastline between Burnham-on-Sea and Brean is visible across Bridgwater Bay. Lighting of the existing Hinkley Point Power Station Complex is visible against the backdrop of Bridgwater Bay. The existing Complex is also a source of significant light glow, which becomes more noticeable in this dark sky area, in particular under low cloud cover or mist.

22.5.314 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a public footpath within the nationally designated landscape. See **Figure 22.38** and **Figure 22.38a**.

Principal Viewpoint 30 – Quantock Hills AONB, PRoW No. 10/28

22.5.315 This long distance viewpoint is located within the Quantock Hills AONB on a PRoW No. 10/28 overlooking Frog Combe. The viewpoint is located within the Central Quantocks Local Landscape Character Area and represents views experienced by walkers.

22.5.316 The hilltops of the central Quantocks Hills are visible in the middle distance. These hills obscure the majority of views towards Bridgwater Bay and the coastline; however, the tallest buildings of the existing Hinkley Point Power Station Complex form a distinctive landmark in the far distance as they punctuate the skyline between the hills. The visibility of the HPC development site is very low due to the distance.

22.5.317 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a public footpath within the nationally designated landscape. See **Figure 22.39** and **Figure 22.39a**.

Principal Viewpoint 31 – Quantock Hills AONB, Will's Neck

22.5.318 This long distance viewpoint is located on Will's Neck ridge (PRoW No. T 30/10) within the Quantock Hills AONB and represents views experienced by walkers. It is located within the Quantock Hills Local Landscape Character Area.

22.5.319 The hilltops of the central Quantocks Hills are visible in the middle distance. These hills obscure the majority of views towards Bridgwater Bay and the coastline; however, the tallest buildings of the existing Hinkley Point Power Station Complex are visible in the distance punctuating the coastline between the hills with the backdrop of Bridgwater Bay. The HPC development site is visible but its prominence is limited due to distance and its location set within the panorama which includes the existing HPA and HPB stations.

22.5.320 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a popular footpath within the nationally designated landscape. See **Figure 22.40** and **Figure 22.40a**.

Principal Viewpoint 32 – Quantock Hills AONB, Cothelstone Hill

22.5.321 This long distance viewpoint is located within the Quantock Hills AONB on the summit of Cothelstone Hill (adjacent to PRoW T 9/11 and in the vicinity of PRoW No. T 9/9) and overlooks the lower-lying coastal landscape with Bridgwater Bay in the distance. This viewpoint is located within the Quantock Hills Local Landscape Character Area.

22.5.322 The viewpoint represents views experienced by walkers on Cothelstone Hill. The viewpoint provides open views of the Quantock Hills landscape and the immediate foreground is formed by the grassy hilltop of Cothelstone Hill. The surrounding landscape of the Quantock Hills comprises a patchwork of agricultural fields and forest plantations separated by hedgerows delineating field boundaries. Despite the long distance, the existing Hinkley Point Station Complex is visible; its tallest structures viewed against the backdrop of Bridgwater Bay. The lower levels of the existing Hinkley Point Power Station Complex are screened by rolling landform and vegetation. The HPC development site is visible but its prominence is limited due to distance and its location set within the wider complex panorama which includes numerous features such as settlement, woodland, farmland and the existing HPA and HPB stations.

22.5.323 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a very popular footpath within the nationally designated landscape. See **Figure 22.41** and **Figure 22.41a**.

Principal Viewpoint 33 – Quantock Hills AONB, Broomfield Hill

22.5.324 This long distance viewpoint is located adjacent to a small forest plantation on Broomfield Hill within the Quantock Hills AONB. This viewpoint is located within the Quantock Hills Local Landscape Character Area and represents views experienced by walkers.

22.5.325 The viewpoint overlooks the lower-lying coastal landscape with Bridgwater Bay in the distance, and Quantock Summits and Quantock Hills and Combes in the medium distance. There is a clear distinction between the dominating landscape of the Quantock Hills AONB characterised by hills covered by a patchwork of small woodland blocks and large agricultural fields divided by hedgerows, and the low lying farmland beyond. The existing Hinkley Point Power Station Complex is visible set against the backdrop of the Bridgwater Bay. The HPC development site is visible but its prominence is limited due to distance and its location set within the wider complex panorama which includes numerous features such as settlement, woodland, farmland and the existing HPA and HPB stations.

22.5.326 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a publicly accessible land within the nationally designated landscape. See **Figure 22.42** and **Figure 22.42a**.

Principal Viewpoint 34 – Quantock Hills AONB, Wind Down, lay-by

22.5.327 This long distance viewpoint is located within the south-eastern fringe of the Quantock Hills AONB, at a popular lay-by at Wind Down. It represents views experienced by drivers stopping in the lay-by, and people starting their walks. This viewpoint is located within the Quantock Hills Local Landscape Character Area.

22.5.328 The Quantock Hills and Combes, characterised by large fields of grassland and some hedges and trees, gently descend and transform into the low lying farmland which is clearly demarcated by small settlements and farms. The existing Hinkley Point Power Station Complex is visible on the coastline with the backdrop of the Bridgwater Bay. The HPC development site is visible but its prominence is limited due to distance and its location set within the wider complex panorama which includes numerous features including settlement, extensive woodland and tree cover, farmland and the existing HPA and HPB stations.

22.5.329 There is no lighting in the foreground and middle ground. Local spot lighting is visible within the Lowland Hills and along the Bridgwater Bay coastline. Lighting of the existing Hinkley Point Power Station Complex is visible against the backdrop of the Bridgwater Bay. The existing Complex is also a source of light glow, which becomes more noticeable in this dark sky area, in particular under low cloud cover or mist.

22.5.330 The sensitivity of visual receptors at this viewpoint has been rated as high due to its popularity and location on the edge of the nationally designated landscape. See **Figure 22.43** and **Figure 22.43a**.

Principal Viewpoint 35 – Cannington Park, Public Footpath

22.5.331 This long distance viewpoint is located on a public footpath leading to the Cannington Park Hill Fort, which is designated as a Scheduled Ancient Monument. The viewpoint is located within the Lowland Hills Local Landscape Character Area and it represents views experienced by walkers.

22.5.332 The existing vegetation covering the hill effectively screens almost all views towards the coast and the HPC development site. However, the tallest buildings within the existing Hinkley Point Power Station Complex and the associated overhead lines are partially visible through gaps in vegetation.

22.5.333 The sensitivity of visual receptors at this viewpoint has been rated as high due to the historic importance of Cannington Park Hill and its visual setting. See **Figure 22.44** and **Figure 22.44a**.

Principal Viewpoint 36 – Puriton Hill, PRoW No. BW 28/3

22.5.334 This long distance viewpoint is located on a PRoW No. BW 28/3 located on the Puriton Hill adjacent to Junction 23 of M5 and provides open views of the countryside between Bridgwater and the coastline. It is located within the Lowland Hills Local Landscape Character Area and represents views experienced by walkers.

22.5.335 The M5 and the adjacent built form are visible in the foreground and several small settlements and can be seen in the distance. The existing Hinkley Point Power Station Complex punctuates the coastline in the far distance on the backdrop of Bridgwater Bay. Green Lane ridge immediately to the south of the application site, is visible in the distance within the wider panorama which includes views of the flat to the gently undulating farmland and scattered woodland and hedgerows, and HPA and HPB stations.

22.5.336 The sensitivity of visual receptors at this viewpoint has been rated as medium due to its location on a PRoW of local importance. See **Figure 22.45** and **Figure 22.45a**.

Principal Viewpoint 37 – Burnham-on-Sea, waterfront (west of the pier)

22.5.337 This long distance viewpoint is located adjacent to the pier on Burnham-on-Sea waterfront within the built up area. It represents views experienced by walkers, motorists and local residents. It is located within the Burnham-on-Sea to Brean Down Local Seascape Character Area.

22.5.338 The sandy beach and waters of the Severn Estuary out into Bridgwater Bay dominate the view with the Quantock Hills forming the backdrop. The view is dominated by a vast expanse of the sea and sky. The existing Hinkley Point Power Station Complex is visible and a notable landmark on the coastline and screens parts of the HPC development site.

22.5.339 The Burnham-on-Sea waterfront is well lit. The existing Hinkley Point Power Station Complex is the only noticeable light source along the distant Bridgwater Bay coastline.

22.5.340 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a very popular waterfront with a number of residential properties and a formal viewpoint on the pier. See **Figure 22.46** and **Figure 22.46a**.

Principal Viewpoint 38 – Brent Knoll (monument)

22.5.341 This long distance viewpoint is located on the top of Brent Knoll hill (near the monument) and represents views experienced by walkers. It is located within the Lowland Hills Local Landscape Character Area.

22.5.342 This viewpoint provides open views of the Bridgwater Bay and the adjacent coastline. The visibility of the taller buildings of the Hinkley Point Power Station Complex is limited due to the long distance from the site (over 14km) set within an expansive panorama of farmland, settlement and Bridgwater Bay and the distant coastline.

22.5.343 The sensitivity of visual receptors at this viewpoint has been rated as medium due to its location on a popular walking destination. See **Figure 22.47** and **Figure 22.47a**.

Principal Viewpoint 39 – Berrow Beach

22.5.344 This long distance viewpoint is located on Berrow Beach and represents views experienced by the visitors to the beach. The sandy beach and waters of the Severn Estuary out into Bridgwater Bay dominate the view with the Quantock Hills forming a backdrop to views to the south west. The viewpoint is located within the Burnham-on-Sea to Brean Down Local Seascape Character Area

22.5.345 This simple view is dominated by a vast expanse of the sand, sea and sky. The existing Hinkley Point Power Station Complex is visible and a notable landmark on the coastline and screens parts of the HPC development site.

22.5.346 The sensitivity of visual receptors at this viewpoint has been rated as medium due to its location on a locally important beach. See **Figure 22.48** and **Figure 22.48a**.

Principal Viewpoint 40 – Brean Down

22.5.347 This long distance viewpoint is located on the ridge of Brean Down, on PRoW No. AX 7/16, looking across Bridgwater Bay. It represents views experienced by walkers and is located within the Mendips Local Landscape Character Area.

22.5.348 The viewpoint provides open views of Bridgwater Bay and long distance views across to the Quantock Hills and parts of Exmoor. This simple view is dominated by a vast expanse of the sea and sky. The visibility of the existing Hinkley Point Power Station Complex and the HPC development site is limited due to long distance (over 15km) and set within the expansive view of Bridgwater Bay.

22.5.349 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location within a popular tourist destination of landscape and historic importance. . See **Figure 22.49** and **Figure 22.49a**.

Principal Viewpoint 41 – Mendip Hills AONB, Bleadon Hill

22.5.350 This long distance viewpoint is located on a public footpath within the Mendip Hills AONB and represents views experienced by walkers. It is located within the Limestone Ridges and Combes Local Landscape Character Area. The Quantock Hills are visible in the far distance establishing a distant backdrop. The visibility of the existing Hinkley Point Power Station Complex and the HPC development site is limited due to the distance and angle of view with the middle ground on Bridgwater Bay and extensive farmland.

22.5.351 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a footpath within a nationally designated landscape. See **Figure 22.50** and **Figure 22.50a**.

Principal Viewpoint 42 – Mendip Hills AONB, Crook Peak

22.5.352 This viewpoint is located on a public footpath leading to Crook Peak (near the summit) within the Mendip Hills AONB and represents views experienced by walkers. It is located within the Mendips Local Landscape Character Area. The Quantocks Hills are visible in the far distance. The visibility of the existing Hinkley Point Power Station Complex and the HPC development site is limited due to the distance.

22.5.353 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a footpath within the nationally designated landscape. See **Figure 22.51** and **Figure 22.51a**.

Secondary Viewpoint S1 – Minehead Waterfront

22.5.354 This long distance viewpoint is located on the waterfront, within urban area of Minehead and represents views experienced by residents, pedestrians and motorists. It is located over 22km from the development site and the existing Hinkley Point Power Station Complex appears as a feature of low prominence punctuating the skyline to the north of the distinctive Quantock ridge. The view is dominated by a vast expanse of the sky and sea and Minehead waterfront development is visible on the side.

22.5.355 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a pedestrian track of local importance and in the vicinity of residential properties. See **Figure 22.52**.

Secondary Viewpoint S2 – Exmoor National Park, North Hill

22.5.356 This long distance viewpoint is located on a PRoW No. WL 14/14 on the North Hill within the Exmoor National Park and represents views experienced by walkers.

22.5.357 The vegetation in the foreground screens views towards Bridgwater Bay and the Hinkley Point Power Station Complex is the only man-made structure visible in the distance through gaps in vegetation. Due to the distance from the site the existing Hinkley Point Power Station Complex is of very low prominence.

22.5.358 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a footpath within a nationally designated landscape. See **Figure 22.53**.

Secondary Viewpoint S3 – Minehead, Paganel Road

22.5.359 This long distance viewpoint is located on Paganel Road, within the most elevated urban area of Minehead. The view is experienced by motorists, pedestrians and residents of the adjacent houses.

22.5.360 The foreground of the view has typically suburban character with a mix of housing and planting located on a slope descending towards the sea. The distinctive Quantock ridge is visible in the long distance, just above the coastline, the existing Hinkley Point Power Station Complex punctuates the skyline. Similarly to other views in this area, due to long distance (over 23km) the existing Complex is of low prominence.

22.5.361 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location in a residential area. See **Figure 22.54**.

Secondary Viewpoint S4 – Exmoor National Park, Conygar Tower

22.5.362 This long distance viewpoint is located within the Exmoor National Park, adjacent to Conygar Tower in Dunster. Conygar Tower is a Grade II listed building in the vicinity of the Dunster Castle (located on a nearby hilltop but not experiencing views of the HPC development site) and a popular tourist destination. The viewpoint represents views experienced by walkers.

22.5.363 The woodland surrounding the tower screens the majority of views towards Bridgwater Bay and the existing Hinkley Point Power Station Complex is visible through gaps in the existing woodland. Due to distance and woodland obscuring the views the Complex is barely perceptible from this viewpoint.

22.5.364 The sensitivity of visual receptors at this viewpoint has been rated as high due the cultural, and heritage importance of the Conygar Tower and its popularity as a walking destination for people visiting and living in Dunster. See **Figure 22.55**.

Secondary Viewpoint S5 – Exmoor National Park, Rodhuish Common

22.5.365 This viewpoint is located within the Exmoor National Park on Rodhuish Common and represents views experienced by walkers on publicly accessible land (south of PRoW No. WL 29/6).

22.5.366 The viewpoint provides open views of the coastline and low lying farmland to the west of the Quantock Hills AONB, whose ridge forms a distinctive skyline. Due to the long distance (over 20km), the existing Hinkley Point Power Station Complex is barely perceptible against a backdrop of Bridgwater Bay and its coastline around Weston-Super-Mare. Similar to other views from this distance and direction, the visibility of the existing Complex depends on the direction of sunlight and weather conditions.

22.5.367 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a footpath within a nationally designated landscape. See **Figure 22.56**.

Secondary Viewpoint S6 – Welsh Coast, Barry Island Waterfront

22.5.368 This long distance viewpoint is located on the Barry Island Waterfront, on the Welsh coast, approximately 19km to the north of the HPC development site. This simple view is characterised by sea, sky and beach and is experienced by residents of Barry, motorists and pedestrians. Due to the long distance, the existing Hinkley Point Power Station Complex and the HPC development site are visible but barely perceptible. The distinctive ridge of the Quantock Hills AONB forms the skyline to the west of the existing Complex in the view.

22.5.369 The sensitivity of visual receptors at this viewpoint has been rated as high due to its location on a popular waterfront and its representative character for a number of receptors, including residents of Barry. See **Figure 22.57**.

22.5.370 **Table 22.8** provides a summary of viewpoints and visual receptors.

Table 22.8: Summary of Viewpoints and Visual Receptors

ID	Viewpoint Name	Receptor	Distance	Sensitivity
1	PRoW No. WL 23/110 west of Benhole Lane	Walkers	Short	High
2	West Somerset Coast Path, PRoW No. WL 23/95	Walkers	Short	High
3	West Somerset Coast Path, Lilstock, PRoW No. WL 24/10	Walkers	Medium	High
4	PRoW No. WL 24/8	Walkers	Medium	Medium
5	Higher Hill, PRoW No. 24/3	Walkers	Medium	Medium
6	PRoW No. WL 24/11 near the edge of the Great Plantation	Walkers	Medium	Medium
7	Fairfield House Driveway	Residents, visitors to Fairfield House	Medium	High
8	Knighton Farm, PRoW No. WL 23/46	Residents, walkers	Short	High
9	Burton	Walkers, motorists	Short	Medium
10	Shurton West, Local Farm near PRoW No. WL 23/48	Residents, walkers	Short	High
11	Shurton East, PRoW No. WL 23/56	Walkers, residents	Short	High
12	Local road to the south of the site (near Gunter's Grove)	Motorists	Short	Low
13	PRoW No. WL 23/57, West of Wick	Walkers	Short	Medium
14	Pixies Mound (Wick Barrow)	Walkers	Short	High
15	PRoW No. WL 23/61	Walkers	Short	High
16	Wick, PRoW No. WL 23/61	Walkers, residents	Short	High
17	Farrington Hill Lane (Farringdon Farm)	Walkers	Short	Medium
18	Residential area at Stogursey, Burgage Road/Lime Street	Pedestrians, motorists, residents	Short	High
19	Stolford, West Somerset Coast Path, PRoW No. WL 23/95	Residents, walkers	Medium	High
20	Stockland Bristol, PRoW No. BW 32/3	Residents, walkers	Medium	High
21	Quantock Hills AONB, PRoW No. WL 24/1	Residents, walkers	Medium	High

ID	Viewpoint Name	Receptor	Distance	Sensitivity
22	East Quantoxhead, PRoW No. WL 8/30	Walkers	Long	High
23	East Quantoxhead, Court House Gardens	Walkers, visitors to Court House	Long	High
24	Entrance to Dodington House	Residents, visitors to Doddington House	Medium	High
25	Nether Stowey, Stogursey Lane	Pedestrians	Medium	Medium
26	Quantock Hills AONB, Beacon Hill	Walkers	Long	High
27	A39, Holford Parking Bay	Motorists, walkers, horse riders	Long	High
28	Quantock Hills AONB, PRoW No. WL 10/9	Walkers	Long	High
29	Quantock Hills AONB, Walford's Gibbet	Walkers	Long	High
30	Quantock Hills AONB, PRoW No. 10/28	Walkers	Long	High
31	Quantock Hills AONB, Will's Neck	Walkers	Long	High
32	Quantock Hills AONB, Cothelstone Hill	Walkers	Long	High
33	Quantock Hills AONB, Broomfield Hill	Walkers	Long	High
34	Quantock Hills AONB, Wind Down, lay-by	Motorists, walkers	Long	High
35	Cannington Park, Public Footpath	Walkers	Long	High
36	Puriton Hill, PRoW No. BW 28/3	Walkers	Long	Medium
37	Burnham-on-Sea, waterfront (west of the pier)	Residents, pedestrians, motorists	Long	High
38	Brent Knoll (monument)	Walkers	Long	Medium
39	Berrow Beach	Walkers, tourists	Long	Medium
40	Brean Down	Walkers	Long	High
41	Mendip Hills AONB, Bleadon Hill	Walkers	Long	High
42	Mendip Hills AONB, Crook Peak	Walkers	Long	High
S1	Minehead Waterfront	Residents, pedestrians, motorists	Long	High
S2	Exmoor National Park, North Hill	Walkers	Long	High
S3	Minehead, Paganel Road	Residents, pedestrians, motorists	Long	High
S4	Exmoor National Park, Conygar Tower	Walkers	Long	High
S5	Exmoor National Park, Rodhuish Common	Walkers	Long	High
S6	Welsh Coast, Barry Island Waterfront	Pedestrians, walkers, motorists, residents	Long	High

iv. Conclusions of Visual Baseline

22.5.371 **Figures 22.9** and **22.9a** show the ZTV and viewpoint locations selected to illustrate the visual impact of the HPC proposed development. Field work has identified the nature of the visibility of the HPC development site illustrated in the viewpoint photographs.

22.5.372 The main areas where the HPC development site is visible and has the potential for visual impact of the HPC proposed development to be apparent can be broadly summarised as:

- Lowland hills around the site (up to 5km), including nearby villages and farms and a number of local Public Rights of Way;
- Somerset coastline from Minehead to Brean Down, including important coastal footpaths and popular recreational areas;
- Eastern hills of Exmoor National Park;
- Summits and north-east facing slopes of the Quantock Hills AONB;
- Western fringe of the Mendip Hills AONB;
- Brent Knoll;
- Puriton Hill; and
- South Wales coastline.

22.5.373 The overall sensitivity of the surrounding area to visual impact is considered to be medium to high. The areas of the highest sensitivity exist along the coastline, Quantock Hills AONB, Mendip Hills AONB, Exmoor National Park, and lowland hills to the east of the HPC development site.

22.6 Assessment of Impacts

a) Introduction

22.6.1 This section assesses the potential landscape and visual impacts which would result from the construction and operational activities relating to the HPC proposed development before implementing mitigation measures.

22.6.2 Mitigation measures embodied in the project have been addressed from the earliest stages of project design and benefited significantly from the inputs of stakeholders. Mitigation measures, whether they take the form of landscape proposals, masterplan configuration and the selection of materials for buildings, are embodied in the DCO application proposals and as such are regarded as being inherent to the scheme.

22.6.3 Residual landscape and visual impacts following implementation of the proposed further mitigation measures are assessed in section 22.8 of this LVIA.

22.6.4 This section of the LVIA provides a summary of key elements of the HPC proposed development that would cause landscape and visual impacts during construction and operational phases and are assessed in the LVIA.

22.6.5 Detailed description of the HPC proposed development is available in the following HPC project DCO application documents:

- Description of Proposed Development (**Chapter 2** of this volume);
- Construction (**Chapter 3** of this volume);
- **Construction Method Statement**;
- Operation (**Chapter 4** of this volume);

- **Hinkley Point C Design and Access Statement**;
- **HPC Landscape Strategy**, which contains detailed description of the landscape proposals during construction and operation;
- **HPC Construction Lighting Strategy** (appended to the **Construction Method Statement**); and
- **HPC Operational Lighting Strategy** (appended to **Chapter 2** of this volume).

22.6.6 The iterative design process included consideration of other EIA disciplines, in particular terrestrial ecology and ornithology (**Chapter 20** of this volume), historic environment (**Chapter 23** of this volume), amenity and recreation (**Chapter 25** of this volume) and transport matters (**Chapter 10** of this volume). The landscape proposals and assessment described in this section have been informed by these disciplines.

22.6.7 This LVIA does not assess landscape and visual impacts arising from HPC off-site associated development which are described in separate ES chapters. Cumulative impacts relating to landscape and visual matters arising from the HPC proposed development in combination with other elements of the HPC project and other relevant plans and projects, including National Grid overhead lines to the east of the HPC proposed development are identified and assessed in **Volume 11** of this ES.

22.6.8 Eleven off-site highway improvement schemes will be included in the HPC project DCO application. They are presented in **Chapter 2** of this volume. The schemes concern land that is presently within the highway, on highway land, such verges, limited areas of hard surfacing and urban green space. The works are of two principal types; modifications to existing road alignments or junction/roundabout arrangements and enhanced safety measures. The highway improvements works have been considered and the sites visited and are considered to be of small scale and have no potential to exert significant landscape and visual impact, with the exception of likely lighting impacts during the hours of darkness at Washford Cross Roundabout and A39 New Road/B3339 Sandford Hill Roundabout.

22.6.9 In terms of visual impact it is assessed that the only receptors affected by the HPC proposed development and the lighting at Washford Cross Roundabout would be PRoW users in Exmoor, represented by Secondary Viewpoint s6 at Rodhuish Common, and no other visual receptors would affected by the HPC proposed development and by lighting at A39 New Road/B3339 Sandford Hill Roundabout. The assessment of lighting impact on receptors at Rodhuish Common is included in this LVIA.

22.6.10 The impact of lighting of the proposed highway improvements at Washford Cross Roundabout and A39 New Road/B3339 Sandford Hill Roundabout is considered for the relevant Local Landscape Character Areas, namely Central West Somerset LLCA and Lowland Hills LLCA. It is considered that both proposed schemes would not cause significant impacts on the landscape character of the remaining LLCAs due to the distance, use of cut-off lanterns, and the reduction of the proposed lighting to the minimum levels possible to minimise upward light spill.

22.6.11 It is considered that none of the remaining schemes have potential for significant landscape and visual impact, and as such the 9 remaining schemes have been scoped out from assessment in this chapter.

22.6.12 A summary of key elements of the project with the potential for exerting landscape and visual impact during HPC construction and operational phases is provided below.

b) Summary of HPC Construction Phase

22.6.13 During the construction phase the intensity, nature and duration of impacts will vary and this is assessed with reference to the overall HPC project programme and construction phasing plans (see **Chapter 3** of this volume and the **Construction Method Statement**). Reference should be made to **Figure 3.1** and **Figure 3.2** in **Chapter 3** of this volume, which illustrates the construction parameters upon which this landscape and visual impact assessment is based.

22.6.14 The construction phasing plans, set out in the **Construction Method Statement**, have been informed by landscape and visual impact considerations to minimise the duration of impacts on landscape and visual receptors. The LVIA informed the construction site layout to minimise the magnitude of landscape and visual impacts by locating the structures of most significant size in clusters or in areas of the site with the least potential for visual impacts (for instance away from the HPC development site boundary and residential receptors).

22.6.15 The key elements of HPC and associated activities during the construction phase which are assessed in this chapter include:

- Site preparation works, including site clearance works, removal of vegetation, excavations and earthworks.
- Construction of the HPC Unit 1 and Unit 2, other ancillary buildings and structures (including sea wall, on-site pylons and meteorological mast).
- Erection of temporary buildings required for construction.
- Construction of roads and other infrastructure.
- Construction machinery, including a number of tower cranes, smaller cranes, batching plants, drilling rigs and others.
- Movement of construction related traffic, including delivery and removal of materials to and from site, off-site road traffic including travel of workers to and from site, and load shipments to and from site.
- Construction, operation and removal of the temporary jetty, including on-shore elements of the temporary jetty such as a sand shed, aggregate stockpiles and silos.
- Construction, operation and removal of on-site accommodation campus.
- Construction of the National Grid substation.
- Landscaping during construction, including: remodelled landform; woodland, hedgerow and shrub planting; creation of water bodies; restoration of arable land and areas of grassland; implementation of the proposed PRoW network; retention of landscape features within the site.

22.6.16 Landscape proposals during DCO construction works is shown on **Figure 22.58**. Landscape proposals during the construction phase comprise retained and proposed landscape features, such as the majority of the locally prominent Green Lane ridge or boundary vegetation, which were considered of landscape value or contribute to visual screening for local residents. The existing boundary vegetation would be reinforced by additional planting to increase screening.

22.6.17 The project involves extensive bulk earthworks, excavation, earth placement and modelling. At this stage indicative information is presented on the soil and rock pile storage heights. See **Figure 3.1** in **Chapter 3** of this volume of the ES.

22.6.18 To help ensure early screening for the local residents, landscaping is proposed within the southern part of the HPC development site which is in advance of the implementation of the final landscape restoration proposals. Proposals include raised, naturally modelled landform and native woodland screen planting which would continue maturing during the HPC construction phase to eventually form part of the final landscape restoration scheme at commencement of HPC operation. The southern area of the HPC development site already contains the advanced screen planting implemented in Spring 2011.

22.6.19 Early landscape restoration proposals also include establishment of new hedgerows along Wick Moor Drove to reduce visual impact on residential receptors to the south east of the HPC development site and additional hedgerows forming an ecological link between Wick Moor Drove and Green Lane.

22.6.20 The planting proposals between Pixies Mound and the proposed northern access roundabout and the adjacent car park would be implemented during the initial construction phase and continue maturing during the HPC construction phase to eventually form part of the final landscape restoration scheme.

22.6.21 It should be noted that the proposed bund along the north-western HPC development site boundary shown on **Figure 22.58** is a temporary screening bund to be implemented specifically and only for the construction phase, and as such is treated as a mitigation measure and assessed in Section 22.8, Residual Impacts.

22.6.22 Due to the large scale of the construction works, it is not possible to define the exact activities taking place at a specific moment in time. Instead, the construction within the HPC development site has been divided into zones, for which a set of parameters has been defined. The indicative construction parameters are described in **Figure 3.1** and **Table 3.2** of **Chapter 3** of this volume. For each construction zone within the HPC development site the potential height and working parameters have been defined under general (normal) conditions. Two zones showing exceptional conditions ('worst-case scenario') have also been defined. The landscape and visual assessment is based on the most likely, general condition, but it also takes account the potential exceptional condition, which may occur during limited periods of construction and its occurrence (or lack of it) cannot be accurately predicted at this stage.

22.6.23 The indicative heights for spoil and rock storage, together with the parameters set out in **Figure 3.1** in **Chapter 3** of this volume have been assessed and in conclusion there would be no change to the significance of impacts reported in this LVIA.

22.6.24 The majority of construction would require 24-hour working, however, the intensity of construction activities would vary between day and night. The main construction activities would be carried out between 6.00 and 22.00 from Monday to Friday and 6.00 to 15.00 on Saturday with no major construction activities on Sunday. The night shifts would be predominantly required for maintenance and logistics, however, it may be also used to catch up delayed day-time works or in other exceptional circumstances.

c) Summary of HPC Operational Phase

22.6.25 The operational phase of the HPC would commence following the completion of all construction works and the full implementation of the landscape restoration plan (see **Figure 22.59**).

22.6.26 The HPC proposed development would include the following key components with the potential to exert landscape and visual impacts:

- Permanent development including completed HPC Unit 1 and Unit 2 and other ancillary buildings and structures (including sea wall, on-site pylons and meteorological mast).
- National Grid substation and associated transmission infrastructure within the HPC development site.
- Access roads (including emergency access road within the southern part of the HPC development site) and parking.
- Perimeter security fence, which will enclose the majority of the HPC permanent development.
- Vehicle movements associated with the operational activities within the HPC proposed development.
- Fully implemented landscape restoration plan, including remodelled landform; woodland, hedgerow and shrub planting; creation of water features; restoration of arable land and areas of grassland; implementation of the proposed PRoW network.

22.6.27 The final landscape restoration proposals are illustrated on the landscape restoration plan (see **Figure 22.59**) and landscape restoration rendered masterplan (see **Figure 22.60**).

22.6.28 The landscape restoration plan aims to re-establish the existing landform within the HPC development site and outside the HPC permanent development area incorporating enhanced screening through local landform modification and the provision of new woodland areas. The relative height and prominence of Green Lane within the local landscape will be maintained. The landform to the west of the HPC proposed development and in the southern part of the HPC development site is modelled for visual screening. The Holford Stream valley will be restored and a smooth transition between the HPC development site and adjacent land, and integration with the surrounding landscape will be provided.

22.6.29 The landscape restoration plan involves extensive bulk earthworks, excavation, earth placement and modelling. At this indicative information on the formation levels across the landscape restoration area is provided in the landscape restoration plan (see **Figure 22.59**), setting out the likely finished ground levels. Details including the finished ground levels will be submitted as part of the detailed landscape scheme, submitted pursuant to a requirement in the DCO.

22.6.30 The impact assessment has therefore been based on the likely ground levels across the site and has factored into the assessment potential changes to ground levels that may arise in the design development process, allowing for a potential variation in the stated heights of +1m to +1.5m has been assumed. Such variations have been assessed and it is considered that such change across the site would not give rise to any additional significant impact on landscape or visual receptors than that already identified. The effectiveness of the proposed screening earthworks and planting mitigation proposed and illustrated in the VVIs will not be materially altered.

22.6.31 The land use proposals, outside the built development, have been guided by the objective to integrate with the existing landscape character of the Quantock Vale. The landscape character restoration for the HPC development site would comprise:

- A coastal slope field pattern character, recreated with hedgerows and hedgerow trees, a mix of grazing and arable land and neutral grassland, and a scrub edge to the cliffs and hedgerows.
- Retention and enhancement of the Green Lane hedgerow through additional planting.
- Holford Valley field pattern character recreated with hedgerows and hedgerow trees, and species rich grassland.
- Land to the north-west of the HPC development site is proposed to be returned to the land owner following the construction period.

22.6.32 The **HPC Landscape Strategy** contains details of the proposed landscape restoration plan, including the phasing of landscape works, description of how the HPC development site restoration has been integrated with the plot plan, and description of restored PRoW network. It also contains details of landscape materials and proposed management within the restored HPC development site, including the integration of the ecological strategy and associated biodiversity targets.

22.6.33 The **HPC Landscape Strategy** submitted with the DCO application provides further illustrations and plans and includes supporting cross-sections, planting strategy, planting schedules and hardscape palette.

22.6.34 The assessment of impacts takes account of the proposed planting mixes and growth rates taking account of the local context. The planting palette comprises 3 distinctive planting typologies: ‘coastal slopes’, ‘valley wetlands’ and ‘inland wooded ridge’.

22.6.35 The landscape strategy has been designed to accommodate a PRoW network and providing wider access opportunities to the restored landscape. Green Lane will be upgraded to a bridleway following the construction period and the existing footpath along Bum Brook will be maintained providing access for streamside walks. The restored South West Coast Path would be located on the landward side of the new sea wall.

22.6.36 The assessment of operational impacts on landscape and visual receptors is based on the parameters of the project described in **Chapter 2** of this volume and includes an allowance for the proposed height of the buildings and structures (illustrated on **Figure 2.3** in **Chapter 2** of this volume) to increase by an additional 3m above stated roof heights to permit additional roof plant or machinery to be secured. Visually

Verifiable Images (VVIs) are based on building height parameters without the 3m additional height allowance.

d) Landscape Impacts

i. Summary of Landscape Impacts

22.6.31 The following paragraphs provide a summary of key construction and operational impacts on landscape receptors identified in the baseline assessment.

National Landscape Character

22.6.32 The construction and operation of the HPC proposed development will result in both direct and indirect impacts to the Vale of Taunton and Quantock Fringes NCA. Direct impacts will arise as a result of changes to the fabric of the landscape within the HPC development site such as through the loss of landscape elements and features, modification of the environment and introduction of new elements to the landscape, including built elements and landscape proposals such as permanent landform and planting. Indirect impacts will arise as a result to changes to views and experience of the wider NCA landscape as a result of the HPC proposed development.

22.6.33 The Vale of Taunton and Quantock Fringes NCA is an extensive area as such direct impact on its key characteristics would be localised to a small proportion of the overall area. Indirect impacts would also be limited in extent and significance, as the HPC proposed development is located in close proximity to, and would therefore be seen in the context of, the existing Hinkley Point Nuclear Power Station Complex that is a well-established local landmark.

22.6.34 The HPC proposed development would not result in direct impacts on any other NCAs or RLCAs located within the LVIA study area as all material changes to the fabric of the landscape are limited to the HPC development site. Indirect impacts on neighbouring NCAs within the LVIA study area will occur principally as a result of changes to views, most notably views towards the coast from neighbouring elevated areas such as the Quantock Hills. Indirect impacts on key characteristics of neighbouring NCAs are judged to be not significant as alterations to views will be of a limited extent, form part of wider panoramas and view the HPC in the context of the existing Hinkley Point Power Station Complex. It is judged that the intrinsic character of all neighbouring NCAs and RLCAs within the LVIA study area will prevail.

Local Landscape Character

22.6.35 During construction, impact the Quantock Vale LLCA and the St Audries Bay to Hinkley Point LSCA would be of major adverse significance due to significant loss of landscape features (direct impact) within these areas and the visibility of HPC construction. There would be no direct impact on the remaining LLCAs and LSCAs and the main impact would be associated with the change (negative) in views from these areas. The construction impact on the character of Central Quantocks LLCA, Quantock Hills LLCAs and Blue Anchor to St Audries Bay would be of moderate adverse significance. The remaining LLCAs and LSCAs would experience limited views of HPC construction and the impact would be adverse or neutral and of minor significance during HPC construction.

22.6.36 During operation, the impact on the Quantock Vale LLCA would be adverse and of minor significance (year 1) to become neutral and of minor significance (year 15) when the planting proposals begin to mature. The key characteristics of the LLCA would not change, and the proposed landscape features would contain features of high value which would contribute to the character of this LLCA. During operation (year 1 and 15) the impact on St Audries Bay to Hinkley Point LSCA would decrease from major to moderate adverse due to cessation of construction activities and lower magnitude of changes in coastal views, but a degree of physical change due to the operational HPC, including a sea wall which would be created along the cliff fronting the HPC. The operational impacts on the remaining LLCAs and LSCAs would not be significant and would be adverse or neutral and of minor significance, depending on the visibility of the HPC proposed development.

Site Scale Landscape Character

22.6.37 During construction, impacts of major adverse significance would occur in 3 site scale landscape character sub areas of the Quantock Vale LLCA, namely Coastal – Lilstock, Rolling Farmland East – Stogursey and Wick Moor and Coast. The HPC construction would cause significant changes in views from these sub areas and a significant loss of landscape features within the HPC development site, which would affect Coastal – Lilstock and Rolling Farmland East – Stogursey. The impact on Fairfield character area would be of moderate adverse significance due to change in views from this area (but no direct impact on its landscape elements and features). Due to the distance of the Quantock Fringes – Dodington and Wall Common and Coast sub areas from the HPC development site and limited change in views compared to other site scale landscape character sub areas, the construction impact on their character would be of minor adverse significance.

22.6.38 During operation (year 1), the impact on the Coastal – Lilstock sub area would be of major adverse significance. The landscape proposals would have been implemented, however, they would not be mature, so their screening and landscape value would be still limited at this stage. This impact would change to neutral and of moderate significance during year 15 of the operational phase, due the increasing integration of the HPC development into the landscape character of this area and maturation of landscape proposals within the restored HPC development site.

22.6.39 During the operational phase (year 1 and 15) impacts on the character of the remaining landscape character sub areas within the Quantock Vale would not be significant due to increasing screening of the HPC development and introduction of valuable landscape features within the HPC development site.

Landscape Elements and Features

22.6.40 The construction of HPC would cause adverse impacts of major significance on landscape elements and features within the HPC development site and the adjacent landscape up to 50m from its boundary due to widespread loss of landscape elements and features as a result of construction activities.

22.6.41 During operation year 1, the most significant adverse impacts of moderate to major significance would be on land use / settlement and landcover and vegetation. Once the landscape proposals begin to mature (year 15 of the operational phase), the impact on landcover and vegetation would be beneficial and of moderate significance due to a significant gain in valuable landscape features, such as woodland and species-rich hedgerows. The impact on the remaining landscape elements and features, such as landform, and PRoW would not be significant once the HPC development site is restored.

ii. National Landscape Character

22.6.42 National Character Areas for England and Regional Landscape Character Areas for Wales provide a context for the detailed assessment of the impact on local and site scale landscape character areas.

22.6.43 The key characteristics of NCAs (England) and RLCAs (Wales) were described in the landscape baseline and the potential for change of these key characteristics due to the proposed HPC development is evaluated below.

Vale of Taunton and Quantock Fringes

22.6.44 The HPC development, due to its location and large scale, would cause direct (physical) changes to the Area 146: Vale of Taunton and Quantock Fringes however would not cause any substantial change the key characteristics of this area. Although the proposed development is of large scale it is effectively an extension of the existing Hinkley Point Power Station Complex, which is described as a prominent, existing landmark. The combined HPC and the existing Hinkley Point Power Station Complex would become more prominent within this area; however this change would not be substantial in the existing context. During operation, the proposed landscape strategy would create several valuable landscape elements and features, such as hedgerows or woodlands, which are characteristic for this area.

Somerset Levels and Moors/Mid Somerset Hills

22.6.45 The HPC proposed development would not cause any direct change to this area or affect its key characteristics described in the landscape baseline.

22.6.46 The existing Hinkley Point Power Station Complex is visible from the coast and hills within Somerset Levels and Moors/Mid Somerset Hills and has some influence (negative) on the views out from these areas. The HPC would have some impact on views (especially during construction) but this change would not be significant on the character on the NCA.

Quantock Hills AONB

22.6.47 The HPC proposed development is located outside Area 144: The Quantock Hills and as such it would not cause any direct change to this area. The proposed HPC development would have some negative impact on views out from Quantock Hills (particularly from the main ridge and summits), but this change would not alter the character of the area itself due to the long distance of the HPC development site and the presence of the existing Hinkley Point Power Station Complex, which has influence on the character of views from this NCA.

Exmoor

22.6.48 The HPC proposed development is located outside Area 145: Exmoor and it would not cause any direct change to this area. The proposed HPC development would have very limited negative impact on views out from Exmoor (particularly from the main ridge and summits), but this change of views out from Exmoor would not alter the character of the area itself due to the long distance of the HPC development site.

Furthermore, when viewed from the west the HPC would be seen in line with the existing Hinkley Point Power Station Complex and the intensification of built form in views from Exmoor would be minimal.

Mendip Hills AONB

22.6.49 The proposed development is located outside Area 141: Mendip Hills and it would not cause any direct change to this area. The proposed HPC development would have some negative impact on views out from the western fringe of Mendips, but this change would not alter the character of the area itself due to the long distance of the HPC development site and the presence of the existing Hinkley Point Power Station Complex, which has influence on the character of views from this NCA.

Cardiff and Newport RLCA

22.6.50 The proposed development is located outside this RLCA and it would not cause any direct change to this area. The proposed HPC development would have some negative impact on views from the Welsh coastline; however this change would not alter the character of the area itself due to the long distance of the HPC development site and the presence of the existing Hinkley Point Power Station Complex, which has influence on the character of views from this RLCA.

Vale of Glamorgan RLCA

22.6.51 The proposed development is located outside this RLCA and it would not cause any direct change to this area. The proposed HPC development would have some negative impact on views out from this part of the Welsh coastline, but this change would not alter the character of the area itself due to the long distance of the HPC development site and the presence of the existing Hinkley Point Power Station Complex, which has influence on the character of views from this RLCA.

iii. Local Landscape Character

Quantock Vale

22.6.52 The HPC development site is situated entirely within the Quantock Vale LLCA. The HPC construction would cause a direct impact on landscape elements and features within this area. In this lowland landscape of gentle hills, the construction of HPC would be partially visible due to its scale, however, the construction activities taking place at the lower level would be screened from many areas. The skyline would be affected by the construction of the tallest structures and the presence of tower cranes but these features would be seen next to the existing Hinkley Point Power Station Complex and therefore the impact is less significant than it would be in a remote rural landscape. This adverse change in views across Quantock Vale would gradually decrease during site restoration and would eventually become neutral once the HPC is operational and the landscape proposals begin to mature. This includes the impact of lighting, which must be seen against the existing Hinkley Point Power Station Complex and would decrease once the construction activities are complete.

22.6.53 During the construction phase, the impact on the landscape of Quantock Vale would be an adverse medium-term impact of high magnitude and **major** significance, predominantly due to large scale loss of landscape elements and features within the HPC development site (direct impact). The key characteristics of this landscape character area would not change but some of the valued coastal agricultural landscape within the HPC development site would be temporarily lost.

22.6.54 During the operational phase, the adverse impacts on the physical landscape of this character area would gradually decrease and would eventually become neutral once the HPC is operational. The restored landscape would contain many new valuable landscape features and provide good screening of the lower levels of the HPC proposed development.

22.6.55 In the context of the entire Quantock Vale character, the operational impact (year 1) would be adverse, medium-term, of low magnitude and **minor** significance. During the operational phase (year 15) the impact would become long-term, neutral, of low magnitude and **minor** significance.

22.6.56 **Table 22.9** provides a summary of impacts on the Quantock Vale LLCA.

Table 22.9: Impacts on the landscape character of Quantock Vale LLCA

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	Medium	Adverse, medium-term	High	Major
2	Operation year 1	Medium	Adverse, medium-term	Low	Minor
3	Operation year 15	Medium	Neutral, long-term	Low	Minor

Doniford Stream and Quantock Fringe

22.6.57 The HPC proposed development is located outside the Doniford Stream and Quantock Fringe LLCA and its construction and operation would not cause any direct impact on the landscape or the key characteristics of this LLCA, as described in the landscape baseline.

22.6.58 The Doniford Valley, sub area of Doniford Stream and Quantock Fringe character area, would not receive any views of the proposed development due to its location to the west of the Quantocks ridge screening all views of the proposed development.

22.6.59 The only impact associated with the construction and operation of the HPC proposed development would be impact on the views from the North East Quantock Agricultural Fringe sub area towards the east. Construction impacts would be adverse, medium-term, of low magnitude and **minor** significance due to the distance of the HPC proposed development from this area, the rolling topography that would provide some screening to the construction activities, and the location of the HPC development site adjacent to the existing Hinkley Point Power Station Complex (and in line with it when looking from the west).

22.6.60 The during the operational phase (year 1 and year 15) it is judged that the impact would change to neutral, medium to long-term, of very low magnitude and **minor** significance due to the limited change in skyline created by the HPC reactor domes.

22.6.61 **Table 22.10** provides a summary of impacts on the Doniford Stream and Quantock Fringe LLCA.

Table 22.10: Impacts on the landscape character of Doniford Stream and Quantock Fringe LLCA

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	Medium	Adverse, medium-term	Low	Minor
2	Operation year 1	Medium	Neutral, medium-term	Very low	Minor
3	Operation year 15	Medium	Neutral, long-term	Very low	Minor

Central Quantocks

22.6.62 The HPC proposed development is located outside the Central Quantocks and its construction and operation would not cause any direct impact on landscape or the key characteristics of this LLCA described in the landscape baseline.

22.6.63 The Western Scarp Slope, sub area of the Central Quantocks character area, would not receive any views of the proposed development as the views would be screened by the main Quantocks ridge and the sub character area is located outside the ZTV.

22.6.64 The impact of the HPC development on the Central Quantocks would be limited to the summits and eastern slopes of the Upland Plateau and Combes sub area. The impact would be indirect as a result of a change in distant, elevated views towards Bridgwater Bay and the HPC development site. During the construction phase, this is assessed as being of adverse, medium-term, low magnitude and **moderate** significance due to construction activities within the view. During the operational phase (year 1 and year 15) the HPC proposed development would be visible but the impact would change to adverse, medium to long-term, of very low magnitude and **minor** significance. This is due to the simple outline of the completed HPC which would be an extension of the existing Hinkley Point Power Station Complex and due to the distance from the HPC development site.

22.6.65 **Table 22.11** provides a summary of impacts on the Central Quantocks LLCA.

Table 22.11: Impacts on the landscape character of Central Quantocks LLCA

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	High	Adverse, medium-term	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Very low	Minor

Quantock Hills

22.6.66 The HPC proposed development is located outside the Quantock Hills LLCA and its construction and operation would not cause any direct impact on landscape or the key characteristics of this LLCA described in the landscape baseline.

22.6.67 The construction impact would be indirect as a result of a change in distant, elevated views towards Bridgwater Bay and the HPC development site. During the construction phase, this is assessed as being of adverse, medium-term, low magnitude and **moderate** significance due to construction activities within the view.

22.6.68 The HPC proposed development during the operational phase (year 1 and year 15) would have an adverse, medium to long-term impact of very low magnitude and of **minor** significance on the landscape character of the Quantock Hills LLCA predominantly due to the long distance of the proposed development from the southern part of the AONB and the site forming a small part of the wide panorama and the presence of the existing Hinkley Point Power Station Complex.

22.6.69 **Table 22.12** provides a summary of impacts on the Quantock Hills landscape character area.

Table 22.12: Impacts on the landscape character of Quantock Hills

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	High	Adverse, medium-term	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Very low	Minor

Central West Somerset

22.6.70 The HPC proposed development is located outside the Central West Somerset LLCA and its construction and operation would not cause any direct impact on landscape or the key characteristics of this LLCA described in the landscape baseline.

22.6.71 The majority of this character area would not receive any views of the proposed development due to its location to the west of the Quantocks ridge screening all views of the proposed development.

22.6.72 The only impact associated with the construction and operation of the HPC development would be the impact on the views from the Coast (Blue Anchor to St Audries) sub area and the impact of lighting from the proposed highway improvement scheme at Washford Cross Roundabout. The construction and operational impacts (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance due to limited views of the HPC development site, the distance of the HPC proposed development from this area (over 10km), and the location of the HPC development site adjacent to the existing Hinkley Point Power Station Complex (and in line with it when looking from the west). The proposed lighting at Washford Cross Roundabout would cause a very localised impact (predominantly visual) which would be seen in the context of existing lighting effects at Williton and Watchet, and would not increase the significance of impacts on landscape character caused by the HPC development.

22.6.73 **Table 22.13** provides a summary of impacts on the Central West Somerset landscape character area.

Table 22.13: Impacts on the landscape character of Central West Somerset

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	Medium	Neutral, medium-term	Very low	Minor
2	Operation year 1	Medium	Neutral, medium-term	Very low	Minor
3	Operation year 15	Medium	Neutral, long-term	Very low	Minor

Lowland Hills

22.6.74 The HPC proposed development is located outside the Lowland Hills LLCA and its construction and operation would not cause any direct impact on landscape or the key characteristics of this LLCA described in the landscape baseline.

22.6.75 The only impact associated with the construction and operation of the HPC proposed development would be impact on the views from the western fringe of this character area, and from Isolated Hills and Polden Hills sub areas, and the impact associated with lighting from the proposed highway improvement scheme at A39 New Road/B3339 Sandford Hill Roundabout. This impact would be limited due to the distance of these elevated areas from the HPC development site and the alignment of the proposed development with the existing Hinkley Point Power Station Complex, which would provide some screening of the HPC. Views from the Stockland Hills would also be available, however they would be also limited due to the rolling topography providing some screening, the distance from the HPC development site and the presence of the existing Hinkley Point Power Station Complex. The HPC would be viewed as an extension of the existing Hinkley Point Power Station Complex rather than a separate new development. The proposed lighting at Washford Cross Roundabout would cause a very localised impact (predominantly visual) due to the reduction of upward light spill and would not increase the significance of impacts on landscape character caused by the HPC proposed development. The construction impacts would be adverse, medium-term, of low magnitude and **minor** significance. Once the HPC becomes operational (year 1 and year 15), the impacts would become neutral, medium to long-term, of very low magnitude and **minor** significance.

22.6.76 **Table 22.14** provides a summary of impacts on the Lowland Hills landscape character area.

Table 22.14: Impacts on the landscape character of Lowland Hills

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	Medium	Adverse, medium-term	Low	Minor
2	Operation year 1	Medium	Neutral, medium-term	Very low	Minor
3	Operation year 15	Medium	Neutral, long-term	Very low	Minor

Levels and Moors

22.6.77 The HPC proposed development is located outside the Levels and Moors LLCA and its construction and operation would not cause any direct impact on landscape or the key characteristics of this LLCA described in the landscape baseline.

22.6.78 The main impact associated with the construction and operation of the HPC proposed development would be on the views from the coast within this character area. Inland areas of Levels and Moors would receive very limited or no views of the HPC proposed development due to the low elevation of this character area and its flat topography, where any intervening features (notably vegetation and built form) provide screening of long distance views. The impact would be also limited due to the distance of the eastern areas of Level and Moors from the HPC development site and the alignment of the proposed development with the existing Hinkley Point Power Station Complex, which would provide some screening of the HPC. The magnitude of the construction and operational impacts would be neutral, medium to long-term of very low magnitude and **minor** significance due to very limited visibility of the HPC proposed development, the simple outline of the HPC compared to the construction phase, the long distance and existing features obscuring the views.

22.6.79 **Table 22.15** provides a summary of impacts on the Levels and Moors landscape character area.

Table 22.15: Impacts on the landscape character of Levels and Moors

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	High	Neutral, medium-term	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor

Limestone Ridges and Combes

22.6.80 The HPC proposed development is located outside the Limestone Ridges and Combes LLCA and its construction and operation would not cause any direct impact on landscape or the key characteristics of this LLCA described in the landscape baseline.

22.6.81 The only impact associated with the construction and operation of the HPC proposed development would be impact on views from the Limestone Ridges and Combes to the west. Due to distance of the proposed development from this elevated area and the location of the HPC adjacent to the existing Hinkley Point Power Station Complex, which would partially screen the HPC, the construction and operational impact on the character of Limestone Ridges and Combes would not be significant. The impacts during all phases would be neutral, medium to long-term, of very low magnitude and **minor** significance.

22.6.82 **Table 22.16** provides a summary of impacts on the Limestone Ridges and Combes landscape character area.

Table 22.16: Impacts on the landscape character of Limestone Ridges and Combes

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	High	Neutral, medium-term	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor

Mendips

22.6.83 The HPC proposed development is located outside the Mendips LLCA and its construction and operation would not cause any direct impact on landscape or the key characteristics of this LLCA described in the landscape baseline.

22.6.84 The only impact associated with the construction and operation of the HPC proposed development would be a visual impact on the views from the Mendips to the west. Due to long distance of the proposed development form this elevated area, and the location of the HPC location adjacent to the existing Hinkley Point Power Station Complex, which would partially screen the HPC, the construction and operational impact on the character of Mendips would not be significant. The impacts during all phases would be neutral, medium to long-term, of very low magnitude and **minor** significance

22.6.85 **Table 22.17** provides a summary of impacts on the Mendips LLCA.

Table 22.17: Impacts on the landscape character of Mendips LLCA

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	High	Neutral, medium-term	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor

LSCA Blue Anchor to St Audries Bay

22.6.86 The HPC proposed development is located outside the Blue Anchor to St Audries LSCA and its construction and operation would not cause any direct impact on seascape or the key characteristics of this LSCA described in the landscape baseline.

22.6.87 The only impact associated with the construction of the HPC proposed development would be impact on the coastal views to the east, which are generally limited due to topography and the alignment of the coast. Impact would be caused by construction activities within the HPC development site and off-shore construction activities, such as the temporary jetty and movements of vessels. The construction impacts on this local seascape character area would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.88 During the operational phase the impacts would decrease compared to the construction phase due to the removal of the temporary jetty and the cessation of off-shore activities related to construction. There would be very limited views of the HPC development due to the long distance of the HPC proposed development from this area, and the location of the HPC development site adjacent to the existing Hinkley Point Power Station Complex (and aligned with it when looking from the west). The operational impact (year 1 and 15) on this LSCA would be neutral, medium to long-term, of very low magnitude and of **minor** significance.

22.6.89 **Table 22.18** provides a summary of impacts on the Blue Anchor to St Audries Bay LSCA character area.

Table 22.18: Impacts on the seascape character of Blue Anchor to St Audries Bay LSCA

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	High	Adverse, medium-term	Low	Moderate
2	Operation year 1	High	Neutral, medium-term	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor

LSCA St Audries Bay to Hinkley Point

22.6.90 The HPC development site is located within the St Audries Bay to Hinkley Point LSCA and its construction and operation would cause a direct impact on the character of this LSCA described in the landscape baseline.

22.6.91 The construction of HPC would cause a direct impact on the eastern part of the cliff within the HPC development site, as a result of sea wall construction. Although the direct impact of the temporary jetty on the intertidal zone (wave cut rock platforms) would be limited, the visibility of the temporary jetty and the on-shore and off-shore HPC construction activities would be evident, in particular from Lilstock to Hinkley

Point. West of Lilstock, the indirect impact would be lower due to decreasing visibility of the construction activities. The construction impact would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.92 During the operational phase (year 1 and year 15) the seascape impacts would decrease as a consequence of the removal of the temporary jetty and cessation of off-shore activities related to construction. The main impacts would be associated with the physical change to a cliff adjacent to the Permanent Development (sea wall) and visibility of the HPC along the coastline. The operational impact (year 1 and year 15) on this LSCA would be adverse, medium to long-term, of low magnitude and **moderate** significance.

22.6.93 **Table 22.19** provides a summary of impacts on the St Audries Bay to Hinkley Point LSCA.

Table 22.19: Impacts on the seascape character of St Audries Bay to Hinkley Point LSCA

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	High	Adverse, medium-term	Medium	Major
2	Operation year 1	High	Adverse, medium-term	Low	Moderate
3	Operation year 15	High	Adverse, long-term	Low	Moderate

LSCA Hinkley Point to River Parrett

22.6.94 The HPC proposed development is located outside the Hinkley Point to River Parrett LSCA and its construction and operation would not cause any direct impact on seascape or the key characteristics of this LSCA described in the landscape baseline.

22.6.95 The only impact associated with the construction of the HPC proposed development would be impact on the coastal views to the west towards the existing Hinkley Point Power Station Complex. This impact would be caused by construction activities within the HPC development site (partially screened by the HPA, HPB and coastal vegetation) and off-shore construction activities, such as the temporary jetty and movements of vessels. The construction impacts on this local seascape character area would be adverse, medium-term, of low magnitude and **minor** significance.

22.6.96 During the operational phase (year 1 and year 15) the impacts would decrease due to the removal of the temporary jetty and cessation of off-shore activities related to construction. There would be very limited views of the HPC development due screened by the existing Hinkley Point Power Station Complex and the alignment of the coastline. The operational impact (year 1 and year 15) on this LSCA would be neutral, medium to long-term, of very low magnitude and of **minor** significance.

22.6.97 **Table 22.20** provides a summary of impacts on the Hinkley Point to River Parrett LSCA character area.

Table 22.20: Impacts on the seascape character of Hinkley Point to River Parrett LSCA

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	Medium	Adverse, medium-term	Low	Minor
2	Operation year 1	Medium	Neutral, medium-term	Very low	Minor
3	Operation year 15	Medium	Neutral, long-term	Very low	Minor

LSCA Burnham-on-Sea to Brean Down

22.6.98 The HPC proposed development is located outside the Burnham-on-Sea to Brean Down LSCA and its construction and operation would not cause any direct impact on seascape or the key characteristics of this LSCA described in the landscape baseline.

22.6.99 The only impact associated with the construction of the HPC proposed development would be impact on the coastal views to the west towards the existing Hinkley Point Power Station Complex. This impact would be caused by construction activities within the HPC development site (partially screened by the HPA and HPB) and off-shore construction activities, such as the temporary jetty and movements of vessels. The construction impacts on this local seascape character area would be adverse, medium-term, of low magnitude and **minor** significance.

22.6.100 During the operational phase (both year 1 and 15) the impacts would decrease due to removal of the temporary jetty and cessation of off-shore activities related to construction. There would be very limited views of the HPC development predominantly due to the long distance. The operational impact (year 1 and year 15) on this LSCA would be neutral, medium to long-term, of very low magnitude and of **minor** significance.

22.6.101 **Table 22.21** provides a summary of impacts on the Burnham-on-Sea to Brean Down LSCA character area.

Table 22.21: Impacts on the seascape character of Burnham-on-Sea to Brean Down LSCA

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	Medium	Adverse, medium-term	Low	Minor
2	Operation year 1	Medium	Neutral, medium-term	Very low	Minor
3	Operation year 15	Medium	Neutral, long-term	Very low	Minor

LSCA Brean Down

22.6.102 The HPC proposed development is located outside the Brean Down LSCA and its construction and operation would not cause any direct impact on seascape or the key characteristics of this LSCA described in the landscape baseline.

22.6.103 The only impact associated with the construction of the HPC proposed development would be impact on the coastal views to the west towards the existing Hinkley Point Power Station Complex. This impact would be caused by construction activities within the HPC development site (partially screened by the HPA and HPB) and off-shore construction activities, such as the temporary jetty and movements of vessels. The construction impacts on this LSCA would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.104 During the operational phase (year 1 and year 15) the impacts would decrease due to removal of the temporary jetty and cessation of off-shore activities related to construction. There would be very limited views of the HPC development predominantly due to the distance to the HPC proposed development from this LLCA. The operational impact (year 1 and year 15) on this LSCA would be neutral, medium to long-term, of very low magnitude and of **minor** significance.

22.6.105 **Table 22.22** provides a summary of impacts on the Brean Down LSCA character area.

Table 22.22: Impacts on the seascape character of Brean Down LSCA

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	High	Adverse, medium-term	Low	Moderate
2	Operation year 1	High	Neutral, medium-term	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor

iv. Site Scale Landscape Character

Wick Moor and Coast

22.6.106 The only impact associated with the construction and operation of the HPC proposed development would be an impact on views within this character area. Due to the screening provided by the existing Hinkley Point Power Station Complex, the northern parts of the Wick Moor and Coast would receive limited or no views of the HPC proposed development. The middle and southern part of Wick Moor and Coast would receive views of construction and operation of the HPC.

22.6.107 The construction impacts on the character of this area would be adverse, medium-term, of medium magnitude and **major** significance due to a change in views. The operational phase impacts (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance due to a limited change in views once the HPC is operational.

22.6.108 **Table 22.23** provides a summary of impacts on the Wick Moor and Coast landscape character area.

Table 22.23: Impacts on the Wick Moor and Coast landscape character area

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	High	Adverse, medium-term	Medium	Major
2	Operation year 1	High	Adverse, medium-term	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Very low	Minor

Wall Common and Coast

22.6.109 The proposed development is located outside the Wall Common and Coast character area and its construction and operation would not affect any of the area's key characteristics described in the landscape baseline.

22.6.110 The main impact associated with the construction and operation of the HPC proposed development would be impact on some views within this character area.

The impact would be similar to the impact on Wick Moor and Coast but more limited due to the longer distance of the Wall Common and Coast character area from the HPC development site, lower visibility of the site from the coastline (due to its alignment) and the prominence of the existing Hinkley Point Power Station Complex and electricity infrastructure, which is visible from this area. The magnitude of construction phase impacts would be adverse, medium-term, of low magnitude and **minor** significance. The operational phase impacts (year 1 and year 15) would change to neutral, medium to long-term of very low magnitude and **minor** significance due to the simpler form of the HPC compared to its construction phase, the distance and existing landscape features obscuring the views towards the HPC.

22.6.111 **Table 22.24** provides a summary of impacts on the Wall Common and Coast landscape character area.

Table 22.24: Impacts on the Wall Common and Coast landscape character area

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	Medium	Adverse, medium-term	Low	Minor
2	Operation year 1	Medium	Neutral, medium-term	Very low	Minor
3	Operation year 15	Medium	Neutral, long-term	Very low	Minor

Coastal - Lilstock

22.6.112 The northern part of the HPC development site (north of Green Lane) lies within the eastern part of the Coastal – Lilstock character sub area, adjacent to the existing Hinkley Point Power Station Complex.

22.6.113 The construction impact on the character of this area would include both physical changes to landscape within the HPC development site and changes to views, predominantly within the eastern part of this character area. The construction of the HPC, including the temporary jetty, would be visible along the coastline. To the west of Lilstock the visibility would decrease due to the distance and gently undulating topography, which would provide some screening from the areas located at a lower elevation. The visibility of HPC construction would be very limited in the western parts of Coastal – Lilstock character area. The construction impact on the character of the Coastal – Lilstock area would be adverse, medium-term, of high magnitude and of **major** significance.

22.6.114 Following landscape restoration, the operational (year 1) impact would change to adverse, medium-term, of medium magnitude and of **major** significance due to the completed restoration of landform within the HPC development site, which would provide screening of the lower levels of the proposed development along the coastline and returning the land outside the HPC permanent development to gently sloping topography which is characteristic of this character area. The landscape proposals would have been implemented however, they would not be mature at this stage, so their screening and landscape value would be limited at this stage. The proposed PRoW network would restore access to the countryside around the HPC.

22.6.115 The HPC proposed development would cause a significant loss of greenfield areas within the HPC development site. However, during the operational phase (year 15), the addition of valuable landscape features, and the decreasing visual impact to the west of Lilstock would change of nature of landscape impacts in the long term as the planting matures and integrates with the surrounding landscape. Therefore, following the maturation of landscape proposals, the operational (year 15) impacts would change to neutral, long-term, of low magnitude and of **moderate** significance.

22.6.116 **Table 22.25** provides a summary of impacts on the Coastal - Lilstock landscape character sub area.

Table 22.25: Impacts on the Coastal – Lilstock landscape character sub area

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	High	Adverse, medium-term	High	Major
2	Operation year 1	High	Adverse, medium-term	Medium	Major
3	Operation year 15	High	Neutral, long-term	Low	Moderate

Rolling Farmland East - Stogursey

22.6.117 The southern part of the HPC development site (south of Green Lane) lies within the north-western part of the Rolling Farmland East –Stogursey landscape character sub area, in the vicinity of the existing Hinkley Point Power Station Complex.

22.6.118 The construction impact on the character of this area would include both physical changes to landscape within the HPC development site and changes to views. The construction impact on the character of the entire Rolling Farmland East – Stogursey area would be adverse, medium-term, of high magnitude and of **major** significance due to change is views and significant loss of landscape features within the HPC development site.

22.6.119 Following landscape restoration, the operational (year 1) impact would change to adverse, medium-term, of low magnitude and of **minor** significance due to the completed restoration of landform within the HPC development site and returning the land outside the HPC permanent development to naturalistic rolling topography characteristic of this character area. The landscape proposals would have been implemented however, they would not be mature at this stage, so their screening and amenity value would be limited at this stage. The proposed PRoW network would restore access to the countryside around the HPC.

22.6.120 Following the maturation of landscape proposals the operational (year 15) impacts would change to neutral, long-term, of low magnitude and of **minor** significance.

22.6.121 **Table 22.26** provides a summary of impacts on the Rolling Farmland East – Stogursey landscape character sub area.

Table 22.26: Impacts on the Rolling Farmland East – Stogursey landscape character sub area

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	Medium	Adverse, medium-term	High	Major
2	Operation year 1	Medium	Adverse, medium-term	Low	Minor
3	Operation year 15	Medium	Neutral, long-term	Low	Minor

Fairfield

22.6.122 The proposed development is located outside the Fairfield character area and its construction and operation would not affect any of the area's key characteristics described in the landscape baseline.

22.6.123 The proposed development would cause no direct impact on the landscape features within this landscape character sub area during construction and operational phases. The only impact on Fairfield would be associated with the change of views towards the coast. This change would be higher during the construction phase, when the construction machinery and some construction activities would be visible above the local vegetation and would punctuate the skyline. During the operational phase the impact would decrease due to the simple form of the HPC, which would not significantly change the character of this area as it would be seen in the context of the existing Hinkley Point Power Station Complex. During construction phase the impact would be adverse, medium-term, of low magnitude and **moderate** significance. During operation (year 1 and year 15) the impact would change to neutral, medium to long-term, of very low magnitude and **minor** significance.

22.6.124 **Table 22.27** provides a summary of impacts on the Fairfield landscape character sub area.

Table 22.27: Impacts on the Fairfield landscape character sub area

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	High	Adverse, medium-term	Low	Moderate
2	Operation year 1	High	Neutral, medium-term	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor

The Quantock Fringes - Dodington

22.6.125 The proposed development is located outside The Quantock Fringes – Dodington character area and its construction and operation would not affect any of the area's key characteristics described in the landscape baseline.

22.6.126 The proposed development would cause no direct impact on landscape features within this landscape character area during construction and operational phases. The only impact on The Quantock Fringe - Dodington would be associated with the change of views towards the coast as a result of the construction activities and the visibility of the operational HPC proposed development. The general visibility of the HPC from this area is lower than from Fairfield due to the longer distance from the HPC development site.

22.6.127 The visual change would be more noticeable during the construction phase, when the construction machinery would be visible above the local vegetation and would punctuate the skyline looking from Dodington House and other elevated areas of farmland. During the operational phase the impact would decrease due to the simple form of the HPC, which would not significantly change the character of this area as it would be seen in the context of the existing Hinkley Point Power Station Complex. During the construction phase the impact would be adverse, medium-term, of very low magnitude and **minor** significance. During operation (year 1 and year 15) the impact would change to neutral, medium to long-term, of very low magnitude and **minor** significance.

22.6.128 **Table 22.28** provides a summary of impacts on the Quantock Fringes – Dodington landscape character sub area.

Table 22.28: Impacts on the Quantock Fringes – Dodington landscape character sub area

ID	Phase	Sensitivity	Nature	Magnitude	Significance
1	Construction	High	Adverse, medium-term	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor

v. Landscape Elements and Features

Landform

22.6.129 There would be significant changes to the topography within the HPC development site during the construction phase due to major earthworks including topsoil stripping, site levelling and terracing to create the development platforms. During construction, the majority of the locally important Green Lane ridge and the area to the south of construction zone (immediately north of Bum Brook) would be retained. The construction impact on topography within the HPC development site would be adverse, medium-term, of high magnitude and **major** significance.

22.6.130 During operation the landform within the HPC development site located outside the HPC permanent development would be restored to recreate the gently undulating topography of the Coastal – Lilstock landscape character area and rolling topography of the Rolling Farmland East – Stogursey landscape character area (to the south of Green Lane). The restored landform is designed to make a smooth transition with surrounding landform at the edges of the landscape restoration scheme, building on existing ridges and valleys, and using characteristic shapes and gradients already found in the area. During the operational phase (year 1 and 15), the impact on landform would be neutral, medium to long-term, of very low magnitude and **minor** significance.

Land Use/Settlements

22.6.131 During the construction phase, land use within the HPC development site would change due to construction activities. The construction phase impact on land use / settlements within the HPC development site and its immediate vicinity would be adverse, medium-term, of high magnitude and **major** significance.

22.6.132 During operation the majority of the HPC development site to the north of Green Lane and outside the HPC permanent development area would be returned to agricultural use. The majority of land to the south of Green Lane would become a nature reserve managed by EDF Energy. The operational impact (year 1 and year 15) on land use / settlements within the HPC development site and its immediate vicinity would be adverse**,** medium to long-term, of high magnitude and **major** significance.

Landcover and Vegetation

22.6.133 During the construction phase, the majority of landcover and vegetation within the HPC development site would be cleared for construction activities. The most valuable features, such as vegetation along Green Lane and Benhole Lane, riparian vegetation along Bum Brook, hedgerows within the southern part of the HPC development site (to the south of construction zone) and some boundary hedgerows in the eastern part of the application site would be retained. Advanced planting implemented in Spring 2011 within the southern part of the HPC development site would continue to mature during the construction phase providing both visual mitigation to residents of western Shurton and some overall compensation of the vegetation lost within the HPC development site. The construction impact on landcover and vegetation would be adverse, medium-term, of high magnitude and **major** significance.

22.6.134 During the operational phase (year 1), the implemented landscape restoration plan would create an angular field pattern defined by hedgerow field boundaries. The field boundary pattern would be based on existing field patterns, which would link to the surrounding remnant hedgerows. Additional hedgerows would be added, to replace some of the hedgerows that have been lost in the last 100 years due to changes in agricultural practices. Woodland blocks would be angular, shaped as linear north-south aligned brakes or shelter belts on the coastal slopes, and shaped as a linked group of fields on the rolling farmland to the south of Green Lane. During operational phase (year 1) the majority of the proposed vegetation would not be mature (except from advance planting implemented in Spring 2011 and early restoration). The impact on landcover / vegetation during operational phase (year 1) would be adverse, medium-term, of medium magnitude and **moderate** significance.

22.6.135 Following the maturation of restoration proposals, the impact during operational phase (year 15) would be beneficial, long-term, of medium magnitude and of **moderate** significance.

22.6.136 **Table 22.29** shows the proposed landcover and vegetation coverage within the HPC development site (all figures are approximate).

Table 22.29: Proposed Landscape Elements Coverage within the HPC Development Site

Areas and Linear Features	Measurement
Broad-leaved woodland	39.7 ha (gain of 36.2 ha)
Plantation woodland	n/a (loss of 3.2 ha)
Scrub (including scrub/hedges)	0.9 ha (loss of 0.2 ha)
Calcareous Grassland	17.7 ha (gain of 14.2 ha)
Improved Grassland	n/a (loss of 30.6 ha)
Species-poor semi-improved grassland	n/a (loss of (16.1 ha)
Semi-improved grassland/ Species rich hay meadow	30.9 ha (gain of 30.9ha)
Arable (Farmland Birds Annual Cover Crop)	3.8 ha (loss of 93.8 ha)
Agricultural Land	16 ha (gain of 93.8 ha)
Wetland (including ponds)	0.43 ha (gain of 0.42 ha)
Native Species-rich Hedgerow	13.1 km (gain of 5.36 km)

Species-poor Hedgerow	n/a (loss of 3.4 km)
Watercourses (excluding Bum Brook and including Holford Valley ditches)	1.2 km (loss of 0.82km)

Watercourses/water bodies

22.6.137 During the construction phase there would be no direct impact on Bum Brook. The Holford stream, which does not have a high landscape value, would be culverted during construction. The impact on watercourses / water bodies during construction would be adverse, medium-term, of medium magnitude and **moderate** significance.

22.6.138 Once the site is restored, the Holford Stream valley would be restored, however. the Holford Stream would remain in the culvert. The landscape strategy would compensate for this loss by creating a number of watercourses and wetland areas of similar landscape value. The impact during the operational phase (year 1 and year 15), would be neutral, medium to long-term, of very low magnitude and **minor** significance.

Public Rights of Way

22.6.139 During the construction phase all PRoW within the HPC development site would be closed and diverted around the HPC development site boundary, including the West Somerset Coast Path. The impact on the local PRoW during construction would be adverse, medium-term, of high magnitude and **major** significance.

22.6.140 Once the site is restored, the PRoW would be restored with some minor modifications. The impact during operational phase (year 1 and year 15), would be neutral, medium to long-term, of very low magnitude and **minor** significance.

22.6.141 **Table 22.30** provides a summary of impacts on landscape elements and features.

Table 22.30: Impacts on Landscape Elements and Features

ID	Phase	Sensitivity	Nature	Magnitude	Significance
Landform					
1	Construction	Medium	Adverse, medium-term	High	Major
2	Operation year 1	Medium	Neutral, medium-term	Very low	Minor
3	Operation year 15	Medium	Neutral, long-term	Very low	Minor
Land Use /settlement					
1	Construction	Medium	Adverse, medium-term	High	Major
2	Operation year 1	Medium	Adverse, medium-term	High	Major
3	Operation year 15	Medium	Adverse, long-term	High	Major
Landcover and Vegetation					
1	Construction	Medium	Adverse, medium-term	High	Major
2	Operation year 1	Medium	Adverse, medium-term	Medium	Moderate
3	Operation year 15	Medium	Beneficial, long-term	Medium	Moderate
Watercourses / water bodies					
1	Construction	Medium	Adverse, medium-term	Medium	Moderate

2	Operation year 1	Medium	Neutral, medium-term	Very low	Minor
3	Operation year 15	Medium	Neutral, long-term	Very low	Minor
Public Rights of Way					
1	Construction	High	Adverse, medium-term	High	Major
2	Operation year 1	High	Neutral, medium-term	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor

c) Visual Impacts

i. Introduction

22.6.142 The assessment of magnitude and significance of impacts has been undertaken in line with the criteria set out in section 22.4 and includes consideration of mitigation proposals embodied in the proposal. The assessment of impacts is also influenced by the professional judgment of the assessor, which is informed by a number of factors including the quality of the design, understanding of context and perceptual factors associated with the architectural design.

22.6.143 In relation to the HPC proposed development, this professional judgement has been influenced by a number of factors, principally based on the understanding of the design in the context of the baseline views. These factors included:

- scale of existing and new development at Hinkley Point and their relationship and relative massing;
- extent of visual separation between each power station and the perception of the extent of development along the coast;
- distribution of built elements and relative scale of individual buildings and the amount of ‘clutter’ within each view;
- the consideration of building colour; and
- the effects of the landscape strategy and its integration with the surroundings and its screening effects over time.

22.6.144 For each viewpoint, the potential visual impacts are summarised in tables showing the sensitivity of receptors, nature, duration, magnitude and significance of impact of the HPC proposed development during the day and at night.

ii. Visual Impacts Summary

22.6.145 The visual impact assessment records impacts on the 48 viewpoints identified in the visual baseline and extending throughout the LVIA study area. These views can be broadly subdivided into short, medium and long distance views. The following viewpoints are highlighted as broadly representative for summary purposes;

- Short range – Principal Viewpoints 1 (west), 11 (south) and 16 (east);
- Medium range – Principal Viewpoints 4 (west), 18 (south) and 19 (east);
- Long range – Principal Viewpoints 26 (west), 29 (south west) and 33 (south).

22.6.146 The range of impacts resulting from the HPC proposed development varies and is not only related to distance from the development. A summary of the range of impacts from short, medium and long range views is provided below.

Short range viewpoints

22.6.147 During construction, visual impacts on the local residents up to approximately 1.5km from the HPC development site (short distance views) would be adverse and predominantly of major significance. Advance planting and early restoration would provide a degree of screening to the construction activities taking place at the lower levels of the HPC development site, but the construction activities would be visible above the landscape proposals due to the large scale of HPC construction. The main visual impacts would arise during the peak of construction activities and would be lower during the initial and last phases of construction, when the largest construction machinery will not be operating.

22.6.148 During the first year of operation and in the short distance, the significance of visual impacts on the local residents would generally decrease to moderate adverse to become neutral and moderate in the residential areas in the vicinity of the mature landscape proposals in year 15 of the operational phase.

22.6.149 In the short distance, the significance of visual impacts on the PRoW users would be predominantly moderate to major adverse during construction, to become minor to moderate adverse once the landscape proposals are mature during year 15 of the operational phase.

Medium range viewpoints

22.6.150 In the middle distance, visual impacts on residents on settlement edges would be predominantly adverse and of minor to moderate significance during construction. Localised major adverse impacts may occur in open areas from elevated viewpoints.

22.6.151 In the medium distance (1.5km to 5km), visual impacts during construction would slightly decrease compared to short range views due to distance, topography and screening effects of intervening landscape, and would be predominantly of moderate significance. The visual impacts on PRoW users along the coastline and between Lilstock and the HPC development site would be relatively high due to proximity of the HPC development site and small potential for visual mitigation of the large scale construction. Users of PRoW to the east of the existing Hinkley Point Power Station Complex, would experience a smaller change in views due to screening provided by the existing Complex, however the visual impacts would remain high.

22.6.152 During operation, the significance of these impacts would decrease to minor / moderate (adverse), due to removal of construction machinery, more ‘static’ views broadly similar to the views of the existing Hinkley Point Power Station Complex, but with higher amount of built form within views, which, however, would better integrate with the surrounding landscape once the proposed landscape matures (year 15).

Long range viewpoints

22.6.153 The visual impacts of construction phase activity in long range views on PRoW users and walkers within the Quantock Hills AONB would be adverse and more significant in the north-eastern, elevated areas of the AONB. Moving further south-east along the main Quantocks ridge, adverse visual impacts would decrease in significance due to longer distance, different angle of views and different character of these views that would decrease the prominence of the proposed HPC development compared to more open views from the north-eastern part of the Quantocks. During the construction phase, the visual impacts on residents and PRoW users in Exmoor, Mendips, Wales and Lowland Hills would be typically of minor adverse significance due to distance from the HPC development site. The majority of these impacts would change from adverse to neutral during the operational phase.

22.6.154 The operational impacts on the PRoW users and walkers within the Quantock Hills AONB would vary from moderate adverse within the north-eastern part of the AONB to neutral (adverse) in the south-eastern, more distant part.

Lighting impacts

22.6.155 During construction, lighting impacts in the short to medium distance would vary from minor to major adverse significance, depending on the distance to the HPC development site and the proportion of construction activities apparent in the view. The majority of long distance viewpoints would experience minor adverse visual impacts; however, elevated long distance views from the Quantock Hills AONB would experience impacts of moderate adverse significance.

22.6.156 During operation, the lighting impacts would vary from minor neutral to minor adverse for all viewpoint ranges.

22.6.157 The following paragraphs provide a summary of key construction and operational impacts on visual receptors within the LVIA study area.

iii. Visual Impacts

Principal Viewpoint 1 – PRoW No. WL23/110 west of Benhole Lane

22.6.158 All construction activities taking place within the HPC development site to the north of Green Lane would be visible from this viewpoint. Earthworks, construction of the HPC permanent development, the temporary jetty, contractors' areas and machinery within the site, including tower cranes would change the character of the view. Due to the large scale of works and the large proportion of the view occupied by the construction activities, the impact would be adverse, medium-term, of high magnitude and **major** significance during the construction phase.

22.6.159 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction. Lighting during site restoration works would be limited to day time hours. The visual impact of lighting during construction would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.160 During year 1 of the operational phase, the HPC permanent development would be seen from this viewpoint, substantially screening the existing HPA and HPB buildings. The lower levels of HPC would be significantly screened by the proposed landform. The early coastal planting would not offer screening at this stage. The proposed development would be more prominent than the existing Hinkley Point Power Station Complex due to its proximity to the viewpoint. The view would alter to comprise undulating farmland integrated with the surrounding landscape and it is acknowledged that long distance views across the Bridgwater Bay will be screened.

However, long distance views would still be possible from many other locations in the vicinity. Following the removal of the temporary jetty, construction compound and the implementation of landscape restoration plan, the character of the view would be substantially settled as part of the Coastal – Lilstock sub character area. The impact during operation phase (year 1) would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.161 During the operational phase (year 15) the majority of the proposed landscape would increase in maturity, leading to greater integration and assimilation of the HPC proposed development within the view with the surrounding rural landscape. Landform and vegetation will also help screen the lower levels of the HPC proposed development. The impact during operation phase (year 15) would be adverse, long-term, of low magnitude and **moderate** significance.

22.6.162 The existing lighting scheme for the HPA and HPB would be screened by the HPC proposed development. The impact of operational lighting (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.10b**.

Table 22.31: Impacts on receptors at Principal Viewpoint 1

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	High	Major	Medium	Major
2	Operation year 1	High	Adverse, medium-term	Medium	Major	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Low	Moderate	Very low	Minor

Principal Viewpoint 2 – West Somerset Coast Path, PRoW No. WL 23/95

22.6.163 The majority of construction activities taking place within the HPC development site to the north of Green Lane would be visible from this viewpoint due to its location on the open, gently undulating topography of the Quantock Vale (Coastal - Lilstock) Local Landscape Character Area and few intervening landscape features. Earthworks, construction of the HPC permanent development, the temporary jetty, contractors' areas and machinery within the site, including tower cranes would alter the skyline. Despite the distance to the HPC development site the character of the view would change due to the addition of construction activities to the simple form of the existing Hinkley Point Power Station Complex. The impact would be adverse, medium-term, of high magnitude and **major** significance during the construction phase.

22.6.164 The construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction. Lighting during site restoration works would be limited to day time hours. The visual impact of lighting during construction would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.165 During year 1 of the operational phase, the majority of the HPC permanent development would be seen from this viewpoint. The early coastal planting would not offer screening at this stage, however, from this elevation the proposed landform would be effective in screening the lower levels of the proposed development. The proposed buildings would screen the existing Hinkley Point Power Station Complex. The view would alter to comprise undulating farmland integrated with the surrounding landscape, surmounted by the varied forms of the HPC proposed development. The amount of 'clutter' within the view would be minimal due to screening provided by the proposed landform. The impact during operation (year 1) would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.166 During year 15 of the operational phase the majority of the proposed planting would increase in maturity and soften the transition between the rural landscape and the proposed development, and assimilate with the surrounding landscape. The planting would also help screen the lower levels of the HPC proposed development. The impact during operation phase (year 15) would be adverse, long-term, of low magnitude and **moderate** significance. The operational lighting (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.11b**.

Table 22.32: Impacts on receptors at Principal Viewpoint 2

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	High	Major	Medium	Major
2	Operation year 1	High	Adverse, medium-term	Medium	Major	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Low	Moderate	Very low	Minor

Principal Viewpoint 3 – West Somerset Coast Path, Lilstock, PRoW No. WL 24/10

22.6.167 The character of this simple open coastal view would change during the HPC construction phase due to the visibility of large scale construction activities within the HPC development site, which would be seen in the context of and to a degree screen the existing Hinkley Point Power Station Complex, and the addition of views of the temporary jetty and associated barges. Due to the distance from the HPC development site, the construction detail would have limited visibility and the main impact would be associated with the erection of the tallest structures within the HPC development site (reactor buildings), tower crane operations and the temporary jetty. Due to the low elevation of the viewpoint the construction activities at the lower level would be screened by the cliff within the view. The impact during construction would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.168 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction. Lighting during site restoration works would be limited to day time hours. The visual impact of lighting during construction would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.169 Due to the distance from the site and the low elevation of this viewpoint, the proposed vegetation would not contribute to visual screening, and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. Over time, the proposed woodland would begin to appear within the view, however this change would be minimal and the woodland would not fully screen the proposals even when mature. During the operational phase, the simple main structures of the HPC proposed development would screen the existing Hinkley Point Power Station Complex and views of low level development within the view would be minimal, similar to the baseline view. The impact during the entire operational phase (year 1 and year 15) would be adverse, medium to long-term, of low magnitude and **moderate** significance. The operational lighting (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figures 22.12b, 22.12c, 22.12d**.

Table 22.33: Impacts on receptors at Principal Viewpoint 3

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Medium	Major	Medium	Major
2	Operation year 1	High	Adverse, medium-term	Low	Moderate	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Low	Moderate	Very low	Minor

Principal Viewpoint 4 – PRoW No. WL 24/8

22.6.170 During the first phase of construction only small changes in views would be experienced from this viewpoint due to the existing landform screening the ground level of the HPC development site. The site preparation works, construction of lower smaller buildings and the temporary jetty would be screened from this viewpoint. The main visual impact would be associated with the construction of the reactor buildings (Unit 1 and Unit 2) and operation of the large machinery, such as the tower cranes or silos, which would punctuate the skyline. The character of this simple view would temporarily change due to a variety of new built form (including partially completed Unit 1 and Unit 2) and construction machinery punctuating the skyline. The construction impact would be adverse, medium-term, of medium magnitude and **moderate** significance.

22.6.171 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced by the landform screening the lower levels of the construction site. Due to light glow from the existing Hinkley Point Power Station Complex, the change caused by the proposed construction lighting would not be high. Lighting during site restoration works would be limited to day time hours. The visual impact of lighting during construction would be adverse, medium-term, of low magnitude and **minor** significance.

22.6.172 During operation, only the upper portions of Unit 1, Unit 2, and associated stacks and electricity pylons, would be visible. A large part of HPA would be screened by the proposed HPC proposed development, which would appear generally of the same scale. The proposed planting would not be seen from this viewpoint due to existing landform obscuring views and as such the impacts during the entire operational phase would be the same. The addition of simple structures of the HPC and partial replacement of HPA buildings would not substantially change the character of this view. The impact during the operational phase (year 1 and year 15) would be adverse, medium to long-term, of low magnitude and **minor** significance.

22.6.173 The operational lighting impact (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.13b**.

Table 22.34: Impacts on receptors at Principal Viewpoint 4

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	Medium	Adverse, medium-term	Medium	Moderate	Low	Minor
2	Operation year 1	Medium	Adverse, medium-term	Low	Minor	Very low	Minor
3	Operation year 15	Medium	Adverse, long-term	Low	Minor	Very low	Minor

Principal Viewpoint 5 – Higher Hill, PRoW No. 24/3

22.6.174 Due to the elevation of this viewpoint and few intervening elements, the construction area to the south of Green Lane would be visible. Detailed construction activities would be apparent but limited at this distance (over 3km). Construction activities taking place in the northern part of the HPC development site (to the north of Green Lane) would be also visible from this viewpoint, however the retained Green Lane ridge would screen the lower construction activities, such as earthworks, southern part of the temporary jetty, smaller machinery or low buildings. The construction of the tallest structures within the HPC permanent development site and the construction machinery of significant size, including tower cranes, would be visible next to the existing Hinkley Point Power Station Complex and would punctuate the skyline. The construction impact would be adverse, medium-term, of medium magnitude and **moderate** significance.

22.6.175 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction. Lighting during site restoration works would be limited to day time hours. The impact of lighting during construction would be adverse, medium-term, of medium magnitude and **moderate** significance.

22.6.176 During year 1 of the operational phase, the tallest structures of the HPC would be visible above the Green Lane ridge, which would screen views of the lower buildings. The early planting would not offer screening at this stage. The HPC proposed development would be seen in the context of the existing Hinkley Point Power Station Complex. The impact during the operational phase (year 1) would be adverse, medium-term, of low magnitude and **minor** significance.

22.6.177 During the operational phase (year 15) the majority of the proposed planting would be maturing and the proposed woodland areas to the south of Green Lane would soften the visual transition between the rural landscape and the proposed development, however it would not fully screen the built form visible above Green Lane. The impact during the operational phase (year 15) would be adverse, long-term, of low magnitude and **minor** significance. The operational lighting (both year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.14b**.

Table 22.35: Impacts on receptors at Principal Viewpoint 5

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	Medium	Adverse, medium-term	Medium	Moderate	Medium	Moderate
2	Operation year 1	Medium	Adverse, medium-term	Low	Minor	Very low	Minor
3	Operation year 15	Medium	Adverse, long-term	Low	Minor	Very low	Minor

Principal Viewpoint 6 – PRoW No. WL 24/11 near the edge of the Great Plantation

22.6.178 During the first phase of construction only a small change in views would be experienced from this viewpoint due to the landform screening most of the ground level of the HPC development site. The construction of lower buildings and the temporary jetty would be screened from this viewpoint. Earthworks associated with site preparation works would be partially visible just below the ridge of Green Lane but they would not cause a significant change in the view. The main visual impact would be associated with the construction of the reactor buildings (Unit 1 and Unit 2) and operation of the large machinery, such as the tower cranes or silos, which would punctuate the skyline above the Green Lane ridge. The character of this simple view would temporarily change due to a variety of new built form (including partially completed Unit 1 and Unit 2) and construction machinery punctuating the skyline. The construction impact would be adverse, medium-term, of medium magnitude and **moderate** significance.

22.6.179 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced by the landform screening the lower levels of the construction site. Due to light glow from the existing Hinkley Point Power Station Complex, the change caused by the proposed construction lighting would not be high. Lighting during site restoration works would be limited to day time hours. The visual impact of lighting during construction would be adverse, medium-term, of low magnitude and **minor** significance.

22.6.180 During operation, the main structures within the HPC proposed development, such as Unit 1, Unit 2 and associated stacks and electricity pylons, would be visible above the ridge of Green Lane and seen in the context of the existing Power Station Complex. The proposed planting in the southern part of the HPC development site would not be seen from this viewpoint due to existing landform obscuring views. The impacts during the entire operational phase would be the same. The addition of the HPC structures would not change the character of this view but extend the visual influence of the existing Hinkley Point Power Station Complex. The impact during the operational phase (year 1 and year 15) would be adverse, medium to long-term, of medium magnitude and **moderate** significance.

22.6.181 The operational lighting impact (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.15b**.

Table 22.36: Impacts on receptors at Principal Viewpoint 6

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	Medium	Adverse, medium-term	Medium	Moderate	Low	Minor
2	Operation year 1	Medium	Adverse, medium-term	Medium	Moderate	Very low	Minor
3	Operation year 15	Medium	Adverse, long-term	Medium	Moderate	Very low	Minor

Principal Viewpoint 7 – Fairfield House Driveway

22.6.182 The early phases of construction, including the site preparation works, the construction and operation of the temporary jetty, and construction activities at a lower level would be entirely screened from this viewpoint due to existing landform and planting. The construction of Unit 1 and Unit 2, including operation of large construction machinery, such as tower cranes, would be visible above the vegetated skyline. The restoration phase activities and planting scheme would not be visible from this viewpoint. The construction impact would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.183 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced by the landform and vegetation screening the lower levels of the HPC development site. Due to light glow from the existing Hinkley Point Power Station Complex, the change caused by the proposed construction lighting would not be high. Lighting during site restoration works would be limited to day time hours. The visual impact of lighting during construction would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.184 During operation, only the tallest structures within the HPC proposed development, including Unit 1, Unit 2, and associated stacks and electricity pylons, would be visible above the vegetated skyline, which would provide some screening and additional detail in the middle ground. The proposed planting in the southern part of the HPC development site would not be seen from this viewpoint due to existing landform obscuring views, and as such visual impacts during the entire operational phase (year 1 and 15) would be the same. The addition of upper portions of main HPC structures would not change the character of this view and its skyline but be seen in the context of the existing Hinkley Point Power Station Complex. The impact during the operational phase (year 1 and year 15) would be adverse, medium to long-term, of low magnitude and **moderate** significance.

22.6.185 The operational lighting impact (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figures 22.16b, 22.16c, 22.16d**.

Table 22.37: Impacts on receptors at Principal Viewpoint 7

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Medium	Major	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Low	Moderate	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Low	Moderate	Very low	Minor

Principal Viewpoint 8 – Knighton Farm, PRoW No. WL 23/46

22.6.186 During the first phase of construction only a small change in views would be experienced from this viewpoint due to the existing landform and vegetation screening the majority of construction activities to the north and south of Green Lane. The main visual impact would be associated with the construction of Unit 1 and Unit 2, the presence of large machinery, such as tower cranes or silos, to the north of Green Lane, and some construction activities to the south of Green Lane. The construction of Unit 1 and Unit 2 would be partially screened by a small block of woodland within the view. The character of this view would temporarily change due to a variety of man-made structures (including partially completed Unit 1 and Unit 2) and machinery punctuating the skyline. The construction impact would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.187 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced by the landform screening the lower levels of the northern part of the HPC development site. Due to light glow from the existing Hinkley Point Power Station Complex, the change caused by the proposed construction lighting would not be high. Lighting during site restoration works would be limited to day time hours. The visual impact of lighting during construction would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.188 During operation year 1, only the tallest structures within the HPC proposed development would be visible, such as Unit 1, Unit 2, and associated stacks and electricity pylons, which would be visible above the existing ridge. Smaller buildings within the HPC permanent development would be screened by the existing landform and vegetation. During the first year of the operational phase only the early restoration planting and advanced planting proposals would be visible from this viewpoint. Once the remaining proposed restoration planting within the southern part of the HPC development site increases in maturity (year 15) it would partially screen the existing electricity pylons to the east of the HPC development site. The addition of the HPC Unit 1 and Unit 2 would not significantly change the character of this view and would be seen in the context of the existing Hinkley Point Power Station Complex. The mature landscape restoration planting would complement the existing planting along Benhole Lane and create a more densely vegetated skyline. The impact during the operational phase year 1 would be adverse, medium-term, of low magnitude and **moderate** significance. The impact during the operational phase (year 15) would reduce due to the maturation of restoration proposals, which would effectively screen the HPB. Long term impacts would be adverse, long-term, of very low magnitude and **minor** significance.

22.6.189 The operational lighting impact (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.17b**.

Table 22.38: Impacts on receptors at Principal Viewpoint 8

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Medium	Major	Medium	Major
2	Operation year 1	High	Adverse, medium-term	Low	Moderate	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 9 – Burton

22.6.190 During the first phase of construction only a small change in views would be experienced from this viewpoint due to the existing landform and vegetation screening the majority of construction activities to the north of Green Lane. The main visual impact would be associated with the construction of Unit 1 and Unit 2, the presence of large machinery, such as tower cranes or silos, to the north of Green Lane, and some construction activities to the south of Green Lane. The construction of Unit 1 and Unit 2 would be partially screened by vegetation. The character of this view would temporarily change due to a variety of man-made structures (including partially completed Unit 1 and Unit 2) and machinery punctuating the skyline. The construction impact would be adverse, medium-term, of medium magnitude and **moderate** significance. The impact of lighting during construction would be adverse, medium-term, of medium magnitude and **moderate** significance.

22.6.191 During operation year 1, only the tallest structures within the HPC proposed development would be visible, including Unit 1, Unit 2, and associated stacks and electricity pylons, which would punctuate the skyline over the existing ridge. Smaller buildings within the HPC permanent development would be screened by the existing landform and vegetation. During the first year of the operational phase only the early restoration planting and advanced planting proposals would be visible from this viewpoint. The addition of the HPC Unit 1 and Unit 2 would not significantly change the character of this view which would be seen in the context of the existing Hinkley Point Power Station Complex. The impact during the operational phase year 1 would be adverse, medium-term, of medium magnitude and **moderate** significance.

22.6.192 Once the remaining proposed restoration planting within the southern part of the HPC development site matures (year 15) it would add more landscape features to the view and partially screen the existing electricity pylons to the east of the HPC development site. It would complement the existing planting along Benhole Lane and create a more densely vegetated skyline. The impact during the operational phase (year 15) would change due to the maturation of restoration proposals and increased assimilation and would be adverse, long-term, of low magnitude and **minor** significance. The operational lighting impact (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figures 22.18b, 22.18c, 22.18d**.

Table 22.39: Impacts on receptors at Principal Viewpoint 9

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	Medium	Adverse, medium-term	Medium	Moderate	Medium	Moderate
2	Operation year 1	Medium	Adverse, medium-term	Medium	Moderate	Very low	Minor
3	Operation year 15	Medium	Adverse, long-term	Low	Minor	Very low	Minor

Principal Viewpoint 10 – Shurton West, Local Farm near PRoW No. WL 23/48

22.6.193 During the first phase of construction, construction activities would take place behind the local ridge within the view (latitude 144750m), which would minimise the visual impact on the residents of Shurton. Moving the construction zone behind this latitude was requested by the local residents during informal consultation. Due to this buffer zone, the majority of the initial construction activities would be screened from this viewpoint, however security fence and limited amount of earthworks would be visible on top of the ridge causing a very low visual impact. Once the main construction activities commence, including the construction of the HPC permanent development and the use of tower cranes and other tall plant, they will become visible to the north of the ridge and the magnitude of impacts would rise. To ensure the visual impact of construction is minimised, the areas of the landscape restoration scheme which are located within the buffer zone would be implemented early during the construction process. The advance planting proposals agreed during the consultation process and implemented within the HPC development site would also contribute to early screening and softening the view during the main phases of construction. The construction impact would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.194 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced by the ridge screening the construction activities. Due to light glow from the existing Hinkley Point Power Station Complex, the change caused by the proposed construction lighting would not be high. The construction zone immediately to the north of the viewpoint would not be well lit. Lighting during site restoration works would be limited to day time hours. The impact of lighting during construction would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.195 During the operational phase (year 1) the main visual impact would be caused by the HPC Unit 1 and Unit 2, which would be partially visible above the ridge line. The early landscape restoration and advance planting would be maturing at this stage and provide some screening to the HPC proposed development. The impact during the operational phase (year 1) would be neutral (screening existing views of HPA and HPB resulting in greater sense of enclosure), medium-term, of low magnitude and

moderate significance. The impact of lighting during the operational phase (year 1) would be neutral, medium-term, of very low magnitude and **minor** significance.

22.6.196 During the operational phase (year 15) the planting within the view would increase in maturity (advance planting would be approximately 25 years old, early landscape restoration would be 22 years old and the remaining planting would be 15 years old) and would provide screening of the HPC, although glimpsed views of Unit 1 and Unit 2 are likely to be available in winter months. The proposed planting would also increase the screening of the existing Hinkley Point Power Station Complex, and as it matures, establish a new, wooded character of the local ridge, which would complement the existing local landscape character and integrate with the landscape restoration proposals for the HPC development site. The impact during the operational phase (year 15) would be neutral, long-term, of low magnitude and **moderate** significance. The operational lighting impact (year 15) would be neutral, long-term, of very low magnitude and **minor** significance. See **Figures 22.19b, 22.19c, 22.19d**.

Table 22.40: Impacts on receptors at Principal Viewpoint 10

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Medium	Major	Low	Moderate
2	Operation year 1	High	Neutral, medium-term	Low	Moderate	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Low	Moderate	Very low	Minor

Principal Viewpoint 11 – Shurton East, PRoW No. WL 23/56

22.6.197 During the first phase of construction, construction activities would take place behind the local ridge within the view (latitude 144750m), which would minimise the visual impact on the residents of eastern parts of Shurton. Moving the construction zone behind this latitude was requested by the local residents during informal consultation. Due to this buffer zone, the majority of the initial construction activities would be screened from this viewpoint, however, security fencing and limited amount of earthworks would be visible on top of the ridge causing a very low impact. The upper storeys of the on-site campus accommodation blocks would be visible above the existing ridge. Once the main construction activities commence, the construction of the HPC permanent development, use of tower cranes and other tall machinery will become visible behind the ridge and the impacts would rise, especially due to open character of this view and a simple skyline created by the local ridge. To ensure the visual impact of construction is minimised, the areas of the landscape restoration scheme which are located within the buffer zone would be implemented early during the construction process. These proposals include a bund located immediately to the south of the proposed on-site campus accommodation to reduce its visual impact. The advance planting proposals agreed during the consultation process and implemented within the HPC development site would also contribute to early screening during the last phases of construction. The construction impact would be adverse, medium-term, of high magnitude and **major** significance.

22.6.198 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be greatly reduced by the ridge screening the construction activities. Due to substantial light glow from the existing Hinkley Point Power Station Complex, the change caused by the proposed construction lighting would not be high. The proposed lighting within the on-site construction zone immediately to the north of the viewpoint would not be significant. Lighting during site restoration works would be limited to day time hours. The impact of lighting during construction would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.199 During the operational phase (year 1) the main visual impact would be caused by Unit 1 and Unit 2, which would be visible above the ridge line. The early landscape restoration and advance planting increase maturity at this stage and would provide some screening to the HPC proposed development and the existing Hinkley Point Power Station Complex. The proposed planting would change the character of the local ridge from its simple outline (in its central part) to a more varied, vegetated ridge, which would be similar to the adjacent areas. The impact during the operational phase (year 1) would be neutral, medium-term, of low magnitude and **moderate** significance.

22.6.200 During the operational phase (year 15) the planting within the view would be maturing (advance planting would be in the order of 25 years old, early landscape restoration would be 22 years old and the remaining planting would be 15 years old) and would provide screening of the HPC, with likely glimpsed views of Unit 1 and Unit 2 in winter months. The proposed planting would also increase the screening of the existing Hinkley Point Power Station Complex. As planting matures the impact during the operational phase (year 15) would be neutral, long-term, of low magnitude and **moderate** significance. The operational lighting impact (both year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. See **Figures 22.20b, 22.20c, 22.20d**.

Table 22.41: Impacts on receptors at Principal Viewpoint 11

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	High	Major	Low	Moderate
2	Operation year 1	High	Neutral, medium-term	Low	Moderate	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Low	Moderate	Very low	Minor

Principal Viewpoint 12 – Local road to the south of the site (near Gunter's Grove)

22.6.201 During the first phase of construction only a small change in views would be experienced from this viewpoint due to the existing landform and vegetation screening the majority of construction activities to the north of Green Lane. Site preparation works to the south of Green Lane would be visible but due to their nature (predominantly earthworks) and their location below the ridge of Green Lane, site preparation works would not significantly change the character of the view. The main visual impact would be associated with the construction of Unit 1 and Unit 2, the presence of large machinery, such as tower cranes or silos, to the north of Green Lane, construction activities to the south of Green Lane and the on-site campus accommodation located in the south-eastern part of the HPC development site. Some construction activities to the north of Green Lane (and below its ridge) would be screened by vegetation. Construction traffic on the local road network will be apparent. The character of this view would temporarily change due to a variety of man-made structures (including partially completed Unit 1 and Unit 2) and machinery punctuating the skyline, although this change would not be of high magnitude due to the prominence of the existing Hinkley Point Power Station Complex, which has a strong influence on the existing view. The construction impact would be adverse, medium-term, of medium magnitude and **minor** significance.

22.6.202 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced by the landform screening the lower levels of the northern part of the HPC development site. Due to light glow from the existing Hinkley Point Power Station Complex, the change caused by the proposed construction lighting would not be high but it would be noticeable. Lighting of the on-site accommodation campus would be partially screened by the proposed early restoration landform. Lighting during site restoration works would be limited to day time hours. The impact of lighting during construction would be adverse, medium-term, of medium magnitude and **minor** significance.

22.6.203 During operation year 1, the majority of the HPC proposed development would be visible, in particular Unit 1, Unit 2, stacks, electricity pylons and other tall structures, which would punctuate the skyline over the existing vegetated ridge. Smaller buildings within the HPC permanent development site would be screened by the Green Lane ridge. During the first year of the operational phase only limited amount of early restoration planting and advanced planting proposals would be visible from this viewpoint, and it would not contribute to visual screening from this viewpoint. The addition of the HPC Unit 1 and Unit 2 would not significantly change the character of this view but be seen in the context of the existing Hinkley Point Power Station Complex, adding additional structures to the skyline. The impact during the operational phase year 1 would be adverse, medium-term, of medium magnitude and **minor** significance. The lighting impact during year 1 of the operational phase would be adverse, medium-term, of low magnitude and **minor** significance.

22.6.204 As the remaining proposed restoration planting within the southern part of the HPC development site increases in maturity (year 15), a significant area of woodland would become visible but it would not fully screen the HPC proposed development. The impact during the operational phase (year 15) would be adverse, long-term, of medium magnitude and **minor** significance. The operational lighting impact (year 15) would be adverse, long-term, of low magnitude and **minor** significance. See **Figures 22.21b, 22.21c, 22.21d**.

Table 22.42: Impacts on receptors at Principal Viewpoint 12

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	Low	Adverse, medium-term	Medium	Minor	Medium	Minor
2	Operation year 1	Low	Adverse, medium-term	Medium	Minor	Low	Minor
3	Operation year 15	Low	Adverse, long-term	Medium	Minor	Low	Minor

Principal Viewpoint 13 – PRoW No. WL 23/57, West of Wick

22.6.205 During the first phase of construction a limited change in views would be experienced from this viewpoint due to the existing vegetation along Wick Moor Drove screening early construction activities. In subsequent construction phases, the visual impact would increase due to the construction of Unit 1 and Unit 2, the presence of large machinery, such as tower cranes or silos, which would be visible above the existing vegetation and would punctuate the skyline, and construction activities to the south of Green Lane, including on-site campus accommodation. The existing hedgerow and tree planting along Wick Moor Drove would effectively screen some construction activities in the lowest parts of the HPC development site but would not be effective in screening the largest machinery and main HPC buildings. Construction traffic would be apparent on the local road network. The character of this view would temporarily change due to a variety of man-made structures (including partially completed Unit 1 and Unit 2) and machinery punctuating the skyline. The construction impact would be adverse, medium-term, of medium magnitude and **moderate** significance. The impact of lighting during construction would adverse, medium-term, of medium magnitude and **moderate** significance.

22.6.206 During operation year 1, only the tallest structures within the HPC proposed development would be visible, such as Unit 1, Unit 2, stacks and electricity pylons, and some lower buildings, such as the National Grid substation, within the south-eastern parts of the HPC permanent development. Smaller HPC buildings would be screened by the existing vegetation along Wick Moor Drove. The addition of the HPC Unit 1 and Unit 2 would not significantly change the character of this view which would be seen in the context of the existing Hinkley Point Power Station Complex. The extent of visual separation between HPA, HPB and HPC would retain the character of the skyline in this view. The restoration planting would not be mature and would not provide significant screening at this stage. The impact during the operational phase (year 1) would be adverse, medium-term, of medium magnitude and **moderate** significance. The lighting impact during the operational phase (year 1) would be adverse, medium-term, of low magnitude and **minor** significance

22.6.207 Once the proposed restoration planting increases in maturity (year 15) it would add to the existing planting along Wick Moor Drove, create a more densely vegetated skyline and provide some screening of the lower levels of the HPC. The impact during the operational phase (year 15) would change due to the maturation of restoration proposals and would be adverse, long-term, of medium magnitude and **moderate** significance. The operational lighting impact (year 15) would be adverse, long-term, of low magnitude and **minor** significance. See **Figure 22.22b**.

Table 22.43: Impacts on receptors at Principal Viewpoint 13

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	Medium	Adverse, medium-term	Medium	Moderate	Medium	Moderate
2	Operation year 1	Medium	Adverse, medium-term	Medium	Moderate	Low	Minor
3	Operation year 15	Medium	Adverse, long-term	Medium	Moderate	Low	Minor

Principal Viewpoint 14 –Pixies Mound (Wick Barrow)

22.6.208 Due to close proximity of this viewpoint to the HPC development site the construction activities would change the existing view which presently includes views of the Hinkley Point Power Station Complex. The viewpoint would include views of all major construction activity across the site and construction traffic on the local road and site access. The impact would be adverse, medium-term, of high magnitude and **major** significance. Construction lighting would be visible and its impact would be adverse, medium-term, of high magnitude and **major** significance.

22.6.209 During the operational phase (year 1) the HPC permanent development would dominate the view and the restoration planting within the HPC development site in the vicinity of the Pixies Mound would be apparent but not be mature enough to effectively screen the proposed development. The impact during the operational phase (year 1) would be adverse, medium-term, of medium magnitude and **major** significance. The operational lighting impact (year 1) would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.210 During the operational phase (year 15) the maturing belt of woodland within the HPC development site, planted between the Pixies Mound and the adjacent northern roundabout at Wick Moor Drove, would screen the majority of the development, although the tallest structures would be apparent punctuating the skyline. The impact during the operational phase (year 15) would be adverse, long-term, of low magnitude and **moderate** significance. The operational lighting impact (year 15) would be adverse, long-term, of low magnitude and **moderate** significance. See **Figure 22.23b**.

Table 22.44: Impacts on receptors at Principal Viewpoint 14

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	High	Major	High	Major
2	Operation year 1	High	Adverse, medium-term	Medium	Major	Low	Moderate
3	Operation	High	Adverse,	Low	Moderate	Low	Moderate

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
	year 15		long-term				

Principal Viewpoint 15 - PRoW No. WL 23/61

22.6.211 During the construction phase, the majority of construction activities would be screened by the adjacent vegetation, which effectively screens the existing Hinkley Point Power Station Complex. The tower cranes which would be used during the construction of Unit 1 and Unit 2 are likely to be visible above the existing vegetation but the resulting visual change would be low due to the distance and very small proportion of view which would be affected. The construction impact would be adverse, medium-term, of low magnitude and **moderate** significance. Some lighting would be visible but the visual change would not be significant due to the light glow associated with the existing Hinkley Point Power Station Complex. The impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance.

22.6.212 Once the tower cranes are removed, the proposed development would be screened by the existing vegetation within the view, however, in winter months, glimpsed views of the reactor domes would be potentially available. No vegetation proposed as part of the landscape restoration scheme would be seen from this viewpoint therefore the impacts during the entire operational phase would remain the same. The operational impact (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The impact of lighting during the operational phase would be neutral, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.24b**.

Table 22.45: Impacts on receptors at Principal Viewpoint 15

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 16 – Wick, PRoW No. WL 23/61

22.6.213 During the first phase of construction only a small change in views would be experienced from this viewpoint due to the existing vegetation within Wick Moor screening the majority of early construction activities, including site preparation works to the south of Green Lane. The main visual impact would be associated with the construction of Unit 1 and Unit 2, the presence of large machinery, such as tower cranes or silos, to the north of Green Lane, some construction activities to the south of Green Lane and the on-site campus accommodation located in the south-eastern part of the HPC development site and construction traffic. The construction activities to the north of Green Lane and below its ridge would be screened by landform and vegetation. The character of this view would temporarily change due to a variety of man-made structures (including partially completed Unit 1 and Unit 2) and machinery punctuating the skyline, although this change would not be of high magnitude due to the presence of the existing Hinkley Point Power Station Complex, which influences the character of the existing view and due to the distance from the HPC proposed development. The construction impact would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.214 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced by the landform and vegetation screening the lower levels of the HPC development site and distance from its boundary. Due to light glow from the existing Hinkley Point Power Station Complex, the change caused by the HPC construction lighting would not be high but it would be noticeable. Lighting during site restoration works would be limited to day time hours. The impact of lighting during construction adverse, medium-term, of low magnitude and **moderate** significance.

22.6.215 During operation year 1, only the tallest structures within the HPC proposed development would be visible, such as Unit 1, Unit 2, stacks and electricity pylons, which would be seen against the skyline over the existing vegetation. Smaller buildings within the HPC permanent development would be screened by the Green Lane ridge and Wick Moor hedgerows which provide effective screening in this gently undulating landscape. The addition of the HPC Unit 1 and Unit 2 would not significantly change the character of this view but extend the visual influence of the existing Hinkley Point Power Station Complex. The impact during the operational phase year 1 would be adverse, medium-term, of low magnitude and **moderate** significance. The operational lighting impact (year 1) would be adverse, medium-term, of very low magnitude and **minor** significance.

22.6.216 Once the remaining proposed restoration planting within the southern part of the HPC development increases in maturity (year 15) it would add more characteristic landscape features to the existing planting visible along Wick Moor Drove but its overall visibility would be low. The impact during the operational phase (year 15) would be adverse, long-term, of low magnitude and **moderate** significance. The operational lighting impact (year 15) would be adverse, long-term, of very low magnitude and **minor** significance. See **Figures 22.25b, 22.25c, 22.25d**.

Table 22.46: Impacts on receptors at Principal Viewpoint 16

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Medium	Major	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Low	Moderate	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Low	Moderate	Very low	Minor

Principal Viewpoint 17 – Farrington Hill Lane (Farringdon Farm)

22.6.217 During the first phase of construction only a small change in views would be experienced from this viewpoint due to the existing landform and vegetation screening the majority of construction activities to the north of Green Lane. The construction of smaller buildings and the temporary jetty would be screened from this viewpoint. Site preparation works, the construction of on-site campus accommodation to the south of Green Lane construction traffic on the local road network would be visible. Due to the distance from the HPC development site, the construction activities would occupy a smaller proportion of the view compared to viewpoints located in the immediate vicinity of the HPC development site but the character of this view would temporarily change due to a variety of new built form (including partially completed Unit 1 and Unit 2) and machinery punctuating the skyline. The construction impact would be adverse, medium-term, of medium magnitude and **moderate** significance.

22.6.218 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced by the landform screening the lower levels of the northern parts of the construction site. Due to light glow from the existing Hinkley Point Power Station Complex, the change caused by the proposed construction lighting would not be high. Lighting during site restoration works would be limited to day time hours. The visual impact of lighting during construction would be adverse, medium-term, of medium magnitude and **moderate** significance.

22.6.219 During operation year 1, only the tallest structures within the HPC proposed development would be visible, including Unit 1, Unit 2, stacks and electricity pylons, which would punctuate the skyline over the Green Lane vegetated ridge, similar to HPA and HPB. Most of the lower buildings within the HPC permanent development would be screened. During the first year of the operational phase only the early restoration planting and advanced planting proposals would be visible from this viewpoint. The addition of the HPC Unit 1 and Unit 2 would not significantly change the character of this view and the new structures would be seen in the context of the existing Hinkley Point Power Station Complex. The impact during the operational phase year 1 would be adverse, medium-term, of low magnitude and **minor** significance.

22.6.220 Once the remaining proposed restoration planting within the southern part of the HPC development site increases in maturity (year 15), a dense belt of woodland would be visible below the Green Lane ridge. This maturing vegetation would screen part of the low level buildings / operations within the HPC proposed development. The impact during the operational phase (year 15) would change due to the increasing maturity of restoration proposals and would be adverse, long-term, of low magnitude and **minor** significance. The operational lighting impact (both year 1 and year 15) would be adverse, medium to long-term, of low magnitude and **minor** significance. See **Figure 22.26b**.

Table 22.47: Impacts on receptors at Principal Viewpoint 17

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	Medium	Adverse, medium-term	Medium	Moderate	Medium	Moderate
2	Operation year 1	Medium	Adverse, medium-term	Low	Minor	Low	Minor

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
3	Operation year 15	Medium	Adverse, long-term	Low	Minor	Low	Minor

Principal Viewpoint 18 – Residential area at Stogursey, Burgage Road/Lime Street

22.6.221 The majority of construction activities would be screened by the existing vegetation and residential buildings within the view from the road with views to the wider construction area apparent from upper floors of residential dwellings on the northern edge of Stogursey. The construction of Unit 1 and 2 and the tallest construction machinery, such as tower cranes, would be the principal elements that would be partially visible in the gap between the buildings and apparent in views from the first floor of properties. As a result, the visual change would be small due to the small proportion of the view occupied by the HPC construction and the character of the existing view. The construction impact would be adverse, medium-term, of low magnitude and **moderate** significance. The impact of lighting during construction would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.222 The proposed restoration planting would not be visible from this viewpoint at road level but would be apparent from upper floors of dwellings, therefore the visual impacts would remain the generally the same during the entire HPC operational phase. The HPC proposed development would be barely visible in the break between the residential buildings, above the hedge in the vicinity of the Village Hall but would be visible in first floor views from dwellings. The impact during the operational phase (both year 1 and year 15) would be adverse, medium to long-term, of low magnitude and **moderate** significance. The operational lighting impact (both year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figures 22.27b, 22.27c, 22.27d**.

Table 22.48: Impacts on receptors at Principal Viewpoint 18

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Low	Moderate	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Low	Moderate	Very low	Minor

Principal Viewpoint 19 – Stolford, West Somerset Coast Path, PRoW No. WL 23/95

22.6.223 The character of this open coastal view would change during the construction phase due to the visibility of construction activities within the HPC development site, which would be partially screened by the existing Hinkley Point Power Station Complex. Due to the distance from the HPC development site, the construction details would not be evident and the main impact would be associated with the erection of the tallest structures within the HPC development site (reactor buildings) and the tower crane operations. The temporary jetty would not be visible due to screening by the existing Hinkley Point Power Station Complex and the existing cliff, although some barge movements around the temporary jetty head are likely to be visible. Due to the low elevation of the viewpoint the construction activities at the ground level within the HPC development site would be screened by the existing landform and vegetation. The impact during construction would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.224 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction. Lighting during site restoration works would be limited to day time hours. The visual impact of lighting during the construction phase would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.225 Due to the distance from the site and the low elevation of this viewpoint, the proposed vegetation would not contribute to visual screening, and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. During the operational phase, the HPC proposed development would be seen in the context of the existing Hinkley Point Power Station Complex. This addition would not change the view's character, which is influenced by the existing Hinkley Point Power Station Complex and the associated power line infrastructure. The impact during the entire operational phase (year 1 and year 15) would be adverse, medium to long-term, of low magnitude and **moderate** significance. The operational lighting (both year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figures 22.28b, 22.28c, 22.28d**.

Table 22.49: Impacts on receptors at Principal Viewpoint 19

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Medium	Major	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Low	Moderate	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Low	Moderate	Very low	Minor

Principal Viewpoint 20 – Stockland Bristol

22.6.226 The character of this open view would change during the HPC construction phase due to the visibility of large scale construction activities within the HPC development site. This change would not be high, as the existing view is heavily influenced by the existing power line infrastructure. The construction details would not be evident from this distance, and the main impact would be associated with the erection of the HPC Unit 1 and Unit 2 and the tower cranes operations. The construction activities at the lower levels within the HPC development site would be partially screened by the existing landform and vegetation. The impact during construction would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.227 The construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction. Lighting during site restoration works would be limited to day time hours. The visual impact of lighting during construction would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.228 Due to the distance from the site, combined with the relatively low elevation of this viewpoint the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. During the operational phase, the simple HPC proposed development would appear next to the existing Hinkley Point Power Station Complex, behind the existing pylons, extending the impact of the existing Complex. This addition would not change the view's character, which is influenced by the existing Hinkley Point Power Station Complex and the associated power line infrastructure. The impact during the entire operational phase (year 1 and year 15) would be adverse, medium to long-term, of low magnitude and **moderate** significance. The operational lighting (both year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.29b**.

Table 22.50: Impacts on receptors at Principal Viewpoint 20

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Medium	Major	Medium	Major
2	Operation year 1	High	Adverse, medium-term	Low	Moderate	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Low	Moderate	Very low	Minor

Principal Viewpoint 21 – Quantock Hills AONB, PRoW No. WL 24/1

22.6.229 During the construction phase the large scale construction activities within the HPC development site would be seen in the context of the existing Hinkley Point Power Station Complex. Due to the distance of the viewpoint from the HPC development site (approximately 3.7km), the construction detail would not be evident and the main impact would be associated with the erection of the tallest structures (HPC Unit 1 and Unit 2) and the tower cranes operations. Due to the distance and rolling landform screening the HPC development site (including the Green Lane ridge), the construction activities below Green Lane would not be visible. The impact during the construction phase would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.230 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction. Lighting during site restoration works would be limited to day time hours. The visual impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance.

22.6.231 Due to surrounding landform which would screen the lower levels of the proposed development, the restoration proposals would not be visible, and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. During the operational phase, the HPC proposed development would partially replace the existing Hinkley Point Power Station Complex (HPA in particular) in views and would not significantly alter the character of the view and the skyline due its similar scale and extent. The existing Hinkley Point Power Station Complex would remain apparent within the view but the landscape, even in the more distant background, would retain its dominance. The HPA, HPB and HPC buildings would remain subservient to the landscape. The impact during the entire operational phase (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. The operational lighting (both year 1 and year 15) would be also adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.30b**.

Table 22.51: Impacts on receptors at Principal Viewpoint 21

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Very low	Minor
2	Operation year 1	High	Adverse, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 22 – East Quantoxhead, PRoW No. WL 8/30

22.6.232 During the construction phase the large scale construction activities within the HPC development site would be seen in the context of the existing Hinkley Point Power Station Complex. Due to the distance of the viewpoint from the HPC development site, the construction detail would not be evident and the main impact would be associated with the construction of the tallest structures (HPC Unit 1 and Unit 2) and the tower crane operations. Due to the distance and rolling landform most of the construction activities would be screened. The impact during the construction phase would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.233 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction but due to the long distance and the light pollution from the existing Hinkley Point Power Station Complex, the change in view would be limited. The visual impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance.

22.6.234 Due to landform screening the lower levels of the HPC proposed development, the restoration proposals would not be visible, and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. During the operational phase, the simple HPC proposed development would replace the existing Hinkley Point Power Station Complex (HPA) and would not significantly alter the character of the view and the skyline due its similar scale and extent. The impact during the entire operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting (both year 1 and year 15) would be also neutral, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.31b**.

Table 22.52: Impacts on receptors at Principal Viewpoint 22

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 23 – East Quantoxhead, Court House Gardens

22.6.235 During the construction phase the large scale construction activities within the HPC development site would be seen in the context of the existing Hinkley Point Power Station Complex. Due to the distance from the HPC development site, the construction detail would not be evident and the main impact would be associated with the construction of the tallest structures (HPC Unit 1 and Unit 2) and the tower crane operations. Due to the distance and rolling landform the majority of the construction activities would be screened. The impact during construction would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.236 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction but due to the long distance and the light pollution from the existing Hinkley Point Power Station Complex, the change in view would be limited. The visual impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance.

22.6.237 Due to landform screening the lower levels of the HPC proposed development, the restoration proposals would not be visible, and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. During the operational phase, the HPC proposed development would replace the existing Hinkley Point Power Station Complex (HPA in particular) in the view and would therefore not significantly alter the character of the view and the skyline due its similar scale and extent. The impact during the entire operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting (both year 1 and year 15) would be also neutral, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.32b**.

Table 22.53: Impacts on receptors at Principal Viewpoint 23

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation	High	Neutral,	Very low	Minor	Very low	Minor

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
	year 15		long-term				

Principal Viewpoint 24 – Entrance to Dodington House

22.6.238 The early phases of construction, including the site preparation works, the temporary jetty development, and most of construction activities would be entirely screened from this viewpoint by the mature woodland and tree planting visible in middle distance behind the existing barn. The construction of Unit 1 and Unit 2, including operation of large construction machinery, such as tower cranes, would be visible above the vegetated skyline. The existing planting would partially screen the construction activities which would appear less prominent in this view than in simpler views with less landscape features. The restoration phase activities and planting scheme would not be visible from this viewpoint. The construction impact would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.239 Construction lighting impacts would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced by the vegetation screening the lower levels of the HPC development site. Due to light glow from the existing Hinkley Point Power Station Complex and the distance (over 4.6km), the change caused by the proposed construction lighting would be limited. The visual impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance.

22.6.240 Landscape restoration proposals would not be visible from this viewpoint, and therefore the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. During operation, the visual impact would be caused by the partially visible reactor domes of HPC Unit 1 and 2 and the associated stacks. The addition of these structures, of which only a very small proportion would be visible, would not change the character of this view. The impact during the operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting impact (both year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.33b**.

Table 22.54: Impacts on receptors at Principal Viewpoint 24

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 25 – Nether Stowey, Stogursey Lane

22.6.241 During the construction phase only glimpsed views of construction activities would be available due to vegetation screening the HPC development site. The main visual change would be caused by the tower cranes. The HPC structures themselves would be almost completely screened by the vegetation. The construction impact would be adverse, medium-term, of low magnitude and **minor** significance. The impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance.

22.6.242 The landscape restoration proposals would not be visible from this viewpoint, therefore the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. Glimpsed views of the HPC proposed development would be visible through vegetation but due to the distance from the development (over 4.2km) reducing the visibility of the HPC proposed development and much higher visual influence of the existing Hinkley Point Power Station Complex, the character of the view would not change substantially. The impact during the operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting impact (both year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.34b**.

Table 22.55: Impacts on receptors at Principal Viewpoint 25

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	Medium	Adverse, medium-term	Low	Minor	Very low	Minor
2	Operation year 1	Medium	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	Medium	Neutral, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 26 – Quantock Hills AONB, Beacon Hill

22.6.243 The summit of Beacon Hill offers some of the best views into the HPC development site from the Quantock summits. Further to the south-east, along the Quantock Hills ridgeline, the visibility will gradually decrease, which is documented by the viewpoint panoramas. Due to the high elevation of the viewpoint the majority of construction activities within the HPC development site would be visible and the existing landform and vegetation would provide a limited degree of screening during construction. The visibility of construction details would be limited due to the long distance from the HPC development site (above 8km) but the proposed development under construction and the construction machinery, in particular tower cranes, would be clearly evident from this viewpoint and would provide temporary ‘clutter’ in the view. The existing Hinkley Point Power Station Complex is evident in the view, lying in the vale forming an intermediate element, backed by more distance views of the intertidal platform and ultimately the Mendip Hills. In its context, the HPC proposed development represents an intensification of the Hinkley Point Power Station Complex and is seen in the context of the existing development due to the angle of view and the limited of visual separation between the HPA, HPB and HPC. Furthermore, the scale of the proposed development is not appreciably different from the existing and therefore would not significantly alter the character of the view which will prevail. The construction impact would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.244 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced due to the long distance from the HPC development site and light glow from the existing Hinkley Point Power Station Complex. The impact of lighting during construction would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.245 During operation year 1, the completed HPC proposed development would be visible. Once all construction machinery is removed, especially the tower cranes, the visual impact would decrease compared to the construction phase due to removal of construction 'clutter' from the view. The remaining simple form of the HPC would not significantly change the character of the view due to the presence of the existing Hinkley Point Power Station Complex, which has an influence on the existing view. The visibility of the lower HPC structures would be very low. The impact during the operational phase (year 1) would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.246 Once the proposed restoration planting within the southern part of the HPC development increases in maturity (year 15), a dense belt of woodland would be visible below the Green Lane ridge and to the west of the HPC permanent development site. The impact during the operational phase (year 15) would not change following the restoration planting growth and would be adverse, long-term, of low magnitude and **moderate** significance. The operational lighting impact (both year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.35b**.

Table 22.56: Impacts on receptors at Principal Viewpoint 26

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Medium	Major	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Low	Moderate	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Low	Moderate	Very low	Minor

Principal Viewpoint 27 – A39, Holford Parking Bay

22.6.247 Due to the location of this viewpoint at the edge of the Quantock Hills and its relatively low elevation compared with the Quantock summits, many construction activities within the HPC development site would be screened by the existing landform and vegetation. Due to the long distance from the HPC development site, the construction detail would not be evident and the main impact would be associated with the erection of the tallest structures (HPC Unit 1 and Unit 2) and the tower cranes operations. Due to the long distance and rolling landform and vegetation screening the HPC development site, the construction activities to the north of and below the Green Lane ridge would not be visible. The construction impact would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.248 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced due to the long distance from the HPC development site and light glow from the existing Hinkley Point Power Station Complex. The impact of lighting during construction would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.249 During operation year 1, the completed HPC proposed development would be visible. Once all construction machinery is removed, in particular the tower cranes, the visual impact would decrease (compared to the construction phase) due to removal of construction 'clutter' from the view. The remaining simple form of the HPC would not significantly change the character of the view seen in the context of the existing Hinkley Point Power Station Complex, which has an influence on the existing view. The lower structures of the HPC would be barely visible. The impact during the operational phase (year 1) would be adverse, medium-term, of very low magnitude and **minor** significance.

22.6.250 Once the proposed restoration planting within the southern part of the HPC development site increases in maturity (year 15), a dense belt of woodland would be apparent below the Green Lane ridge. This maturing vegetation would become visible in the long term but its visibility would be very low due to the elevation of the viewpoint and distance. The impact during the operational phase (year 15) would be adverse, long-term, of very low magnitude and **minor** significance. The operational lighting impact (both year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figures 22.36b, 22.36c, 22.36d**.

Table 22.57: Impacts on receptors at Principal Viewpoint 27

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 28 – Quantock Hills AONB, PRoW No. WL 10/9

22.6.251 The PRoW No. WL 10/9 located between Woodland Hill and Dowsborough offers views into the HPC development site due to its elevation and location at the north-eastern edge of the Quantocks ridge. The majority of construction activities within the HPC development site would be visible and the existing landform and vegetation would provide a limited degree of screening during construction. The construction machinery, in particular tower cranes, and construction activities would be evident from this viewpoint and would provide temporary 'clutter' in the view. The existing Hinkley Point Power Station Complex is evident in the view, lying in the vale forming an intermediate element, backed by more distance views of the intertidal platform and ultimately the Mendip Hills. In its context, the HPC proposed development represents an intensification of the existing Hinkley Point Power Station Complex and is seen in the context of the existing development due to the angle of view and the limited of visual separation between the HPA, HPB and HPC. Furthermore, the scale of the proposed development is not appreciably different from the existing and therefore would not significantly alter the character of the view which will prevail. The construction impact would be adverse, medium-term, of medium magnitude and **major** significance.

22.6.252 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced due to the long distance from the HPC development site and light glow from the existing Hinkley Point Power Station Complex. The impact of lighting during construction would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.253 During operation year 1, the completed HPC proposed development would be visible. The HPC would not significantly change the character of the view due to the presence of the existing Hinkley Point Power Station Complex, which has an influence on the existing view. The visibility of the lower structures of the HPC would be very low. The impact during the operational phase (year 1) would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.254 Once the proposed restoration planting within the southern part of the HPC development increases in maturity (year 15), a dense belt of woodland would be visible below Green Lane and to the west of the HPC permanent development site. The impact during the operational phase (year 15) would be adverse, long-term, of low magnitude and **moderate** significance. The operational lighting impact (both year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.37b**.

Table 22.58: Impacts on receptors at Principal Viewpoint 28

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Medium	Major	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Low	Moderate	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Low	Moderate	Very low	Minor

Principal Viewpoint 29 – Quantock Hills AONB, Walford's Gibbet

22.6.255 Due to the location of this viewpoint at the edge of the Quantock Hills and its relatively low elevation (compared to the Quantock summits), many construction activities within the HPC development site would be screened by the existing landform and vegetation. Due to the distance from the HPC development site (approximately 7km), detailed construction activities would not be evident and the main impact would be associated with the erection of the tallest structures (HPC Unit 1 and Unit 2) and the tower cranes operations. Due to the long distance and rolling landform and vegetation screening the HPC development site, the construction activities to the north of and below the Green Lane ridge would not be visible. The construction impact would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.256 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced due to the long distance from the HPC development site and light glow from the existing Hinkley Point Power Station Complex. The impact of lighting during the construction phase would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.257 During operation year 1, the completed HPC proposed development would be visible above the ridge of Green Lane. The HPC proposed development would not significantly change the character of the view as it would be seen in the context of the existing Hinkley Point Power Station Complex, which has an influence on the existing view. The visibility of the lower structures of the HPC would be low due to the distance. Due to the angle of view there would a degree of visual separation between HPA, HPB and HPC but the scale of the HPC proposed development is not appreciably different from the existing and therefore would not significantly alter the character of the view which will prevail. The impact during the operational phase (year 1) would be adverse, medium-term, of very low magnitude and **minor** significance.

22.6.258 Once the proposed restoration planting within the southern part of the HPC development site increases in maturity (year 15), the visibility of a dense belt of woodland below Green Lane would be very low. This maturing vegetation would add some benefit in the longer term but this change would be very low due to the long distance, the low elevation of the viewpoint and limited visibility of the landscape restoration proposals. The impact during the operational phase (year 15) would be adverse, long-term, of very low magnitude and **minor** significance. The operational lighting impact (both year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figures 22.38b, 22.38c, 22.38d**.

Table 22.59: Impacts on receptors at Principal Viewpoint 29

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 30 – Quantock Hills AONB, PRoW No. 10/28

22.6.259 During the construction phase the main visual impact would be associated with the erection of the tallest HPC structures (Unit 1 and Unit 2) and the tower cranes operations. Due to the distance from the HPC development site (approx. 8600m), and rolling landform and vegetation screening much of the HPC development site, the construction activities to the north of ridge below the Green Lane ridge would not be apparent. The construction impact would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.260 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced due to the long distance from the HPC development site and light glow from the existing Hinkley Point Power Station Complex. The impact of lighting during construction would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.261 The magnitude of impacts during year 1 and year 15 of the operational phase would be the same. The visibility of landscape restoration proposals would be very low from this viewpoint due to the distance, although woodland planting would become more visible once increased in maturity (year 15). During the operational phase the completed HPC proposed development would be visible above the ridge of Green Lane, which would screen the lower HPC structures. The visibility of pylons and stacks would be very low due to the distance. The operational HPC proposed development would not significantly change the character of the view as it would be seen in the context of the existing Hinkley Point Power Station Complex, which has an influence on the existing view, however it would extend its visual impact due to a degree of visual separation between HPA, HPB and HPC. The summits visible in middle ground visually dominate the view and decrease the perception of visual change as a result of the HPC proposed development. The impact during the operational phase (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance.

22.6.262 The impact of the operational lighting would be significantly lower than during the construction phase due to design features in the operational lighting scheme, such as light control measures and measures to reduce light pollution. The operational lighting impact (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.39b**.

Table 22.60: Impacts on receptors at Principal Viewpoint 30

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 31 – Quantock Hills AONB, Will's Neck

22.6.263 During the construction phase the main visual impact would be associated with the erection of the tallest HPC structures (Unit 1 and Unit 2) and the tower cranes operations. Due to the distance of the viewpoint from the HPC development site, rolling landform and intervening vegetation detailed construction activities would not be evident. The construction impact would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.264 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced due to the long distance from the HPC development site and light glow from the existing Hinkley Point Power Station Complex. The impact of lighting during construction would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.265 The magnitude of impacts during year 1 and year 15 of the operational phase would be the same. The visibility of landscape restoration proposals would be very low from this viewpoint due to the distance, although woodland planting would become more visible once it increases in maturity (year 15). During the operational phase the completed HPC proposed development would be visible above the ridge of Green Lane, which would screen the lower HPC structures. The visibility of pylons and stacks would be very low due to the distance. The operational HPC would not significantly change the character of the view as it would be seen in the context of the existing Hinkley Point Power Station Complex, which has an influence on the existing view, however it would extend its visual impact due to a degree of visual separation between HPA, HPB and HPC. The wooded rolling hills visible in middle ground have a strong influence on the existing view and decrease the perception of visual change as a result of the HPC proposed development. The impact during the operational phase (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. The operational lighting impact (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.40b**.

Table 22.61: Impacts on receptors at Principal Viewpoint 31

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 32 – Quantock Hills AONB, Cothelstone Hill

22.6.266 During the construction phase the visual impact would be associated with the erection of the tallest HPC structures (Unit 1 and Unit 2) and the tower cranes operations. Due to the distance from the HPC development site, rolling landform and vegetation, the construction activities below the Green Lane ridge would not be apparent. The construction impact would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.267 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced due to the long distance from the HPC development site and light glow from the existing Hinkley Point Power Station Complex. The impact of lighting during construction would be adverse, medium-term, of low magnitude and moderate significance.

22.6.268 The magnitude of impacts during year 1 and year 15 of the operational phase would be the same. The visibility of landscape restoration proposals would be very low from this viewpoint due to the distance, although woodland planting would become more visible once it increases in maturity (year 15). During the operational phase the completed HPC proposed development would be visible above the ridge of Green Lane, which would screen the lower HPC structures. The visibility of pylons and stacks would be very low due to the distance. The operational HPC proposed development would not significantly change the character of the view as it would be seen in the context of the existing Hinkley Point Power Station Complex, which has an influence on the existing view, however it would extend its visual impact due to a degree of visual separation between HPA, HPB and HPC. The wooded summits of the south-eastern Quantock Hills visible in middle ground visually dominate the view and decrease the perception of visual change as a result of the HPC proposed development visible in the distance. The impact during the operational phase (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance.

22.6.269 The impact of the operational lighting would be significantly lower than during the construction phase due to design features in the operational lighting scheme, such as light control measures and measures to reduce light pollution. The operational lighting impact (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.41b**.

Table 22.62: Impacts on receptors at Principal Viewpoint 32

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 33 – Quantock Hills AONB, Broomfield Hill

22.6.270 During the construction phase the visual impact would be associated with the erection of the tallest HPC structures (Unit 1 and Unit 2) and the tower cranes operations. Due to the distance from the HPC development site, rolling landform and vegetation, the construction activities below the Green Lane ridge would not be apparent. The construction impact would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.271 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced due to the long distance from the HPC development site and light glow from the existing Hinkley Point Power Station Complex. The impact of lighting during construction would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.272 The magnitude of impacts during year 1 and year 15 of the operational phase would be the same. The visibility of landscape restoration proposals would be very low from this viewpoint due to the distance, although woodland planting would become more visible once increased in maturity (year 15). During the operational phase the completed HPC proposed development would be visible above the ridge of Green Lane, which would screen the lower structures of the HPC. The visibility of pylons and stacks would be very low due to the distance. The operational HPC would not significantly change the character of the view as it would be seen in the context of the existing Hinkley Point Power Station Complex, which has an influence on the existing view, however it would extend its visual impact due to a degree of visual separation between HPA, HPB and HPC. The rolling hills visible in middle ground visually dominate the view and decrease the perception of visual change as a result of the HPC which would be visible in the distance. The impact during the operational phase (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance.

22.6.273 The impact of the operational lighting would be significantly lower than during the construction phase due to design features in the operational lighting scheme, such as light control measures and measures to reduce light pollution. The operational lighting impact (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.42b**.

Table 22.63: Impacts on receptors at Principal Viewpoint 33

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 34 – Quantock Hills AONB, Wind Down, lay-by

22.6.274 During the construction phase the visual impact would be associated with the erection of the tallest HPC structures (Unit 1 and Unit 2) and the tower crane operations. Due to the distance of the viewpoint from the HPC development site, rolling landform and vegetation, the construction activities below the Green Lane ridge would not be apparent. The construction impact would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.275 Construction lighting would be visible from this viewpoint 24 hours a day during the main phases of construction, however, this impact would be reduced due to the long distance from the HPC development site and light glow from the existing Hinkley Point Power Station Complex. The impact of lighting during construction would be adverse, medium-term, of low magnitude and **moderate** significance.

22.6.276 The magnitude of impacts during year 1 and year 15 of the operational phase would be the same. The visibility of landscape restoration proposals would be very low from this viewpoint due to the distance, although woodland planting would become more visible once it increases in maturity (year 15). The rolling hills and vegetation visible in middle ground visually dominate the view and decrease the perception of visual change as a result of the HPC proposed development visible in the distance. During the operational phase the completed HPC proposed development would be visible above the ridge of Green Lane, which would screen the lower structures of the HPC. The visibility of pylons and stacks would be very low due to the distance. The operational HPC proposed development would not significantly change the character of the view as it would be seen in the context of the existing Hinkley Point Power

Station Complex, which has an influence on the existing view, however it would extend its visual impact due to a degree of visual separation between HPA, HPB and HPC. The impact during the operational phase (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance.

22.6.277 The impact of the operational lighting would be significantly lower than during the construction phase due to design features in the operational lighting scheme, such as light control measures and measures to reduce light pollution. The operational lighting impact (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figures 22.43b, 22.43c, 22.43d**.

Table 22.64: Impacts on receptors at Principal Viewpoint 34

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Low	Moderate
2	Operation year 1	High	Adverse, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 35 – Cannington Park, Public Footpath

22.6.278 During the construction phase, glimpsed views of construction activities would be available but due to screening provided by the vegetation in the foreground all construction activities, including the construction of Unit 1 and Unit 2 and the use of large construction machinery, would be barely perceptible. The construction impact would be adverse, medium-term, of very low magnitude and **minor** significance. The impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance.

22.6.279 The landscape restoration proposals would not be visible from this viewpoint and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. Due to the screening provided of vegetation in the foreground, the visibility of the HPC proposed development through the existing vegetation would be very low. The operational HPC would not change the character of the view as it would be seen in the context of the existing Hinkley Point Power Station Complex, which would be more visible than the HPC. The impact during the operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting impact (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. . See **Figure 22.44b**

Table 22.65: Impacts on receptors at Principal Viewpoint 35

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse,	Very Low	Minor	Very low	Minor

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
			medium-term				
2	Operation year 1	High	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 36 – Puriton Hill, PRoW No. BW 28/3

22.6.280 During the construction phase, only the construction of the main HPC buildings (Unit 1 and Unit 2) would be visible. These buildings, together with tower cranes, would punctuate the skyline, but due to the long distance between this viewpoint and the HPC development site (11.5km), and the presence of the existing Hinkley Point Power Station Complex, which would screen some of the construction activities and is seen in the existing view, the resulting visual change during the construction phase would be very low. The construction impact would be adverse, medium-term, of very low magnitude and **minor** significance. The impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance.

22.6.281 The landscape restoration proposals would not be visible from this viewpoint and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. Following the removal of all construction machinery and cessation of construction activities, the visibility of the HPC proposed development through the existing vegetation would be very low. The operational HPC would not change the character of the view as it would be seen in the context of the existing Hinkley Point Power Station Complex. The impact during the operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting impact (both year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.45b**

Table 22.66: Impacts on receptors at Principal Viewpoint 36

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	Medium	Adverse, medium-term	Very low	Minor	Very low	Minor
2	Operation year 1	Medium	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	Medium	Neutral, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 37 – Burnham-on-Sea, waterfront (west of the pier)

22.6.282 During the construction phase, the majority of the HPC proposed development, including Unit 1 and Unit 2, would be screened by the existing Hinkley Point Power Station Complex. The tower cranes would punctuate the skyline and be seen against a backdrop of the distinctive ridges of the Quantock Hills AONB and Exmoor National

Park. The visibility of the temporary jetty would be low due to its alignment with the horizon line and its limited height. The construction impact would be adverse, medium-term, of low magnitude and **moderate** significance. The impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance due to the light glow from the existing Hinkley Point Power Station Complex but also visual screening it provides.

22.6.283 Landscape restoration proposals would not be visible from this viewpoint and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. Following the removal of all construction machinery and cessation of construction activities, the HPC proposed development would be almost entirely screened by the existing Hinkley Point Power Station Complex, which would remain the main feature within the view. The impact during the operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting impact (both year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. See **Figures 22.46b, 22.46c, 22.46d**.

Table 22.67: Impacts on receptors at Principal Viewpoint 37

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 38 – Brent Knoll (monument)

22.6.284 During the construction phase, a large proportion of the HPC would be screened by the existing Hinkley Point Power Station Complex. The tower cranes would be seen against a backdrop of the distinctive ridge of the Quantock Hills AONB and Exmoor National Park. The visibility of the temporary jetty and other, less visually intrusive construction activities, would be low due to long distance (over 14km) from the HPC development site. The construction impact would be adverse, medium-term, of low magnitude and **minor** significance. The impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance due to the distance, light glow from the existing Hinkley Point Power Station Complex but also visual screening it provides.

22.6.285 Landscape restoration proposals would not be visible from this viewpoint and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. Following the removal of all construction machinery and cessation of construction activities, the proposed development would be almost entirely screened by the existing Hinkley Point Power Station Complex, which would remain the main feature within the view. The impact during the operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting impact (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.47b**.

Table 22.68: Impacts on receptors at Principal Viewpoint 38

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	Medium	Adverse, medium-term	Low	Minor	Very low	Minor
2	Operation year 1	Medium	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	Medium	Neutral, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 39 – Berrow Beach

22.6.286 During the construction phase, the main construction activities to the north of Green Lane, including the construction of Unit 1 and Unit 2 and large construction machinery such as tower cranes, would be visible next to the existing Hinkley Point Power Station Complex, which would screen the construction activities located further beyond within the HPC development site. The tower cranes and the HPC under construction would be seen against the backdrop of the distinctive ridge of the Quantock Hills AONB. The visibility of the temporary jetty would be low due to its alignment with the horizon line, limited height and long distance from the viewpoint (over 11km). The construction impact would be adverse, medium-term, of low magnitude and **minor** significance. The impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance due to the light glow from the existing Hinkley Point Power Station Complex but also a degree of visual screening it provides.

22.6.287 Landscape restoration proposals would not be visible from this viewpoint and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. Following the removal of all construction machinery and cessation of construction activities, the HPC proposed development would not significantly change the character of the view as it would be seen in the context of the existing Hinkley Point Power Station Complex, which has an influence on the existing view. The impact during the operational phase (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. The operational lighting impact (both year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.48b**.

Table 22.69: Impacts on receptors at Principal Viewpoint 39

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	Medium	Adverse, medium-term	Low	Minor	Very low	Minor
2	Operation year 1	Medium	Adverse, medium-term	Very low	Minor	Very low	Minor

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
3	Operation year 15	Medium	Adverse, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 40 – Brean Down

22.6.288 During the construction phase, the main construction activities to the north of Green Lane, including the construction of Unit 1 and Unit 2 and large construction machinery such as tower cranes, would be visible next to the existing Hinkley Point Power Station Complex. The tower cranes and the HPC under construction would be seen against the backdrop of the distinctive ridge of the Quantock Hills AONB. The visibility of the temporary jetty would be low due to its alignment with the horizon line, limited height and long distance from the viewpoint. The construction impact would be adverse, medium-term, of low magnitude and **moderate** significance. The impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance due to the distance and light glow from the existing Hinkley Point Power Station Complex.

22.6.289 Landscape restoration proposals would not be visible from this viewpoint and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. Following the removal of all construction machinery and cessation of construction activities, the HPC proposed development would not significantly change the character of the view as it would be seen in the context of the existing Hinkley Point Power Station Complex, which has an influence on the existing view. The impact during the operational phase (year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. The operational lighting impact (both year 1 and year 15) would be adverse, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.49b**.

Table 22.70: Impacts on receptors at Principal Viewpoint 40

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Low	Moderate	Very low	Minor
2	Operation year 1	High	Adverse, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Adverse, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 41 – Mendip Hills AONB, Bleadon Hill

22.6.290 During the construction phase, the construction activities within the HPC development site would be barely noticeable from this viewpoint due to the long distance. The tallest construction machinery within the site is unlikely to punctuate the skyline due to the high elevation of this viewpoint. From this distance the HPC construction activities would be seen against the backdrop of the Quantock Hills. The construction impact would be adverse, medium-term, of very low magnitude and **minor** significance. The impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance.

22.6.291 Landscape restoration proposals would not be visible from this viewpoint and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. Following the removal of all construction machinery and cessation of construction activities, the proposed development would be seen in the context of the existing Hinkley Point Power Station Complex and its visibility would be very low due to the long distance. The character of the view would not change, as the proposed development would be an extension of the existing Hinkley Point Power Station Complex. The impact during the operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting impact (both year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.50b**.

Table 22.71: Impacts on receptors at Principal Viewpoint 41

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Very low	Minor	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor	Very low	Minor

Principal Viewpoint 42 – Mendip Hills AONB, Crook Peak

22.6.292 During the construction phase, the construction activities within the HPC development site would be barely noticeable from this viewpoint due to the long distance. The tallest construction machinery within the site is unlikely to punctuate the skyline due to the high elevation of this viewpoint. From this distance the HPC construction activities would be seen against the backdrop of the Quantock Hills. The construction impact would be adverse, medium-term, of very low magnitude and **minor** significance. The impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance.

22.6.293 Landscape restoration proposals would not be visible from this viewpoint and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. Following the removal of all construction machinery and cessation of construction activities, the HPC would be seen in the context of the existing Hinkley Point Power Station Complex and its visibility would be very low due to the long distance. The character of the view would not change, as the proposed development would be an extension of the existing Hinkley Point Power Station Complex. The impact during the operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting impact (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. See **Figure 22.51b**.

Table 22.72: Impacts on receptors at Principal Viewpoint 42

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-	Very low	Minor	Very low	Minor

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
			term				
2	Operation year 1	High	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor	Very low	Minor

Secondary Viewpoint S1 – Minehead Waterfront

22.6.294 During the construction phase large scale construction activities within the HPC development site would be seen in the context of the existing Hinkley Point Power Station Complex and would partially screen the HPA and HPB stations. Due to the very long distance of the viewpoint from the HPC development site, all construction activities, machinery (including the tower cranes) and HPC buildings would be barely perceptible. The impact during construction would be adverse, medium-term, of very low magnitude and **minor** significance. The visual impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance due to the distance from the HPC development site and light glow from the existing Hinkley Point Power Station Complex.

22.6.295 Landscape restoration proposals would not be visible from this distance, and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. During the operational phase, the HPC proposed development would be seen in the context of the existing Hinkley Point Power Station Complex and would partially screen the HPA and HPB stations. The impact during the entire operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting impact (year 1 and year 15) would be also neutral, medium to long-term, of very low magnitude and **minor** significance.

Table 22.73: Impacts on receptors at Secondary Viewpoint S1

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Very low	Minor	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor	Very low	Minor

Secondary Viewpoint S2 – Exmoor National Park, North Hill

22.6.296 During the construction phase large scale construction activities within the HPC development site would be seen in the context of the existing Hinkley Point Power Station Complex and would partially screen the HPA and HPB stations. Due to the very long distance of the viewpoint from the HPC development site, all construction activities, machinery (including the tower cranes) and HPC buildings would be barely perceptible. The impact during construction would be adverse, medium-term, of very low magnitude and **minor** significance. The visual impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance due to the distance from the HPC development site and light glow from the existing Hinkley Point Power Station Complex.

22.6.297 Landscape restoration proposals would not be visible from this distance, and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. During the operational phase, the HPC would be seen in the context of the existing Hinkley Point Power Station Complex and would partially screen the HPA and HPB stations. The impact during the entire operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting impact (year 1 and year 15) would be also neutral, medium to long-term, of very low magnitude and **minor** significance.

Table 22.74: Impacts on receptors at Secondary Viewpoint S2

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Very low	Minor	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor	Very low	Minor

Secondary Viewpoint S3 – Minehead, Paganel Road

22.6.298 During the construction phase large scale construction activities within the HPC development site would be seen in the context of the existing Hinkley Point Power Station Complex and would partially screen the HPA and HPB stations. Due to the very long distance of the viewpoint from the HPC development site, all construction activities, machinery (including the tower cranes) and HPC buildings would be barely perceptible. The impact during construction would be adverse, medium-term, of very low magnitude and **minor** significance. The visual impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance due to the distance from the HPC development site, light glow from the existing Hinkley Point Power Station Complex and residential area lighting in the foreground.

22.6.299 Landscape restoration proposals would not be visible from this distance, and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. During the operational phase, the HPC would be seen in the context of the existing Hinkley Point Power Station Complex and will partially screen the HPA and HPB stations. The impact during the entire operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting impact (both year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance.

Table 22.75: Impacts on receptors at Secondary Viewpoint S3

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Very low	Minor	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor	Very low	Minor

Secondary Viewpoint S4 – Exmoor National Park, Conygar Tower

22.6.300 During the construction phase large scale construction activities within the HPC development site would be seen in the context of the existing Hinkley Point Power Station Complex and would partially screen the HPA and HPB stations. Due to the long distance of the viewpoint from the HPC development site and mature vegetation in the foreground, all construction activities, machinery (including the tower cranes) and HPC buildings would be barely perceptible. The impact during construction would be adverse, medium-term, of very low magnitude and **minor** significance. The visual impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance due to the distance from the HPC development site and light glow from the existing Hinkley Point Power Station Complex.

22.6.301 Landscape restoration proposals would not be visible from this distance, and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. During the operational phase, the HPC proposed development would be seen in the context of the existing Hinkley Point Power Station Complex and would partially screen the HPA and HPB stations. The impact during the entire operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting (both year 1 and year 15) would be also neutral, medium to long-term, of very low magnitude and **minor** significance.

Table 22.76: Impacts on receptors at Secondary Viewpoint S4

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Very low	Minor	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor	Very low	Minor

Secondary Viewpoint S5 – Exmoor National Park, Rodhuish Common

22.6.302 During the construction phase, all construction activities, machinery (including the tower cranes punctuating the skyline) and HPC buildings would be barely perceptible due to the long distance of the viewpoint from the HPC development site (over

20km). The proposed highway improvement scheme at Washford Cross Roundabout would not increase the significance of impacts caused by the HPC proposed development due to the distance from the viewpoint. The impact during construction would be adverse, medium-term, of very low magnitude and **minor** significance. The visual impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance due to the distance from the HPC development site and the existing Hinkley Point Power Station Complex and the presence of existing light glow apparent in the fore/mid ground in nearby settlement at Watchet and Williton.

22.6.303 The restoration proposals would not be visible from this distance, and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. During the operational phase, the proposed development would be seen in the context of the Hinkley Point Power Station Complex. During the operational phase, the proposed highway improvement scheme at Washford Cross Roundabout, which includes lighting, would be visible during the hours of darkness but is approximately 6km from the viewpoint and would be seen in the context of sky glow already present from built up areas at Watchet and Williton. The impact during the entire operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting (year 1 and year 15) would be also neutral, medium to long-term, of very low magnitude and **minor** significance.

Table 22.77: Impacts on receptors at Secondary Viewpoint S5

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Very low	Minor	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor	Very low	Minor

Secondary Viewpoint S6 – Welsh Coast, Barry Island Waterfront

22.6.304 During the construction phase, the only visual impact on receptors at this viewpoint would be associated with the construction of Unit 1 and Unit 2 and the tallest machinery operating on site (tower cranes), which would be seen against the backdrop of the Quantocks ridge but their visibility would be very low due to the long distance of the viewpoint from the HPC development site (over 22km). The impact during construction would be adverse, medium-term, of very low magnitude and **minor** significance. The visual impact of lighting during construction would be adverse, medium-term, of very low magnitude and **minor** significance due to the distance from the HPC development site and light glow from the existing Hinkley Point Power Station Complex.

22.6.305 The restoration proposals would not be visible from this distance, and as such the magnitude of impacts during year 1 and year 15 of the operational phase would be the same. During the operational phase, the proposed development would be seen adjacent to the existing Hinkley Point Power Station Complex but would occupy a small percentage of the view. The visibility of HPC would be very limited due to distance. The impact during the entire operational phase (year 1 and year 15) would be neutral, medium to long-term, of very low magnitude and **minor** significance. The operational lighting (year 1 and year 15) would be also neutral, medium to long-term, of very low magnitude and **minor** significance.

Table 22.78: Impacts on receptors at Secondary Viewpoint S6

ID	Phase	Sensitivity	Nature	Magnitude	Significance	Magnitude (Night)	Significance (Night)
1	Construction	High	Adverse, medium-term	Very low	Minor	Very low	Minor
2	Operation year 1	High	Neutral, medium-term	Very low	Minor	Very low	Minor
3	Operation year 15	High	Neutral, long-term	Very low	Minor	Very low	Minor

22.7 Mitigation of Impacts

a) Introduction

22.7.1 The majority of landscape and visual mitigation measures are embodied in the HPC development proposals and form an inherent part of the design. It should be noted that the HPC design, including landscape proposals inherent to the scheme, has been influenced by consultation with local residents, Natural England and English Heritage, and Quantocks AONB. The proposed HPC landscape restoration plan (see **Figure 22.59**) incorporates consultation comments on landscape design aimed to minimise landscape and visual impacts. The permanent landscape proposals within the HPC development site (during construction and operation) have been outlined and assessed in the previous section and are described in detail on the HPC landscape restoration plan.

22.7.2 This section identifies the proposed mitigation measures which are temporary (during construction) or are located off-site. They are considered as ‘further landscape mitigation measures’ and are assessed in section 22.8 as part of the residual impact assessment.

b) Mitigation during construction and operation

22.7.3 To mitigate visual impacts during construction a temporary screening earth bund varying in height from 2m to 8.5m (relative to adjacent ground levels) would be created along the north-western boundary of the HPC development site (see **Figure 22.58**). This temporary bund would be planted with native coastal shrub on slopes and would be managed during construction. The temporary bund would be implemented during site preparation works and would be effective for screening the HPC development in the short distance, predominantly from the adjacent PRoW. Although it cannot screen all of the main construction works, it will effectively screen the early construction works (site preparation works) reducing the magnitude of visual impacts.

22.7.4 The temporary screening bund and associated planting along the north-western HPC development site boundary would be used specifically for the construction phase. Following construction, the temporary bund and planting will be replaced by a landscape restoration scheme designed for the operational phase (see **Figure 22.59**).

22.7.5 To safeguard the existing vegetation to be retained, fenced tree protection zones would be created to ensure that development would not encroach onto the root protection areas. Details of tree and hedgerow removal are provided in **Appendix 22C**.

22.7.6 The HPC construction mitigation measures include off-site mitigation measures proposed following consultation with the landowners of the land to the west of the HPC development site. The off-site landscape and visual mitigation measures identified include:

- wildflower meadow planting;
- hedgerow reinforcement;
- changes in management of the existing hedgerows allowing for their full growth; and
- woodland screen planting.

22.7.7 This off-site planting is aimed specifically to minimise visual impacts on Fairfield House and the surrounding land. It also aims to mitigate local visual impacts from some PRoW within the Coastal – Lilstock sub character area. Further details on the off-site mitigation measures are available in the **HPC Landscape Strategy**.

22.7.8 Off-site planting proposals have been prepared to mitigate the impacts on Pixies Mound. They are illustrated on **Figure 22.61** and include predominantly woodland and hedgerow planting along Wick Moor Drove to screen the HPC proposed development when viewed from Pixies Mound. It is estimated that the landscape proposals around Pixies Mound would reach their full screening potential at year 15 of the operational phase, while providing only partial screening during the construction phase.

22.7.9 The off-site planting scheme proposed following consultation with the landowners of the land to the west of the HPC development site would continue mitigating landscape and visual impacts during the HPC operational phase.

22.8 Residual Impacts

22.8.1 The permanent landscape restoration proposals within the HPC development site were assessed in section 22.6.

22.8.2 This section identifies and assesses the potential residual impacts on landscape visual receptors after implementing the proposed mitigation measures described in section 22.7. A summary of impacts, assessed after taking account of mitigation inherent within the design and impacts assessed after any further mitigation has been taken into account, is provided in section 22.9.

22.8.3 Due to the scale of the HPC development, and the extent and magnitude of its landscape and visual impacts, it is not possible to propose sufficient mitigation measures to mitigate the impacts on the majority of the receptors. The proposed further mitigation measures will therefore affect only localised receptors, which are summarised below.

a) Residual Landscape Impacts

22.8.4 The proposed further landscape mitigation measures would be in keeping with the local landscape character. There would be direct impact on the Quantock Vale LLCA, however, due to the small scale of additional planting compared to the area of Quantock Vale, and the magnitude of change due to the HPC construction and operation, the residual impacts on this LLCA would remain the same as before implementing the off-site mitigation measures.

22.8.5 The proposed off-site mitigation measures would be more relevant to the site scale landscape sub character areas, due to their smaller scale.

22.8.6 The site scale landscape character sub areas that would benefit from the implementation of the off-site landscape mitigation measures would be Coastal – Lilstock and Fairfield. Although some off-site landscape mitigation measures are located within the Rolling Farmland East – Stogursey landscape character sub area, the contribution of these measures to the character of the area would be too small to justify any beneficial impact and change of the significance of impact assessed in the Section 22.6.

Coastal - Lilstock

22.8.7 During construction, the proposed screening bund along the north western boundary would provide a degree of screening of early construction activities (site preparation works) within the HPC development site. The magnitude of construction impacts on landscape character would slightly decrease, however during the entire construction phase the impact would remain of major adverse significance. The significance of residual operational impact would not change due to the small scale of off-site planting and hedgerow management compared to the impact of the completed HPC development.

Fairfield

22.8.8 During construction, the proposed off-site planting within this sub area would not be mature enough to screen the construction activities. During operation year 15, the proposed woodland and hedgerow planting would screen the majority of the proposed HPC development and the existing Hinkley Point Power Station Complex from the parkland around Fairfield House. This impact would be localised (limited to the Fairfield House and the parkland) and in the context of the entire Fairfield sub character area the significance of residual landscape impact would not change.

b) Residual Visual Impacts

22.8.9 Due to the scale of the proposed HPC development, under construction and operation, off-site landscape proposals are effective only in close proximity to visual receptors. The proposed further mitigation during construction would reduce localised visual impacts occurring in the vicinity of the western boundary of the HPC development site.

22.8.10 During construction, the most efficient mitigation measure with almost immediate screening effect would be the proposed bund along the north-western boundary of the HPC development site. The off-site planting proposals would not be mature enough to mitigate any visual impacts during construction. The north-western bund would be removed during site restoration.

22.8.11 During operation, the proposed further landscape mitigation measures would include off-site planting which would mitigate visual impacts at year 1 (to a lesser extent) and year 15 of the operational phase and beyond.

22.8.12 The visual receptors likely to be affected by the proposed off-site mitigation include users of PRoW in the vicinity of the north-western boundary of the HPC development site and around Burton; residents of Knighton, Burton and Fairfield; walkers and users of PRoW within the Fairfield and eastern part of the Coastal – Lilstock landscape character sub areas.

22.8.13 The residual impact on the representative viewpoints is assessed below.

Principal Viewpoint 1 – PRoW No. WL23/110 west of Benhole Lane

22.8.14 During the construction phase, the proposed north-western bund would provide a small degree of screening to the site preparation works activities, however due to the elevation of the viewpoint the residual magnitude of change would be too small to justify the change of impact significance from major adverse assessed for the potential visual impact. It should be noted that the bund would be effective in reducing early visual impacts from the PRoW along Benhole Lane.

Principal Viewpoint 2– West Somerset Coast Path, PRoW No. WL 23/95

22.8.15 During the construction phase, the proposed north-western bund would provide a small degree of screening to the site preparation works and the temporary jetty. Once the main construction activities commence, the screening bund would screen vehicle movement and some other activities within on the lower levels of the HPC development site, but would not change the overall major adverse significance of visual impact during the entire construction phase.

Principal Viewpoint 4 – PRoW No. WL 24/8

22.8.16 Visual receptors on PRoW No. WL 24/8 would benefit from off-site hedgerow reinforcement/ management on the raising topography in the foreground of the view. Fully grown hedgerows would have a potential to partially screen the proposed HPC development and the existing Hinkley Point Power Station Complex. It is assessed that the magnitude would not change; however the nature of year 15 residual operational impact would change from adverse to neutral, once the existing hedgerows reach their full growth.

Principal Viewpoint 7 – Fairfield House Driveway

22.8.17 Visual receptors on Fairfield House Driveway would benefit from off-site woodland planting and hedgerow reinforcements implemented adjacent to the existing woodland visible in middle ground. Due to the short distance of the proposed off-site planting from the viewpoint, the proposed HPC development and the existing Hinkley Point Power Station Complex would become partially screened. As a result of the off-site planting, the vegetated skyline would change and some long distance views towards Bridgwater Bay would be lost but the presence of the HPC and the existing Complex would be less evident. It is assessed that the proposed off-site planting would change only the impacts during year 15 of the operational phase, when the proposed off-site planting begins to mature. The residual visual impact during the operational phase (year 15) would be adverse, long-term, of very low magnitude and minor significance.

Principal Viewpoint 8 – Knighton Farm, PRoW No. WL 23/46

22.8.18 Visual receptors on PRoW No. WL 23/46 and the residents of adjacent Knighton Farm would benefit from the change in the management of existing hedgerows on the local ridge in the foreground of the view. The fully grown hedgerows would contribute to screening of the proposed HPC development and the existing Hinkley Point Power Station Complex. It is assessed that the magnitude and nature of impact would not change even during operational phase (year 15) once the hedgerows are fully grown. The construction and operational residual impact (year 1) would remain the same.

Principal Viewpoint 9 – Burton

22.8.19 Visual receptors on PRoW around Burton, and motorists, would benefit from the change in management of existing hedgerows on the local ridge in middle ground. The fully grown hedgerows would contribute to screening of the proposed HPC development and the existing Hinkley Point Power Station Complex. It is assessed that the magnitude and nature of impacts would not change when the hedgerows are fully grown.

Principal Viewpoint 14 – Pixies Mound (Wick Barrow)

22.8.20 The proposed off-site planting around Pixies Mound is illustrated on **Figure 22.62**. The woodland and hedgerow planting would not screen the construction of HPC and would have limited screening potential during the operational phase (year 1). Once the planting increases in maturity, at year 15 of the operational phase, the proposed HPC development would be almost entirely screened from this viewpoint (due to the proximity of planting). It is assessed that the magnitude of change would remain low, however the nature of residual visual impact would change from adverse to neutral.

22.9 Summary of Impacts

22.9.1 **Table 22.79**, **Table 22.80** and **Table 22.81** summarise the predicted construction impacts, operational impacts year 1 and operational impacts year 15 (respectively) of the identified landscape and visual receptors without further mitigation during daylight hours and the residual impacts remaining after further mitigation.

Table 22.79: Summary of Construction Phase Impacts

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Landscape								
Local Landscape Character								
Quantock Vale LLCA	Medium	Change in landscape character	Adverse, medium-term	High	Major	Screening north-western bund, off-site hedgerow and woodland planting	High	Major
Doniford Stream and Quantock Fringe LLCA	Medium	Change in landscape character	Adverse, medium-term	Low	Minor	None proposed	Low	Minor
Central Quantocks LLCA	High	Change in landscape character	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Quantock Hills LLCA	High	Change in landscape character	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Central West Somerset LLCA	Medium	Change in landscape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Lowland Hills LLCA	Medium	Change in landscape character	Adverse, medium-term	Low	Minor	None proposed	Low	Minor
Levels and Moors LLCA	High	Change in landscape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Limestone Ridges and Combes LLCA	High	Change in landscape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Mendips LLCA	High	Change in landscape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Blue Anchor to St Audries LSCA	High	Change in seascape character	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
St Audries Bay to Hinkley Point LSCA	High	Change in seascape character	Adverse, medium-term	Medium	Major	None proposed	Medium	Major
Hinkley Point to River Parrett LSCA	Medium	Change in seascape character	Adverse, medium-term	Low	Minor	None proposed	Low	Minor
Burnham-on-Sea to Brean Down LSCA	Medium	Change in seascape character	Adverse, medium-term	Low	Minor	None proposed	Low	Minor
Brean Down LSCA	High	Change in seascape character	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Site Scale Landscape Character								
Wick Moor and Coast	High	Change in landscape character	Adverse, medium-term	Medium	Major	None proposed	Medium	Major
Wall Common and Coast	Medium	Change in landscape character	Adverse, medium-term	Low	Minor	None proposed	Low	Minor

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Coastal - Lilstock	High	Change in landscape character	Adverse-medium-term	High	Major	Screening north-western bund, hedgerow management	High	Major
Rolling Farmland East - Stogursey	Medium	Change in landscape character	Adverse, medium-term	High	Major	Hedgerow management	High	Major
Fairfield	High	Change in landscape character	Adverse, medium-term	Low	Moderate	Off-site woodland and hedgerow planting, hedgerow management	Low	Moderate
The Quantock Fringes - Dodington	High	Change in landscape character	Adverse, medium-term	Very low	Minor	None proposed	Very low	Minor
Landscape Elements and Features								
Landform	Medium	Change in landform	Adverse, medium-term	High	Major	None proposed	High	Major
Land Use/Settlement	Medium	Change in land use / settlement	Adverse, medium-term	High	Major	None proposed	High	Major
Landcover/Vegetation	Medium	Change in landcover / vegetation	Adverse, medium-term	High	Major	Off-site woodland and hedgerow planting, hedgerow management	High	Major
Watercourses/water bodies	Medium	Change to watercourses / water bodies	Adverse, medium-term	Medium	Moderate	None proposed	Medium	Moderate

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Public Rights of Way	High	Change to PRoW	Adverse, medium-term	High	Major	None proposed	High	Major
Visual								
Principal Viewpoint 1: PRoW No. WL 23/110 west of Benhole Lane	High	Change in composition of view	Adverse, medium-term	High	Major	Screening north-western bund	High	Major
Principal Viewpoint 2: West Somerset Coast Path, PRoW No. WL 23/95	High	Change in composition of view	Adverse, medium-term	High	Major	Screening north-western bund	High	Major
Principal Viewpoint 3: West Somerset Coast Path, Lilstock, PRoW No. WL 24/10	High	Change in composition of view	Adverse, medium-term	Medium	Major	None proposed	Medium	Major
Principal Viewpoint 4: PRoW No. WL 24/8	Medium	Change in composition of view	Adverse, medium-term	Medium	Moderate	Hedgerow management	Medium	Moderate
Principal Viewpoint 5: Higher Hill, PRoW No. 24/3	Medium	Change in composition of view	Adverse, medium-term	Medium	Moderate	None proposed	Medium	Moderate
Principal Viewpoint 6: PRoW No. WL 24/11 near the edge of the Great Plantation	Medium	Change in composition of view	Adverse, medium-term	Medium	Moderate	None proposed	Medium	Moderate
Principal Viewpoint 7: Fairfield House Driveway	High	Change in composition of view	Adverse, medium-term	Medium	Major	Off-site hedgerow and woodland planting, hedgerow management	Medium	Major

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Principal Viewpoint 8: Knighton Farm, PRoW No. WL 23/46	High	Change in composition of view	Adverse, medium-term	Medium	Major	Hedgerow management	Medium	Major
Principal Viewpoint 9: Burton	Medium	Change in composition of view	Adverse, medium-term	Medium	Moderate	Hedgerow management	Medium	Moderate
Principal Viewpoint 10: Shurton West, Local Farm near PRoW No. WL 23/48	High	Change in composition of view	Adverse, medium-term	Medium	Major	None proposed	Medium	Major
Principal Viewpoint 11: Shurton East, PRoW No. WL 23/56	High	Change in composition of view	Adverse, medium-term	High	Major	None proposed	High	Major
Principal Viewpoint 12: Local road to the south of the site (near Gunter's Grove)	Low	Change in composition of view	Adverse, medium-term	Medium	Minor	None proposed	Medium	Minor
Principal Viewpoint 13: PRoW No. WL 23/57, West of Wick	Medium	Change in composition of view	Adverse, medium-term	Medium	Moderate	None proposed	Medium	Moderate
Principal Viewpoint 14: Pixies Mound (Wick Barrow)	High	Change in composition of view	Adverse, medium-term	High	Major	Off-site woodland and hedgerow planting	High	Major
Principal Viewpoint 15: PRoW No. WL 23/61	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 16: Wick, PRoW No. WL 23/61	High	Change in composition of view	Adverse, medium-term	Medium	Major	None proposed	Medium	Major

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Principal Viewpoint 17: Farrington Hill Lane (Farringdon Farm)	Medium	Change in composition of view	Adverse, medium-term	Medium	Moderate	None proposed	Medium	Moderate
Principal Viewpoint 18: Residential area at Stogursey, Burgage Road/Lime Street	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 19: Stolford, West Somerset Coast Path, PRoW No. WL 23/95	High	Change in composition of view	Adverse, medium-term	Medium	Major	None proposed	Medium	Major
Principal Viewpoint 20: Stockland Bristol, PRoW No. BW 32/3	High	Change in composition of view	Adverse, medium-term	Medium	Major	None proposed	Medium	Major
Principal Viewpoint 21: Quantock Hills AONB, PRoW No. WL 24/1	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 22: East Quantoxhead, PRoW No. WL 8/30	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 23: East Quantoxhead, Court House Gardens	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 24: Entrance to Dodington House	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Principal Viewpoint 25: Nether Stowey, Stogursey Lane	Medium	Change in composition of view	Adverse, medium-term	Low	Minor	None proposed	Low	Minor
Principal Viewpoint 26: Quantock Hills AONB, Beacon Hill	High	Change in composition of view	Adverse, medium-term	Medium	Major	None proposed	Medium	Major
Principal Viewpoint 27: A39, Holford Parking Bay	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 28: Quantock Hills AONB, PRoW No. WL 10/9	High	Change in composition of view	Adverse, medium-term	Medium	Major	None proposed	Medium	Major
Principal Viewpoint 29: Quantock Hills AONB, Walford's Gibbet	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 30: Quantock Hills AONB, PRoW No. 10/28	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 31: Quantock Hills AONB, Will's Neck	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 32: Quantock Hills AONB, Cothelstone Hill	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 33: Quantock Hills AONB, Broomfield Hill	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Principal Viewpoint 34: Quantock Hills AONB, Wind Down, lay-by	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 35: Cannington Park, Public Footpath	High	Change in composition of view	Adverse, medium-term	Very Low	Minor	None proposed	Very Low	Minor
Principal Viewpoint 36: Puriton Hill, PRoW No. BW 28/3	Medium	Change in composition of view	Adverse, medium-term	Very Low	Minor	None proposed	Very Low	Minor
Principal Viewpoint 37: Burnham-on-Sea, waterfront (west of the pier)	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 38: Brent Knoll (monument)	Medium	Change in composition of view	Adverse, medium-term	Low	Minor	None proposed	Low	Minor
Principal Viewpoint 39: Berrow Beach	Medium	Change in composition of view	Adverse, medium-term	Low	Minor	None proposed	Low	Minor
Principal Viewpoint 40: Brean Down	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 41: Mendip Hills AONB, Bleadon Hill	High	Change in composition of view	Adverse, medium-term	Very Low	Minor	None proposed	Very Low	Minor
Principal Viewpoint 42: Mendip Hills AONB, Crook Peak	High	Change in composition of view	Adverse, medium-term	Very Low	Minor	None proposed	Very Low	Minor

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Secondary Viewpoint S1: Minehead Waterfront	High	Change in composition of view	Adverse, medium-term	Very Low	Minor	None proposed	Very Low	Minor
Secondary Viewpoint S2: Exmoor National Park, North Hill	High	Change in composition of view	Adverse, medium-term	Very Low	Minor	None proposed	Very Low	Minor
Secondary Viewpoint S3: Minehead, Paganel Road	High	Change in composition of view	Adverse, medium-term	Very Low	Minor	None proposed	Very Low	Minor
Secondary Viewpoint S4: Exmoor National Park, Conygar Tower	High	Change in composition of view	Adverse, medium-term	Very Low	Minor	None proposed	Very Low	Minor
Secondary Viewpoint S5: Exmoor National Park, Rodhuish Common	High	Change in composition of view	Adverse, medium-term	Very Low	Minor	None proposed	Very Low	Minor
Secondary Viewpoint S6: Welsh Coast, Barry Island Waterfront	High	Change in composition of view	Adverse, medium-term	Very Low	Minor	None proposed	Very Low	Minor

Table 22.80: Summary of Operational Phase Impacts Year 1

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Landscape								
Local Landscape Character								
Quantock Vale LLCA	Medium	Change in landscape character	Adverse, medium-term	Low	Minor	Off-site woodland and hedgerow planting	Low	Minor
Doniford Stream and Quantock Fringe LLCA	Medium	Change in landscape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Central Quantocks LLCA	High	Change in landscape character	Adverse, medium-term	Very low	Minor	None proposed	Very low	Minor
Quantock Hills LLCA	High	Change in landscape character	Adverse, medium-term	Very low	Minor	None proposed	Very low	Minor
Central West Somerset LLCA	Medium	Change in landscape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Lowland Hills LLCA	Medium	Change in landscape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Levels and Moors LLCA	High	Change in landscape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Limestone Ridges and Combes LLCA	High	Change in landscape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Mendips LLCA	High	Change in landscape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Blue Anchor to St Audries LSCA	High	Change in seascape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
St Audries Bay to Hinkley Point LSCA	High	Change in seascape character	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Hinkley Point to River Parrett LSCA	Medium	Change in seascape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Burnham-on-Sea to Brean Down LSCA	Medium	Change in seascape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Brean Down LSCA	High	Change in seascape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Site Scale Landscape Character								
Wick Moor and Coast	High	Change in landscape character	Adverse, medium-term	Very low	Minor	None proposed	Very low	Minor
Wall Common and Coast	Medium	Change in landscape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Coastal - Lilstock	High	Change in landscape character	Adverse, medium-term	Medium	Major	Hedgerow management	Medium	Major

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Rolling Farmland East - Stogursey	Medium	Change in landscape character	Adverse, medium-term	Low	Minor	Hedgerow management	Low	Minor
Fairfield	High	Change in landscape character	Neutral, medium-term	Very low	Minor	Off-site woodland and hedgerow planting, hedgerow management	Very low	Minor
The Quantock Fringes - Dodington	High	Change in landscape character	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Landscape Elements and Features								
Landform	Medium	Change in landform	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Land Use / settlement	Medium	Change in land use / settlement	Adverse, medium-term	High	Major	None proposed	High	Major
Landcover / vegetation	Medium	Change in landcover / vegetation	Adverse, medium-term	Medium	Moderate	Off-site woodland and hedgerow planting, hedgerow management	Medium	Moderate
Watercourses / water bodies	Medium	Change to watercourses / water bodies	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Public Rights of Way	High	Change to PRoW	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Visual								
Principal Viewpoint 1: PRoW No. WL 23/110 west of Benhole Lane	High	Change in composition of view	Adverse, medium-term	Medium	Major	None proposed	Medium	Major
Principal Viewpoint 2: West Somerset Coast Path, PRoW No. WL 23/95	High	Change in composition of view	Adverse, medium-term	Medium	Major	None proposed	Medium	Major
Principal Viewpoint 3: West Somerset Coast Path, Lilstock, PRoW No. WL 24/10	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 4: PRoW No. WL 24/8	Medium	Change in composition of view	Adverse, medium-term	Low	Minor	Hedgerow management	Low	Minor
Principal Viewpoint 5: Higher Hill, PRoW No. 24/3	Medium	Change in composition of view	Adverse, medium-term	Low	Minor	None proposed	Low	Minor
Principal Viewpoint 6: PRoW No. WL 24/11 near the edge of the Great Plantation	Medium	Change in composition of view	Adverse, medium-term	Medium	Moderate	None proposed	Medium	Moderate
Principal Viewpoint 7: Fairfield House Driveway	High	Change in composition of view	Adverse, medium-term	Low	Moderate	Off-site hedgerow and woodland planting, hedgerow management	Low	Moderate
Principal Viewpoint 8: Knighton Farm, PRoW No. WL 23/46	High	Change in composition of view	Adverse, medium-term	Low	Moderate	Hedgerow management	Low	Moderate

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Principal Viewpoint 9: Burton	Medium	Change in composition of view	Adverse, medium-term	Medium	Moderate	Hedgerow management	Medium	Moderate
Principal Viewpoint 10: Shurton West, Local Farm near PRoW No. WL 23/48	High	Change in composition of view	Neutral, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 11: Shurton East, PRoW No. WL 23/56	High	Change in composition of view	Neutral, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 12: Local road to the south of the site (near Gunter's Grove)	Low	Change in composition of view	Adverse, medium-term	Medium	Minor	None proposed	Medium	Minor
Principal Viewpoint 13: PRoW No. WL 23/57, West of Wick	Medium	Change in composition of view	Adverse, medium-term	Medium	Moderate	None proposed	Medium	Moderate
Principal Viewpoint 14: Pixies Mound (Wick Barrow)	High	Change in composition of view	Adverse, medium-term	Medium	Major	Off-site woodland and hedgerow planting	Medium	Major
Principal Viewpoint 15: PRoW No. WL 23/61	High	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 16: Wick, PRoW No. WL 23/61	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 17: Farrington Hill Lane (Farringdon Farm)	Medium	Change in composition of view	Adverse, medium-term	Low	Minor	None proposed	Low	Minor

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Principal Viewpoint 18: Residential area at Stogursey, Burgage Road/Lime Street	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 19: Stolford, West Somerset Coast Path, PRoW No. WL 23/95	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 20: Stockland Bristol, PRoW No. BW 32/3	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 21: Quantock Hills AONB, PRoW No. WL 24/1	High	Change in composition of view	Adverse, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 22: East Quantoxhead, PRoW No. WL 8/30	High	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 23: East Quantoxhead, Court House Gardens	High	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 24: Entrance to Dodington House	High	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 25: Nether Stowey, Stogursey Lane	Medium	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Principal Viewpoint 26: Quantock Hills AONB, Beacon Hill	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 27: A39, Holford Parking Bay	High	Change in composition of view	Adverse, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 28: Quantock Hills AONB, PRoW No. WL 10/9	High	Change in composition of view	Adverse, medium-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 29: Quantock Hills AONB, Walford's Gibbet	High	Change in composition of view	Adverse, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 30: Quantock Hills AONB, PRoW No. 10/28	High	Change in composition of view	Adverse, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 31: Quantock Hills AONB, Will's Neck	High	Change in composition of view	Adverse, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 32: Quantock Hills AONB, Cothelstone Hill	High	Change in composition of view	Adverse, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 33: Quantock Hills AONB, Broomfield Hill	High	Change in composition of view	Adverse, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 34: Quantock Hills AONB, Wind Down, lay-by	High	Change in composition of view	Adverse, medium-term	Very low	Minor	None proposed	Very low	Minor

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Principal Viewpoint 35: Cannington Park, Public Footpath	High	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 36: Puriton Hill, PRoW No. BW 28/3	Medium	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 37: Burnham-on-Sea, waterfront (west of the pier)	High	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 38: Brent Knoll (monument)	Medium	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 39: Berrow Beach	Medium	Change in composition of view	Adverse, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 40: Brean Down	High	Change in composition of view	Adverse, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 41: Mendip Hills AONB, Bleadon Hill	High	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 42: Mendip Hills AONB, Crook Peak	High	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Secondary Viewpoint S1: Minehead Waterfront	High	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Secondary Viewpoint S2: Exmoor National Park, North Hill	High	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Secondary Viewpoint S3: Minehead, Paganel Road	High	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Secondary Viewpoint S4: Exmoor National Park, Conygar Tower	High	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Secondary Viewpoint S5: Exmoor National Park, Rodhuish Common	High	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor
Secondary Viewpoint S6: Welsh Coast, Barry Island Waterfront	High	Change in composition of view	Neutral, medium-term	Very low	Minor	None proposed	Very low	Minor

Table 22.81: Summary of Operational Phase Impacts Year 15

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Landscape								
Local Landscape Character								
Quantock Vale LLCA	Medium	Change in landscape character	Neutral, long-term	Low	Minor	Off-site hedgerow and woodland planting	Low	Minor
Doniford Stream and Quantock Fringe LLCA	Medium	Change in landscape character	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Central Quantocks LLCA	High	Change in landscape character	Adverse, long-term	Very low	Minor	None proposed	Very low	Minor
Quantock Hills LLCA	High	Change in landscape character	Adverse, long-term	Very low	Minor	None proposed	Very low	Minor
Central West Somerset LLCA	Medium	Change in landscape character	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Lowland Hills LLCA	Medium	Change in landscape character	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Levels and Moors LLCA	High	Change in landscape character	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Limestone Ridges and Combes LLCA	High	Change in landscape character	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Mendips LLCA	High	Change in landscape character	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Blue Anchor to St Audries LSCA	High	Change in seascape character	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
St Audries Bay to Hinkley Point LSCA	High	Change in seascape character	Adverse, long-term	Low	Moderate	None proposed	Low	Moderate
Hinkley Point to River Parrett LSCA	Medium	Change in seascape character	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Burnham-on-Sea to Brean Down LSCA	Medium	Change in seascape character	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Brean Down LSCA	High	Change in seascape character	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Site Scale Landscape Character								
Wick Moor and Coast	High	Change in landscape character	Adverse, long-term	Very low	Minor	None proposed	Very low	Minor
Wall Common and Coast	Medium	Change in landscape character	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Coastal - Lilstock	High	Change in landscape character	Neutral, long-term	Low	Moderate	Hedgerow management	Low	Moderate

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Rolling Farmland East - Stogursey	Medium	Change in landscape character	Neutral, long-term	Low	Minor	Hedgerow management	Low	Minor
Fairfield	High	Change in landscape character	Neutral, long term	Very low	Minor	Off-site woodland and hedgerow planting, hedgerow management	Very low	Minor
The Quantock Fringes - Dodington	High	Change in landscape character	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Landscape Elements and Features								
Landform	Medium	Change in landform	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Land Use / settlement	Medium	Change in land use / settlement	Adverse, long-term	High	Major	None proposed	High	Major
Landcover / vegetation	Medium	Change in landcover / vegetation	Beneficial, long-term	Medium	Moderate	Off-site hedgerow and woodland planting, hedgerow management	Medium	Moderate
Watercourses / water bodies	Medium	Change to watercourses / water bodies	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Public Rights of Way	High	Change to PRoW	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Visual								
Principal Viewpoint 1: PRoW No. WL 23/110 west of Benhole Lane	High	Change in composition of view	Adverse, long-term	Low	Moderate	None proposed	Low	Moderate

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Principal Viewpoint 2: West Somerset Coast Path, PRoW No. WL 23/95	High	Change in composition of view	Adverse, long-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 3: West Somerset Coast Path, Lilstock, PRoW No. WL 24/10	High	Change in composition of view	Adverse, long-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 4: PRoW No. WL 24/8	Medium	Change in composition of view	Adverse, long-term	Low	Minor	Hedgerow management	Low (neutral)	Minor (neutral)
Principal Viewpoint 5: Higher Hill, PRoW No. 24/3	Medium	Change in composition of view	Adverse, long-term	Low	Minor	None proposed	Low	Minor
Principal Viewpoint 6: PRoW No. WL 24/11 near the edge of the Great Plantation	Medium	Change in composition of view	Adverse, long-term	Medium	Moderate	None proposed	Medium	Moderate
Principal Viewpoint 7: Fairfield House Driveway	High	Change in composition of view	Adverse, long-term	Low	Moderate	Off-site hedgerow and woodland planting, hedgerow management	Very low	Minor
Principal Viewpoint 8: Knighton Farm, PRoW No. WL 23/46	High	Change in composition of view	Adverse, long-term	Very low	Minor	Hedgerow management	Very low	Minor
Principal Viewpoint 9: Burton	Medium	Change in composition of view	Adverse, long-term	Low	Minor	Hedgerow management	Low	Minor
Principal Viewpoint 10: Shurton West, Local Farm near PRoW No. WL 23/48	High	Change in composition of view	Neutral, long-term	Low	Moderate	None proposed	Low	Moderate

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Principal Viewpoint 11: Shurton East, PRoW No. WL 23/56	High	Change in composition of view	Neutral, long-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 12: Local road to the south of the site (near Gunter's Grove)	Low	Change in composition of view	Adverse, long-term	Medium	Minor	None proposed	Medium	Minor
Principal Viewpoint 13: PRoW No. WL 23/57, West of Wick	Medium	Change in composition of view	Adverse, long-term	Medium	Moderate	None proposed	Medium	Moderate
Principal Viewpoint 14: Pixies Mound (Wick Barrow)	High	Change in composition of view	Adverse, long-term	Low	Moderate	Off-site woodland and hedgerow planting	Low (neutral)	Moderate (neutral)
Principal Viewpoint 15: PRoW No. WL 23/61	High	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 16: Wick, PRoW No. WL 23/61	High	Change in composition of view	Adverse, long-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 17: Farrington Hill Lane (Farringdon Farm)	Medium	Change in composition of view	Adverse, long-term	Low	Minor	None proposed	Low	Minor
Principal Viewpoint 18: Residential area at Stogursey, Burgage Road/Lime Street	High	Change in composition of view	Adverse, long-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 19: Stolford, West Somerset Coast Path, PRoW No. WL 23/95	High	Change in composition of view	Adverse, long-term	Low	Moderate	None proposed	Low	Moderate

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Principal Viewpoint 20: Stockland Bristol, PRoW No. BW 32/3	High	Change in composition of view	Adverse, long-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 21: Quantock Hills AONB, PRoW No. WL 24/1	High	Change in composition of view	Adverse, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 22: East Quantoxhead, PRoW No. WL 8/30	High	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 23: East Quantoxhead, Court House Gardens	High	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 24: Entrance to Dodington House	High	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 25: Nether Stowey, Stogursey Lane	Medium	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 26: Quantock Hills AONB, Beacon Hill	High	Change in composition of view	Adverse, long-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 27: A39, Holford Parking Bay	High	Change in composition of view	Adverse, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 28: Quantock Hills AONB, PRoW No. WL 10/9	High	Change in composition of view	Adverse, long-term	Low	Moderate	None proposed	Low	Moderate
Principal Viewpoint 29: Quantock Hills AONB, Walford's Gibbet	High	Change in composition of view	Adverse, long-term	Very low	Minor	None proposed	Very low	Minor

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Principal Viewpoint 30: Quantock Hills AONB, PRoW No. 10/28	High	Change in composition of view	Adverse, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 31: Quantock Hills AONB, Will's Neck	High	Change in composition of view	Adverse, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 32: Quantock Hills AONB, Cothelstone Hill	High	Change in composition of view	Adverse, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 33: Quantock Hills AONB, Broomfield Hill	High	Change in composition of view	Adverse, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 34: Quantock Hills AONB, Wind Down, lay-by	High	Change in composition of view	Adverse, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 35: Cannington Park, Public Footpath	High	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 36: Puriton Hill, PRoW No. BW 28/3	Medium	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 37: Burnham-on-Sea, waterfront (west of the pier)	High	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 38: Brent Knoll (monument)	Medium	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 39: Berrow Beach	Medium	Change in composition of view	Adverse, long-term	Very low	Minor	None proposed	Very low	Minor

Receptor	Sensitivity	Potential Impact	Nature	Magnitude	Impact Significance	Proposed further Mitigation	Magnitude	Residual Impact Significance
Principal Viewpoint 40: Brean Down	High	Change in composition of view	Adverse, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 41: Mendip Hills AONB, Bleadon Hill	High	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Principal Viewpoint 42: Mendip Hills AONB, Crook Peak	High	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Secondary Viewpoint S1: Minehead Waterfront	High	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Secondary Viewpoint S2: Exmoor National Park, North Hill	High	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Secondary Viewpoint S3: Minehead, Paganel Road	High	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Secondary Viewpoint S4: Exmoor National Park, Conygar Tower	High	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Secondary Viewpoint S5: Exmoor National Park, Rodhuish Common	High	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor
Secondary Viewpoint S6: Welsh Coast, Barry Island Waterfront	High	Change in composition of view	Neutral, long-term	Very low	Minor	None proposed	Very low	Minor

References

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CHAPTER 23: HISTORIC ENVIRONMENT

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23. HISTORIC ENVIRONMENT

23.1 Introduction

23.1.1 This Chapter of the Environmental Statement (ES) provides an assessment of the potential impacts to the terrestrial historic environment during the construction, and operational phases of Hinkley Point C (HPC). A detailed description of the proposed development is provided in **Chapter 2** in this volume. Where required, mitigation measures are identified to prevent, reduce and where possible, off-set any potential adverse impacts that are identified to be of significance.

23.2 Scope of Assessment

23.2.1 The scope of this assessment has been determined through a formal Environmental Impact Assessment (EIA) scoping process undertaken with the Infrastructure Planning Commission (IPC). It has also been informed by ongoing consultation with statutory consultees (including Somerset County Council (SCC), English Heritage, West Somerset Council (WSC), Sedgemoor District Council (SDC)) and the local community and the general public in response to the Stage 1, Stage 2, Stage 2 Update and M5 Junction 24 and Highway Improvements consultations.

23.2.2 The assessment of the construction and operational impacts on the terrestrial historic environment arising from the proposed development has been undertaken adopting the methodologies described in Section 23.4.

23.2.3 The existing historic environment baseline conditions, against which the likely environmental impacts of the development are assessed, are described in Section 23.5 of this chapter.

23.2.4 **Figure 23.1** shows the HPC Development Site boundary and a 500m study area on all sides of the site. For the purposes of this assessment, the HPC Development Site has been sub-divided into the Built Development Area West (BDAW), the Built Development Area East (BDAE) and the Southern Construction Phase Area (SCPA).

23.2.5 Where it has been considered that the setting of a heritage asset within a wider study area extending up to 10km from the HPC Development Site may be impacted upon, this has also been included in this assessment. In consultation with English Heritage, it was agreed that only certain designated heritage assets (Scheduled Monuments, Grade I, Grade II* Listed Buildings, Conservation Areas and Registered Parks and Gardens) needed to be identified within the zone of theoretical visibility (ZTV) up to 10km from the HPC Development Site. Grade II Listed Buildings were identified within the ZTV up to 5km from the HPC Development Site.

23.2.6 Eleven off-site highway improvement schemes will be included in the HPC Project DCO application. They are presented in the project description in **Volume 2, Chapter 2** of this ES. The schemes concern land that is presently within the highway, on highway land, such as verges, limited areas of hard surfacing and urban greenspace. Only two schemes, Washford Cross and Sandford Hill, have the potential to affect the historic environment. The remaining nine are scoped out of the baseline and hence are not assessed further in this chapter.

23.2.7 Section 23.6 assesses the potential construction and operational impacts on the historic environment. Appropriate mitigation measures to prevent, reduce or off-set any potential adverse impacts that are identified to be of significance are identified in Section 23.7. The assessment of residual impacts following implementation of the mitigation measures is presented in Section 23.8.

23.2.8 The assessment of cumulative impacts to the historic environment arising from the activities within and adjacent to the HPC Development Site are considered in this chapter.

23.2.9 The objectives of this assessment were to:

- identify all known heritage assets within the HPC Development Site and within 500m of the HPC Development Site boundary that may be affected by the proposed development;
- identify designated heritage assets within 10km of the HPC Development Site boundary that have the potential to be affected by the proposed development;
- identify all known heritage assets within, and in the vicinity of, the Washford Cross and Sandford Hill highway improvements site boundaries that may be affected by the proposed works;
- assess the likely extent of previous impacts on the historic environment resource;
- assess the potential for buried archaeological remains to be present and their likely level of preservation;
- assess the potential impact of the proposed development on the historic environment resource;
- recommend mitigation strategies aimed at preventing, reducing or off-setting any significant adverse impacts in respect of the proposed development, if necessary; and
- determine residual impacts where appropriate.

23.3 Legislation, Policy and Guidance

23.3.1 This section identifies and describes legislation, policy and guidance of relevance to the assessment of potential impacts to the historic environment associated with the construction and operational phases of the proposed development.

23.3.2 As stated in **Volume 1, Chapter 4,** the overarching National Policy Statement (NPS) for Energy (NPS EN-1) when combined with the NPS for Nuclear Power Generation (NPS EN-6) provides the primary basis for decisions by the IPC on applications for nuclear power generation developments that fall within the scope of the NPSs.

23.3.3 Notwithstanding this, the IPC may consider other matters that are both important and relevant to its decision-making. This could include Planning Policy Statements (PPSs), Planning Policy Guidance Notes (PPGs), regional and local policy documents, although, if there is a conflict between these and the NPS, the NPS prevails for the purposes of IPC decision making.

23.3.4 Further, the Planning Act 2008 provides that the IPC must, in making its decision on an application, have regard to any Local Impact Report (LIR) prepared by relevant local authorities. It is anticipated that the LIRs will rely in part on PPSs, PPGs, regional and local policy to provide a context for their assessment. On this basis, regard has been given to these documents (where relevant to the technical assessment) since they are likely to inform the LIRs prepared by the relevant local authorities.

a) International Legislation

23.3.5 The scope of assessment is not affected by European or other international legislation.

b) National Legislation

i. Ancient Monuments and Archaeological Areas Act 1979 (Ref. 23.1)

23.3.6 Under the terms of this act (Ref. 23.1) an archaeological site or historic building of national importance can be designated as a Scheduled Monument and is registered with the Department of Culture, Media and Sport (DCMS).

23.3.7 Any development that might affect either the Scheduled Monument or its setting is subject to the granting of Scheduled Monument Consent. English Heritage advises the government on individual cases for consent and offers advice on the management of Scheduled Monuments.

ii. Planning (Listed Buildings and Conservation Areas) Act 1990

23.3.8 The Planning (Listed Buildings and Conservation Areas) Act 1990 (Ref. 23.2) covers the registration of Listed Buildings (that is those buildings that are seen to be of special architectural or historical interest) and designation of Conservation Areas (areas of special architectural or historic interest, the character or appearance of which it is desirable to preserve or enhance).

23.3.9 A Listed Building may not be demolished or altered or extended in any manner which would affect its character as a building of special architectural or historic interest without listed building consent being granted. There are three grades of listing (in descending order):

- Grade I: buildings of exceptional interest.
- Grade II*: particularly important buildings of more than special interest.
- Grade II: buildings of special interest warranting every effort to preserve them.

iii. Hedgerows Regulations 1997

23.3.10 Important hedgerows (referred to as historic hedgerows in this chapter), as defined by the Hedgerows Regulations 1997 (Ref. 23.3), enjoy statutory protection. A hedgerow is ‘important’ if it or the hedgerow of which it is a part:

> *“(a) has existed for 30 years or more; and*
>
> *(b) satisfies at least one of the criteria listed in Part II of Schedule 1.”*

23.3.11 The archaeological and historical criteria listed in Part II of Schedule 1 are:

"1. The hedgerow marks the boundary, or part of the boundary, of at least one historic parish or township; and for this purpose "historic" means existing before 1850.

2. The hedgerow incorporates an archaeological feature which is: (a) included in the schedule of monuments compiled by the Secretary of State under section 1 (schedule of monuments) of the Ancient Monuments and Archaeological Areas Act 1979; or (b) recorded at the relevant date in a Sites and Monuments Record.

3. The hedgerow: (a) is situated wholly or partly within an archaeological site included or recorded as mentioned in paragraph 2 or on land adjacent to and associated with such a site; and (b) is associated with any monument or feature on that site.

4. The hedgerow: (a) marks the boundary of a pre-1600 AD estate or manor recorded at the relevant date in a Sites and Monuments Record or in a document held at that date at a Record Office; or (b) is visibly related to any building or other feature of such an estate or manor.

5. The hedgerow: (a) is recorded in a document held at the relevant date at a Record Office as an integral part of a field system pre-dating the Inclosure Acts; or (b) is part of, or visibly related to, any building or other feature associated with such a system, and that system (i) is substantially complete; or (ii) is of a pattern which is recorded in a document prepared before the relevant date by a local planning authority, within the meaning of the 1990 Act, for the purposes of development control within the authority's area, as a key landscape characteristic."

c) National Guidance

i. English Heritage Register of Parks and Gardens in England

23.3.12 The Register of Parks and Gardens of Special Historic Interest in England is maintained by English Heritage and divides the sites into three grade bands similar to those used for Listed Buildings.

ii. English Heritage Register of Historic Battlefields in England

23.3.13 The English Heritage Register of Historic Battlefields in England presently identifies 43 important English battlefields. Its purpose is to offer them protection and to promote a better understanding of their significance, but it does not offer any statutory protection.

iii. Ancient Woodlands

23.3.14 Ancient woodlands consist of land that has been continuously wooded since AD 1600. Areas of ancient woodland can be protected as nationally important Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SAC) or as Wildlife Sites recognised at a local level.

23.3.15 Ancient woodland is not a statutory designation and does not give the wood legal protection. However, increasingly, national, regional and local planning policies mention protection of ancient woodland in planning documents. The Woodland Trust (the UK's leading woodland conservation charity) acts wherever possible to secure protection of ancient woodland.

iv. Tax-exempt Heritage Assets

23.3.16 This scheme aims to encourage private owners of land of scenic, scientific or historic value or buildings of outstanding historic or architectural interest to retain and care for our heritage by excluding them from inheritance tax and or capital gains tax provided that the owner, in the case of land, maintains and preserves its character and, in the case of historic buildings, their amenity land and their historically associated contents, maintains, repairs and preserves them and keeps the contents at the building with which they are associated, as well as securing reasonable access to the public. The owner of each asset must make a undertaking setting out the specific steps agreed with Her Majesty's Revenue and Customs (HMRC) to fulfil these obligations.

d) National Planning Policy

i. Planning Policy Statement 1: Delivering Sustainable Development (PPS1) (January 2005) (Ref. 23.4)

23.3.17 PPS1 sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system.

23.3.18 Paragraph 5 states that planning should facilitate and promote sustainable and inclusive patterns of urban and rural development by, amongst other things: protecting and enhancing the natural and historic environment, the quality and character of the countryside, and existing communities.

ii. Planning Policy Statement 5: Planning for the Historic Environment (PPS5) (March 2010) (Ref. 23.5)

23.3.19 PPS5 sets out planning policies on the conservation of the historic environment. It states that planning has a central role to play in conserving our heritage assets and utilising the historic environment in creating sustainable places. The policies contained within PPS5 will enable the Government's vision for the historic environment to be implemented through the planning system (page 2).

23.3.20 PPS5 introduces the concept of a "heritage asset", which is defined as those parts of the historic environment that have significance because of their historic, archaeological, architectural or artistic interest (page 5). Heritage assets include designated heritage assets (World Heritage Sites, Scheduled Monuments, Listed Buildings, Protected Wreck Sites, Registered Parks and Gardens, Registered Battlefields and Conservation Areas) and assets identified by the local planning authority during the process of decision-making or through the plan-making process (including local listing) (page 13).

23.3.21 Policy HE1.3 states that, where conflict between climate change objectives and the conservation of heritage assets is unavoidable, the public benefit of mitigating the effects of climate change should be weighed against any harm to the significance of heritage assets in accordance with the development management principles in this PPS and national planning policy on climate change.

23.3.22 Policy HE6.1 states that local planning authorities should require an applicant to provide a description of the significance of the heritage assets affected and the contribution of their setting to that significance. The level of detail should be proportionate to the importance of the heritage asset and no more than is sufficient to understand the potential impact of the proposal on the significance of the heritage asset. Policy HE6.2 states that this information, together with an assessment of the impact of the proposal, should be set out in the application as part of the explanation of the design concept. Policy HE6.3 states that local planning authorities should not validate applications where the extent of the impact of the proposal on the significance of any heritage assets affected cannot adequately be understood from the application and supporting documents.

23.3.23 Policy HE7.2 states that, in considering the impact of a proposal on any heritage asset, local planning authorities should take into account the particular nature of the significance of the heritage asset and the value that it holds for this and future generations.

23.3.24 Policy HE7.7 states that, where loss of significance is justified on the merits of new development, local planning authorities should not permit the new development without taking all reasonable steps to ensure the new development will proceed after the loss has occurred by imposing appropriate planning conditions or securing obligations by agreement.

23.3.25 Policy HE8.1 considers non-designated heritage assets and states that the effect of an application on the significance of such a heritage asset or its setting is a material consideration in determining the application.

23.3.26 Policy HE9.1 states that there should be a presumption in favour of the conservation of designated heritage assets and the more significant the designated heritage asset, the greater the presumption in favour of its conservation should be. Significance can be harmed or lost through alteration or destruction of the heritage asset or development within its setting. Loss affecting any designated heritage asset should require clear and convincing justification.

23.3.27 Policy HE9.4 states that, where a proposal has a harmful impact on the significance of a designated heritage asset which is less than substantial harm, in all cases local planning authorities should:

> *"(i) weigh the public benefit of the proposal (for example, that it helps to secure the optimum viable use of the heritage asset in the interests of its long-term conservation) against the harm; and*
>
> *(ii) recognise that the greater the harm to the significance of the heritage asset the greater the justification will be needed for any loss."*

23.3.28 Policy HE9.6 states that there are many heritage assets with archaeological interest that are not currently designated as Scheduled Monuments, but which are demonstrably of equivalent significance. The absence of designation for such heritage assets does not indicate lower significance and they should be considered subject to the policies in HE9.1 to HE9.4 and HE10.

23.3.29 Policy HE10.1 states that, when considering applications for development that affect the setting of a heritage asset, local planning authorities should treat favourably applications that preserve those elements of the setting that make a positive contribution to or better reveal the significance of the asset. When considering applications that do not do this, local planning authorities should weigh any such harm against the wider benefits of the application. The greater the negative impact on the significance of the heritage asset, the greater the benefits that will be needed to justify approval.

23.3.30 Policy HE12.3 states that, where the loss of the whole or a material part of a heritage asset's significance is justified, local planning authorities should require the developer to record and advance understanding of the significance of the heritage asset before it is lost, using planning conditions or obligations as appropriate. The extent of the requirement should be proportionate to the nature and level of the asset's significance. Developers should publish this evidence and deposit copies of the reports with the relevant historic environment record.

e) Regional Planning Policy

23.3.31 The Government's revocation of regional strategies was quashed in the High Court on 10 November 2010. However, on that same date the Government reiterated in a letter to Chief Planners its intention to revoke regional strategies through the Localism Bill. This letter was also challenged but, on 7 February 2011, the High Court held that the Government's advice to local authorities that the proposed revocation of regional strategies was to be regarded as a material consideration in their planning development control decisions should stand. The decision of the High Court was upheld by the Court of Appeal on 27 May 2011. Therefore, the regional strategies remain in place but in the case of development control decisions it is for planning decision makers to decide on the weight to attach to the strategies. **Volume 1, Chapter 4** of this ES provides a full summary of the position regarding the status of regional planning policy.

i. Regional Planning Guidance 10 for the South West 2001-2016 (RPG10) (2001) (Ref. 23.6)

23.3.32 RPG 10 sets out the broad development strategy for the period to 2016 and beyond. Policy EN 3 (The Historic Environment) seeks the protection of historic and archaeological areas, sites and monuments of international, national and regional importance. This policy also advises that new development should preserve or enhance historic buildings and conservation areas and important archaeological features and their settings.

ii. The Draft Revised Regional Spatial Strategy (RSS) for the South West Incorporating the Secretary of States Proposed Changes 2008-2026 (July 2008) (Ref. 23.7)

23.3.33 The draft Revised Regional Spatial Strategy (RSS) looks forward to 2026 and sets out policies in relation to the development of land within the region.

23.3.34 Policy SD3 (The Environment and Natural Resources) seeks to protect and enhance the region's environment and natural resources by, amongst other things, positive planning and design to set development within, and to enhance, local character (including setting development within the landscape of the historic environment), and bringing historic buildings back into viable economic use and supporting regeneration.

23.3.35 Policy ENV1 (Protecting and Enhancing the Region's Natural and Historic Environment) states that, where development and changes in land use are planned which would affect the natural and historic environment, local authorities will first seek to avoid loss of or damage to the assets, then mitigate any unavoidable damage, and compensate for loss or damage through offsetting actions.

23.3.36 Policy ENV5 (Historic Environment) states that the historic environment of the South West will be preserved and enhanced.

iii. Somerset and Exmoor National Park Joint Structure Plan Review 1991-2011 (2000) (Policies 'saved' from 27 September 2007) (Ref. 23.8)

23.3.37 The Somerset and Exmoor National Park Joint Structure Plan was adopted in 2000 with relevant policies saved from 27 September 2007. All policies have been saved with the exception of Policy 53 which is unrelated to historic environment impacts. The Plan provides a strategic base for all land use planning within the plan area for the period up to 2011.

23.3.38 Policy 9 (The Built Historic Environment) states that the setting, local distinctiveness and variety of buildings and structures of architectural or historic interest should be maintained and where possible enhanced. The character or appearance of Conservation Areas should be preserved or enhanced.

23.3.39 Policy 10 (Historic Landscapes) states that development proposals should take account of their impact on historic landscape character areas and registered historic landscapes (historic parks, gardens and battlefields).

23.3.40 Policy 11 (Areas of High Archaeological Potential) states that development proposals should take account of identified Areas of High Archaeological Potential or, elsewhere where there is reason to believe that important remains exist, so that appropriate assessment and necessary protection can be afforded to any archaeological remains identified.

23.3.41 Policy 12 (Nationally Important Archaeological Remains) states that there should be a presumption in favour of the physical preservation in-situ of nationally important archaeological remains. The setting and amenity value of the archaeological remains should also be protected.

23.3.42 Policy 13 (Locally Important Archaeological Remains) states that development proposals which affect locally important archaeological remains should take account of the relative importance of the remains. If the preservation in-situ of the archaeological remains cannot be justified, arrangements should be sought to record those parts of the site that would be destroyed or altered.

f) Local Planning Policy

i. West Somerset Local Plan (2006) (Policies 'saved' from 17 April 2009) (Ref. 23.9)

23.3.43 The West Somerset Local Plan forms part of the Development Plan for West Somerset. The Local Plan was adopted in April 2006 (with relevant policies 'saved' from 17 April 2009). The Proposals Map indicates that the HPC Development Site itself is not subject to any specific historic environment designations. A Scheduled Monument, Wick Barrow (Pixies Mound) lies just outside of the eastern boundary of site.

23.3.44 The HPC Development Site is outside of the Development Boundary defined in the Local Plan.

23.3.45 The following saved policies are potentially relevant to the historic environment:

- Policy AH/2 (Locally Important Archaeological Remains) states that development which is likely to damage archaeological remains of local importance will only be permitted where the importance of the development outweighs the intrinsic importance of the remains.
- Policy AH/3 (Areas of High Archaeological Potential) states that within areas of high archaeological potential, planning permission will not be granted unless an evaluation has been carried out to determine whether archaeological remains of local or national value exist on the site.

ii. West Somerset Local Development Framework (LDF) Core Strategy (Options Paper) (January 2010) (Ref. 23.10)

23.3.46 The Core Strategy is at a preliminary stage of preparation and the Options Paper does not include any specific policies relating to historic environment impacts. The paper does however identify the types of policy that the Council considers could be included in the Core Strategy. In relation to historic environment impacts this includes policies which recognise the historic character of settlements where development will be focused, and which will ensure that new development contributes positively to that character.

iii. Supplementary Planning Guidance

23.3.47 Sedgemoor District Council and West Somerset Council have jointly prepared draft supplementary planning guidance in relation to the HPC Project. Box 19 in the draft HPC SPD sets out the approach to masterplanning and design of the HPC Development Site, and sets out a number of requirements that the County Council and District Councils will expect of the HPC project promoter.

23.3.48 In relation to the historic environment at the HPC Development Site, Box 19 states that the HPC Promoter will be expected to:

> *"…minimise the individual and cumulative visual impacts on the landscape and setting of designated areas, buildings and monuments, including Exmoor National Park, AONBs, Conservation Areas, Outstanding Heritage Settlements, Listed Buildings and Scheduled Ancient Monuments and where it has been demonstrated by the HPC project promoter that the*

impacts are unavoidable provide appropriate levels of mitigation and compensation (p.36)".

23.3.49 Further planning policy context is provided in the Legislative Planning Policy Context chapter (**Volume 1, Chapter 4**) and the Introduction chapter (**Volume 2, Chapter 1**).

23.4 Methodology

23.4.1 The baseline assessment and all supporting surveys have been undertaken in accordance with the published guidelines set out by the Institute for Archaeologists' (IfA) Standards and Guidance for Archaeological Desk-Based Assessment (Ref. 23.11) and Archaeological Field Evaluation (Ref. 23.12).

23.4.2 There is, as yet, no standard or guidance published by the IfA or English Heritage specifically relating to EIA for the historic environment. In the absence of this, use has been made (as appropriate) of guidance on assessing the effects of roads schemes on heritage, given in the Design Manual for Roads and Bridges (DMRB), **Volume 11**: Environmental Assessment, Section 3, Part 2, Cultural Heritage (Ref. 23.13).

23.4.3 The generic descriptions used to define the level of significance and the likelihood of occurrence are those given in **Volume 1, Chapter 7** of this ES. This provides a matrix comparing the magnitude of an impact with the value and sensitivity (importance) of the receptor, to determine the level of significance of predicted impacts.

a) Study Area

23.4.4 The geographical extent of the study area comprises:

- the proposed HPC Development Site and a 500m area around the HPC Development Site for which undesignated and designated assets have been considered (shown in **Figure 23.1** and listed in **Appendix 23A**);
- a 10km area around the HPC Development Site for which designated assets within the ZTV have been considered (5km for Grade II) (shown in **Figure 23.2 and Figure 23.3** and listed in **Appendix 23B**); and
- the Washford Cross road junction on the A39 to the west of Williton (shown in **Figure 23.9** and listed in **Appendix 23C**) and the Sandford Hill road junction on the A39 to the west of Wembdon (shown in **Figure 23.9** and listed in **Appendix 23C**) for which undesignated and designated assets have been considered.

b) Baseline Assessment

23.4.5 Heritage assets were initially identified through:

- a search of the records held at the National Monuments Record (NMR) and the Somerset Historic Environment Record (HER), both initially conducted in August 2008 and updated;
- analysis of the Historic Landscape Characterisation (HLC) data conducted in August 2008;

- a search of historical maps and documentation at the Somerset Record Office conducted in October and November 2008;
- an examination of other data sources including the National Mapping Programme, Portable Antiquities Scheme and the South West Archaeological Research Framework (SWARF) (Ref. 23.14) from August 2008 onwards; and
- consultation with Somerset County Council Historic Environment Service (SCC HES) and English Heritage.

23.4.6 On the HPC Development Site, non-intrusive site investigations were also carried out in order to identify previously unrecorded or undiscovered heritage assets (e.g. historic landscape features, buried archaeological remains). These surveys included:

- field reconnaissance survey (FRS) (Ref. 23.15) conducted in September 2008;
- assessment of the extant historic buildings on the Built Development Area West (Ref. 23.16) conducted in November 2008; and
- geophysical survey (Ref. 23.17 and Ref. 23.18) of Built Development Area West and the Southern Construction Area conducted October 2008 to May 2009.

23.4.7 These were followed by a programme of trial trenching carried out in the Built Development Area West and the Southern Construction Phase Area between November 2009 and April 2010 in order to characterise potential archaeological features identified by the non-intrusive site investigations (Ref. 23.19).

23.4.8 Following geophysical survey of selected test areas on Built Development Area East (which demonstrated that the area had been subject to previous disturbance which would have removed any remains of archaeological interest (Ref. 23.18)), it was agreed with SCC HES that no further archaeological investigation was warranted in this area.

23.4.9 The programme of trial trenching was designed in consultation with SCC HES. All work was carried out in accordance with the IfA's Standards and Guidance for Archaeological Field Evaluation (Ref. 23.12) and a Written Scheme of Investigation (WSI) for archaeological investigation (Ref. 23.20).

23.4.10 The aims of the archaeological trial trenching, defined in the WSI, were to:

- undertake trial trenching on areas of suspected archaeological remains identified by the geophysical survey;
- investigate and record all features of possible archaeological origin uncovered within the trial trenches;
- determine (where possible) the nature, depth, extent, character and date of any archaeological deposits or features;
- determine the likely range, quality and quantity of artefact and environmental evidence present; and
- inform the design of appropriate archaeological mitigation.

23.4.11 In addition to the above baseline surveys, various archaeological watching briefs were undertaken during geotechnical site investigations across the HPC

Development Site. The scope of the watching briefs was agreed with SCC HES and carried out in accordance with a WSI (Ref. 23.21).

23.4.12 The aims of the archaeological watching briefs were to:

- monitor mechanical excavation of topsoil and subsoil layers that could contain archaeological deposits; and
- identify and record any archaeological features, deposits, artefacts or other material uncovered during the proposed works.

23.4.13 The full list of identified archaeological and historical sites, features and finds identified within the 500m study area is presented in the gazetteer in **Appendix 23A**.

23.4.14 The locations of heritage assets identified within the HPC Development Site are shown on **Figure 23.4** and detailed in **Table 23.4** and **Table 23.5**.

23.4.15 The locations of designated sites within the wider 10km study area, whose settings may be impacted by the proposed development, are shown on **Figure 23.2** and **Figure 23.3** and are listed in the designated heritage assets gazetteer in **Appendix 23B**.

23.4.16 Designated sites beyond the HPC Development Site boundary were assessed through a combination of desk-based research and site visits. The results of this assessment are presented in a Setting Baseline report (Ref. 23.22).

23.4.17 Heritage assets within and in the vicinity of the Sandford Hill and Washford Cross highway improvements sites were also assessed through a combination of desk-based research and site visits, The areas of landtake for the proposed highway improvements are relatively small, and these areas, adjacent to the existing highway, are likely to have been subject to previous impacts associated with highways construction. The potential for buried archaeological remains to be encountered within the proposed areas of landtake for highway improvements is very, low and therefore it was agreed with SCC HES that further surveys were not required.

c) Consultation

23.4.18 Consultation has been undertaken throughout the EIA process and further information may be found in the **Consultation Report**.

23.4.19 Meetings were held with SCC HES to discuss all stages of the assessment, including the strategy for the archaeological surveys reported herein, and to determine appropriate mitigation.

23.4.20 In 2008, a site walkover was held with the County Archaeologist, the Development Control Archaeologist and the Senior Conservation Officer from SCC HES to discuss the strategy for mitigating impacts on the historic buildings and historic landscape features within the Built Development Area West.

23.4.21 It was agreed that the undesignated historic buildings (barns) within this area should be the subject of a historic buildings assessment, to be carried out by a recognised historic buildings specialist. The results and conclusions are summarised in the Historic Buildings section below (Ref. 23.16).

23.4.22 It was agreed with SCC HES in September 2008 that surviving historic landscape features, and in particular a historic track way occupying a prominent east/west ridge across the centre of the HPC Development Site (known as 'Green Lane'), should be considered to be important features. As a reflection of its longevity, physical survival and the contribution it makes to the historic landscape character of the HPC Development Site, it was considered that Green Lane should be assigned equal, or higher, value than archaeological remains and historic buildings within the assessment.

23.4.23 Meetings were held with English Heritage throughout the EIA process to discuss and agree the scope of the assessment, identify potential impacts on designated sites within the study area and inform the mitigation proposals (including landscaping). Site visits, both to the HPC Development Site and to certain designated assets within the wider study area (including the Fairfield Estate, East Quantoxhead Estate, Dodington Hall, Kilve Chantry and Orchard Wyndham Estate) were also undertaken.

23.4.24 It was agreed with English Heritage at a meeting in March 2010 that a **Monument Management Plan (MMP)** for the Scheduled Monument Wick Barrow should be put in place in order to mitigate any impact to the setting of the monument. Meetings were held with English Heritage and SCC HES on and off-site to discuss and agree the proposals. The MMP will be drafted to address the requirements of the relevant stakeholders.

23.4.25 A Historic Landscape Assessment of the Fairfield Estate (**D18, D19**) was requested by English Heritage in order to inform off-site planting proposed as mitigation (Ref. 23.23). Site visits to discuss this assessment with English Heritage were also undertaken.

d) Assessment Methodology

23.4.26 **Volume 1, Chapter 7** of this ES describes the assessment methodology for this EIA. In addition the following specific methodology was applied for the historic environment in the determination of receptor importance (value) (see **Table 23.1**) and of impact magnitude (see **Table 23.2**).

i. Value and Sensitivity

23.4.27 All of the heritage assets that may be impacted by the development have been assigned a level of importance (value) in accordance with those definitions set out in **Volume 1 Chapter 7** and with the historic environment definitions given in **Table 23.1.**

23.4.28 Assessment of the importance, or value, of heritage assets is based upon existing designations, the potential to contribute to the aims of SWARF (Ref. 23.14) and the criteria described in **Table 23.1**, which are based on the DMRB (Ref. 23.13).

23.4.29 As there are no internationally important sites within the study area (e.g. World Heritage sites), the DMRB category of "Very High Importance" has not been applied.

23.4.30 PPS 5 uses the phrase "*significance of a heritage asset*" to mean "*the value of a heritage asset*" (Ref. 23.5).

23.4.31 Sensitivity, with regard to the historic environment, is a subjective term which describes the potential for a heritage asset to absorb change. It reflects the current setting of an asset and the extent to which changes to that setting would affect the significance of the asset. The importance of a Scheduled Monument, for example, is always high (as shown in **Table 23.1**), regardless of its setting. The sensitivity of a Scheduled Monument in a developed or semi-urban environment would usually be lower than the sensitivity of a similar monument in a remote, or unspoilt, setting. Consequently, sensitivity has been taken into account in the assessment of impacts on setting.

23.4.32 Setting is defined in PPS 5 (Ref. 23.5) as:

23.4.33 *"the surroundings in which an asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or negative contribution to the significance of an asset, may affect the ability to appreciate that significance or may be neutral."*

23.4.34 In terms of considerations which may affect setting, Paragraph 114 of the PPS 5 Practice Guide (Ref. 23. 5) states that:

23.4.35 *"The extent and importance of setting is often expressed by reference to visual considerations. Although views of or from an asset would play an important part, the way in which we experience an asset in its setting is also influenced by other environmental factors such as noise, dust and vibration; by spatial associations; and, by our understanding of the historic relationship between places."*

Table 23.1: Criteria Used to Determine Importance (Value)

Importance	Description
High	Ancient monuments scheduled under the Ancient Monuments and Archaeological Areas Act 1979, or archaeological sites and remains of comparable quality, assessed with reference to the Secretary of State's non-statutory criteria, as set out in DCMS Guidance on Scheduled Monuments, Annex 1 (Ref. 23.1). Historic buildings that can be shown to have exceptional qualities in their fabric or historical association (for example Grade I or II* Listed Buildings). Well preserved historic landscapes preserving visible elements from medieval or earlier patterns.
Medium	Archaeological sites and remains which, while not of national importance, fulfil several of the Secretary of State's criteria and are important remains in their regional context. Historic buildings that can be shown to have important qualities in their fabric or historical association (for example many Grade II Listed Buildings). Averagely well-preserved historic landscapes.
Low	Archaeological sites and remains that are of low potential or minor importance. Historic buildings of modest quality in their fabric or historical association. Historic landscapes with specific and substantial importance to local interest groups, but with limited wider importance.
Very Low	Buildings of no architectural or historical merit. Areas in which investigative techniques have produced negative or minimal evidence for archaeological remains, or where previous large-scale disturbance or removal of deposits can be demonstrated. Almost wholly modern landscapes created through the removal of historic boundaries.

ii. Magnitude of Impacts

23.4.36 The magnitude of impacts has been based on the consequence that the proposed development would have on the historic environment resource and has been considered in terms of high, medium, low and very low (see **Table 23.2**, adapted from DMRB (Ref. 23.13)).

23.4.37 Potential impacts have also been considered in terms of permanent or temporary, adverse (negative) or beneficial (positive) and cumulative.

Table 23.2: Guidelines for the Assessment of Magnitude

Magnitude	Impact
High	Complete removal of an archaeological site. Severe transformation of the setting or context of a designated heritage asset or significant loss of key components in a monument group.
Medium	Removal of a major part of an archaeological site's area and loss of research potential. Partial transformation of the setting or context of a designated heritage asset or partial loss of key components in a monument group. Introduction of significant noise or vibration levels to a designated site, increased traffic, and/or reduction in air quality leading to changes to amenity use, economic viability, accessibility or appreciation of an archaeological site. Diminished capacity for understanding or appreciation (context) of a designated heritage asset site.
Low	Removal of an archaeological site where a minor part of its total area is removed, but that the site retains a significant future research potential. Minor change to the setting of a designated heritage asset.
Very Low	No significant physical impact or change. No significant change in setting or context. No impact from changes in use, amenity or access.

iii. Significance of Impacts

23.4.38 The significance of the impact is judged on the relationship of the magnitude of impact to the assessed sensitivity and/or importance of the resource. The predicted significance of the impacts, without mitigation, is outlined in **Volume 1, Chapter 7.**

23.4.39 For the purpose of this assessment, mitigation measures have been proposed where there is an impact of greater than minor adverse significance and are appropriate given their magnitude, spatial scope and temporal nature.

e) Cumulative Impacts

23.4.40 **Volume 1, Chapter 7** of this ES sets out the methodology used to assess cumulative impacts. Additive and interactive effects between site-specific impacts are considered within this chapter. The assessment of cumulative impacts with other elements of the HPC Project and other proposed and reasonably foreseeable projects are considered in **Volume 11** of this ES.

f) Limitations, Assumptions and Uncertainties

23.4.41 Due to the presence of made ground within Built Development Area East, this area was not investigated by trial excavation. However, historic map evidence, aerial photographs and geophysical survey suggest that there is little, if any, potential for archaeological remains to survive on this part of the HPC Development Site.

23.4.42 Physical and ecological constraints posed by the trees and scrub that form the woodland plantations across Built Development Area West and the Southern Construction Phase Area and the presence of badgers within these areas prevented access for geophysical survey and trial trenching. As such, it has not been possible to determine whether archaeological remains recorded on the Built Development Area West extend into these wooded areas. It is assumed that any archaeological remains within the wooded areas would have been damaged when the trees were planted. Subsequent root action would also have disturbed any archaeological deposits, if present.

23.5 Baseline Environmental Characteristics

a) Introduction

23.5.1 This section presents the historic environment baseline for the HPC Development Site and study area. The information set out in this section is drawn from the Heritage Gazetteers presented in **Appendix 23A, Appendix 23B** and **Appendix 23C**, and the results of the archaeological trial trenching (Ref. 23.19).

23.5.2 Heritage assets have been assigned a unique identification number. These are referred to in the text in **bold**. The prefix **D** denotes an asset in the wider 10km study area and the prefix **H** denotes a heritage asset associated with the highway improvements at Washford Cross and Sandford Hill. The periods and dates used largely follow the terminology included in the Department for Transport's (DfT's) Transport Assessment Guidance (WebTag) Unit 3.3.9 The Heritage of Historic Resources (Ref. 23.24).

b) Study Area Description

23.5.3 The HPC Development Site and 500m study area are located in Stogursey Parish in West Somerset District in the County of Somerset.

23.5.4 The HPC Development Site is bounded to the north by Bridgwater Bay, from which it is separated by a low cliff. The village of Shurton is located to the south of the HPC Development Site. The land immediately to the east of the HPC Development Site is occupied by two existing power stations, Hinkley Point A and Hinkley Point B (known collectively as the Hinkley Point Power Station Complex). Land to the south of this complex forms part of the Bridgwater Bay Site of Special Scientific Interest (SSSI), and an area of flat, open, improved grassland. Land to the west of the HPC Development Site is farmland.

23.5.5 Generally from the village at Shurton, to the south of the HPC Development Site, the ground level climbs gently towards the coast from around 13m Above Ordnance Datum (AOD) up to a east-west ridge at a level of between 29m and 20m AOD. The ground then falls gently towards Holford Stream to the north which lies between 5m and 7m AOD, before climbing steeply to Green Lane running west to east at a maximum elevation of around 35m AOD. This feature generally forms the boundary between the Built Development Areas West and East and the Southern Construction Phase Area.

23.5.6 The ground then falls through several east-west trending undulations from Green Lane towards the coastal cliffs, which are at an elevation of around 15m AOD. The exception to this is the presence of a large spoil mound feature which is located towards the centre of the Built Development Area East. The mound has two main peaks at 24.5m AOD and 21.7m AOD with the area between forming a 'saddle' of land which is elevated relative to the surrounding area.

23.5.7 The general character is rural with the majority of the irregular fields given over to arable farming with some meadow used to graze cattle and a small amount of woodland.

23.5.8 A description of the geology of the HPC Development Site is presented in **Volume 2, Chapter 14**.

23.5.9 Detail on the wider 10km study area is provided in the "Historic Landscape" and "Settings of Designated Heritage Assets" sections below.

23.5.10 The highway improvements study areas are described in the "Washford Cross Highway Improvements" and "Sandford Hill Highway Improvements" sections, below.

c) Statutory Constraints

23.5.11 Within the HPC Development Site there are no Scheduled Monuments, Listed Buildings, Conservation Areas, Registered Parks and Gardens, Registered Battlefields or ancient woodlands.

23.5.12 There are a number of hedgerows that meet the archaeological and historical criteria of 'important' hedgerows as defined in the Hedgerow Regulations 1997 (**Figure 23.5**).

23.5.13 These hedgerows have existed for 30 years or more (Hedgerow Regulations 1997, criterion a) and are recorded in a document held at the County Record Office as an integral part of a field system pre-dating the Inclosure Acts, namely the 1614 Norton maps (Hedgerow Regulations 1997, criterion b).

23.5.14 Immediately outside of the HPC Development Site to the east there is one Scheduled Monument, Wick Barrow (**2**), also known as Pixies Mound (**Plate 23.1**). Wick Barrow dates from the Neolithic and Bronze Age periods and was partially excavated in 1907 (**Table 23.3**).

23.5.15 There are 37 Scheduled Monuments located within 10km of the HPC Development Site that fall within the Zone of Theoretical Visibility (ZTV, described in **Chapter 22** of this volume). These include Wick Barrow, immediately to the east of the HPC Development Site, Stogursey Castle and Stowey Castle (**Appendix 23B**).

Plate 23.1: Wick Barrow Scheduled Monument from the East

23.5.16 Within the 500m study area there are eight Listed Buildings, situated to the south of the HPC Development Site in the nearby village of Shurton. They are all Grade II Listed Buildings of medium importance.

Table 23.3: Statutory Designations within 500m of the HPC Development Site

ID	Name	Designation	Description	Importance
2	Wick Barrow	Scheduled Monument	Neolithic/Bronze Age round barrow, North Moor, Stogursey	High
42	Thatch End	Listed Building	17th century cottages with bridge over stream at entrance to south-east wing, Shurton, Grade II	Medium
43	Footbridge	Listed Building	18th century footbridge, 5m south-west of Thatch End, Shurton, Stogursey, Grade II	Medium
44	Fishers and Brookside	Listed Building	Late 16th/early 17th century farmhouse, Shurton, Stogursey, Grade II	Medium
45	Shurton Lodge and outbuilding	Listed Building	17th century house and outbuilding attached at south-east corner, Shurton, Stogursey, Grade II	Medium
46	Cottage	Listed Building	17th century cottage, 15m north of Shurton Lodge, Shurton, Grade II	Medium
47	Shurton Court and No.2 Shurton Court	Listed Building	Early 17th century farmhouse, Shurton, Grade II	Medium
48	Ash Cottage and Little Ash	Listed Building	16th century farmhouse, Shurton. Grade II	Medium
49	Shurton Mills	Listed Building	17th century mill owner's house, and attached outbuildings to north, Shurton, Grade II	Medium
	Historic hedgerows	Important under Hedgerow Regulations 1997	Surviving hedgerows that are depicted on 1614 Norton maps. Shown on map in **Figure 23.5**.	Low

23.5.17 There are five Grade I Listed Buildings within the 10km study area, including the Church of St Andrew in Stogursey and Court House at East Quantoxhead.

23.5.18 There are 26 Grade II* Listed Buildings within the 10km study area, including Fairfield House, Stogursey Castle and causeway bridge, and the remains of Stowey Castle keep (which is also designated as a Scheduled Monument).

23.5.19 There are 75 Grade II Listed Buildings within a 5km radius of the HPC Development Site, including the eight Listed Buildings in Shurton, mentioned above.

23.5.20 There are two Registered Parks and Gardens within the 10km study area at Fairfield and St Audries.

23.5.21 There are four Conservation Areas within the 10km study area; Holford, Stogursey, Nether Stowey and Spaxton and Four Forks.

23.5.22 There are no Registered Historic Battlefields within the 10km study area (Ref. 23.22).

23.5.23 With regard to the sites for highways improvements, there are no Scheduled Monuments, Listed Buildings, Conservation Areas, Registered Parks and Gardens, Registered Battlefields, historic hedgerows or ancient woodlands within the proposed site boundaries of Washford Cross or Sandford Hill.

23.5.24 There are nine Listed Buildings within 1km of the Washford Cross proposed site, including one Grade I and eight Grade II Listed Buildings. The Grade I Listed Cleeve Abbey (**H1**), a 12th century Cistercian abbey, is also a Scheduled Monument.

23.5.25 Within 1km of the Sandford Hill proposed site there is one Scheduled Monument, a medieval settlement (**H22**), and two Grade II Listed Buildings, Cokerhurst Farmhouse and Sandford Manor (**H26**).

d) Archaeological and Historical Background

23.5.26 The importance of the heritage assets within the study area have been assessed.

23.5.27 Detail on the heritage assets within the wider 10km study area is provided in the "Historic Landscape" and "Settings of Designated Heritage Assets" sections below. Detail on the heritage assets within the highway improvements study areas is provided in the "Washford Cross Highway Improvements" and "Sandford Hill Highway Improvements" sections, below.

23.5.28 Heritage assets within the HPC Development Site boundary are listed in **Table 23.4** and discussed below. The remainder of this section describes the archaeological remains by chronological period.

Table 23.4: Archaeological Sites and Historic Landscape Features within the HPC Development Site

ID	Name and Description	Designation	Importance
3	St Sidwell's Well – medieval (possibly Iron Age) well or spring west of Wick Barrow, North Moor	Undesignated	Low
4	Romano-British settlement – ditched enclosure, ring ditch, pits, post holes etc dating to 3rd – 4th centuries AD	Undesignated	Medium

ID	Name and Description	Designation	Importance
9	Water meadows – post-medieval catch meadow system west of Hinkley Point	Undesignated	Low
11	Water meadows – possible water meadow system north of Shurton	Undesignated	Low
12	Water meadows – possible water meadow system north of Shurton	Undesignated	Low
14	Possible limekiln – north of Knighton, largely destroyed due to cliff erosion	Undesignated	Low
25	Track way – east-west track way running along ridge shown on 1614 map (Green Lane)	Undesignated	Medium
31	Stone bridge – small stone bridge over drainage ditch between fields in north of Built Development Area West	Undesignated	Low
41	Remains of North Lane – ditch (*c* 4 m wide) at northern section of field boundary. A dip in the field to the north probably represents a continuation of the lane northwards	Undesignated	Low
50	Deserted farm, north of Shurton – Corner Farm shown on 1841 Tithe map and OS maps until 1983	Undesignated	Low
53	Stone wall built along Bum Brook – short stretch of stone wall built along north stream bank to prevent undercutting at southern boundary	Undesignated	Low
54	20th century accommodation camp – indistinct earthworks in north-east of site. Possible remains of accommodation block/camp from construction of power station in 1950s and 60s	Undesignated	Low
56	Canalised stream running east-west across Southern Construction Phase Area	Undesignated	Low
67	Romano-British settlement – ditched enclosures and settlement features, dating to 1st – 3rd centuries AD, possibly laid out on line of earlier Iron Age ditch	Undesignated	Medium
68	Middle-late Bronze Age Enclosure – penannular ditched enclosure, with south facing entrance, identified during geophysical survey	Undesignated	Medium
69	Middle-late Bronze Age deposit – large mid-late Bronze Age pottery assemblage (182 sherds) in a charcoal rich matrix	Undesignated	Medium
70	Early Bronze Age cremation – truncated remains of an early Bronze Age cremation	Undesignated	Medium
71	Possible Burnt Mound – truncated pits containing charcoal-rich deposits and fire-cracked stones	Undesignated	Low
72	Mid-late Iron Age settlement – heavily truncated traces of a ditched enclosure and ring ditch	Undesignated	Low
73	Medieval settlement – heavily truncated pits and boundary ditches containing 12th – 14th century – possible medieval precursor to Corner Farm	Undesignated	Low

i. Lower Palaeolithic – Upper Palaeolithic (pre 30,000 BP (Before Present) – 10,000 BP)

23.5.29 There are no recorded archaeological sites of these dates and no evidence for human occupation within the HPC Development Site boundary during this period.

ii. Mesolithic (10,000 BP – 4,500 BC)

23.5.30 Scatters of Mesolithic flints (**1**) were found during field walking in the northern part of the Built Development Area West in 1992, but no evidence for Mesolithic activity was recovered during trial trenching in this area.

iii. Neolithic (4,500 BC – 2,000 BC)

23.5.31 There are no recorded sites of Neolithic date within the HPC Development Site boundary.

23.5.32 Wick Barrow (**2**), a scheduled round barrow with origins in the late Neolithic period, is located 50m beyond the HPC Development Site boundary to the east.

iv. Bronze Age (2,000 – 700 BC)

23.5.33 There are no previously recorded sites of Bronze Age date within the HPC Development Site boundary.

23.5.34 During trial trenching, middle to late Bronze Age pottery was recovered from a shallow, linear feature (**69**) on the eastern edge of Built Development Area West (see **Figure 23.4**). The charcoal rich deposit also contained animal bone and shell. Although the nature of the deposited material suggests domestic activity no structures were identified in the vicinity of this feature.

23.5.35 The remains of a possible prehistoric burnt mound (**71**) were uncovered in the west of the Built Development Area West (see **Figure 23.4**). A small pit containing a single fragment of prehistoric pottery and a shallow pit containing heavily burnt and fragmented stone mixed with charcoal were recorded. The pits were less than 2m apart. Deposits of heat fractured stones, known as burnt mounds, are often interpreted as the remains of ritual sites (akin to a sweat lodge) or, more prosaically, as domestic cooking sites.

23.5.36 Further evidence for Bronze Age activity was recorded close to the southern boundary of the Southern Construction Phase Area (see **Figure 23.4**).

23.5.37 The truncated remains of an early Bronze Age cremation (**70**) were recorded in an area of later archaeological features spanning the Iron Age, Roman and medieval periods (see below).

23.5.38 A substantial ditched enclosure (**68**), approximately 50m in diameter, was previously identified from crop marks and geophysical survey in the south-west of the Southern Construction Phase Area (Ref. 23.15 and Ref. 23.18). Domestic refuse, comprising pottery sherds and butchered animal bone recovered from the fill of the enclosure ditch, suggest that the enclosure was built and occupied during the middle – late Bronze Age (Ref. 23.19.

23.5.39 Wick Barrow (**2**) was enlarged to over 25m in diameter during this period. Three secondary crouched burials were interred within the enlarged mound. One of the burials contained a bell-beaker, the second contained a necked-beaker and the third contained a necked-beaker and a flint knife-dagger. The pottery is typical of the Neolithic/Bronze Age transition phase known as the Beaker period.

v. Iron Age (700 BC – AD 43)

23.5.40 A shallow ditch of probable Iron Age date was excavated during the evaluation of a Romano-British settlement located in the north of the HPC Development Site (centre of the Built Development Area West) (**4**).

23.5.41 Residual Iron Age pottery and possible features of later prehistoric date were also recorded within an area of Romano-British features in the south-east of the Built Development Area West (see **Figure 23.4**). These sites are discussed below.

23.5.42 A possible ring ditch of mid-late Iron Age date and a possible ditched enclosure were recorded in the south-east of the Southern Construction Phase Area (**72**). The full extent of these features was obscured by later disturbance (Ref. 23.19).

23.5.43 St Sidwell's Well (**3**) located just within the eastern site boundary to the west of Wick Barrow (**2**), is a natural spring also known as St Sativolas' Well. During the medieval period it was believed to be a holy well with great healing powers and it is possible that this historical association may have its origins in the Iron Age. The presence of a "well" is inferred from documentary references and place-name evidence but no evidence for a well structure was recovered during archaeological excavations in 1907 (Ref. 23.25). As there is no evidence that St Sidwell's Well is anything other than natural it will not be discussed further.

vi. Roman (AD43-AD450)

23.5.44 A series of possible enclosures and settlement features (**67**) were identified by geophysical survey on the southern boundary of the Built Development Area West. Trial trenching demonstrated that the features in the western half of the site were geological in origin.

23.5.45 Roman pottery sherds and domestic refuse recovered from the backfilled enclosure ditches to the east, suggest that the site was occupied during the 1st to 3rd centuries AD. It is possible that the enclosures were laid out on the line of an earlier, Iron Age ditch, extending across the foot of the steep south-facing slope.

23.5.46 Undated features (**21**) recorded during the construction of a site compound adjacent to Wick Moor Drove, may be associated with a possible Romano-British settlement (**5**) identified by geophysical survey in 1996 (Ref. 23.26) on land east of the road and outside the site boundary.

23.5.47 A 3rd to 4th century Romano-British settlement (**4**) had been identified during previous archaeological investigations in the centre of the Built Development Area West.

23.5.48 Geophysical survey revealed a five-sided enclosure approximately 140m across with probable internal round houses. Trial trenching subsequently confirmed the presence of the enclosure ditches, a round house, occupation spreads, post holes, beam slots and pits (Ref. 23.27).

23.5.49 Fragments of Roman pottery recovered from the upper fills of earlier Iron Age features on the Southern Construction Phase Area suggest that this area was used as agricultural land once the Iron Age settlement went out of use (Ref. 23.19).

vii. Early-medieval (AD 450-AD1066)

23.5.50 There are no known sites of early medieval date within the HPC Development Site boundary.

23.5.51 It has been suggested that the settlement of Sedtammtone (**7**), recorded in the Domesday Book of 1086, may be located in the northern part of the HPC Development Site (centre of the Built Development Area West).

23.5.52 No indication of early medieval or medieval settlement was detected in this location during the field reconnaissance or geophysical surveys. No finds of this date were recovered during the trial trenching.

viii. Medieval (AD 1066-AD1540)

23.5.53 There are no recorded sites of medieval date, and there is no primary documentary evidence relating to land within the HPC Development Site boundary during the medieval period.

23.5.54 However it is probable that the representation of landscape features on the 1614 Norton maps date from the later medieval period, or earlier including the track way (**25**) and field boundaries/hedgerows (Ref. 23.28).

23.5.55 Medieval pottery fragments, of 12th to 14th century date, were recovered from a series of heavily truncated pits and ditches in the south-east corner of the Southern Construction Phase Area (**73**). It is likely that these represent the heavily disturbed remains of the medieval precursor to the deserted post-medieval farm, Corner Farm (**50**), which is described below.

ix. Post-medieval (AD1540 Onwards)

23.5.56 Within the HPC Development Site boundary much of the land may already have been enclosed by the beginning of the post-medieval period. The fields in the centre of the Built Development Area West were enclosed by 1614 in an early example of private enclosure (Ref. 23.28).

23.5.57 A building (**36**) is shown in the west of the Built Development Area West on the more detailed of the 1614 Norton maps (Ref. 23.28), but is not present on the 1794 map. This is likely to be the barn referred to in the fieldname Old Barn 7 acres (referred to as *12* on the 1794 map) (Ref. 23.29). Trial trenching recovered no evidence of this farm building.

23.5.58 The 1794 map shows approximately the same fields as the 1614 Norton maps, with added detail indicating the use of each field (Ref. 23.29).

23.5.59 The enclosure and amalgamation of strip fields was officially implemented in Stogursey Parish by the Stogursey Enclosure Bill of 1800 (Ref. 23.30). Some of the enclosure field boundaries have continued in use and are visible in the landscape today.

23.5.60 The site of Benhole Farm (**10**), in the west of the Built Development Area West, is recorded on the edge of Chilcott's 1794 map of Bullen Farm as Penhole (Ref. 23.29). The 1841 tithe map (Ref. 23.31) shows two buildings, the extant barn and, presumably, the farmhouse to the north-east. Another building is shown adjoining the south-west corner of the barn on the 1st Edition Ordnance Survey 6" map (Ref. 23.32).

23.5.61 Benhole Farm is recorded as having burnt down in 1952 and only the barn survives. Minor earthworks and fragments of brick and tile embedded in the soil were noted at this location during the walkover. Geophysical survey identified magnetic disturbance in the areas known to have been occupied by the former buildings of Benhole Farm and are likely to be indicative of the spread of building debris (Ref. 23.17).

23.5.62 A small, undated hearth structure was recorded to the north of Benhole during the trial trenching. A shallow gully uncovered to the west of the barn contained butchered cattle bone but no dating evidence.

23.5.63 There are several water meadow systems and associated drainage features on the Built Development Area West. The northernmost water meadow (**9**) stretches to the east and west of the Benhole Farm site (**10**). The fields have been ploughed during recent years and no signs are visible on the surface.

23.5.64 Another water meadow system (**12**) with drains and feeder channels lies further south and is visible as earthworks on aerial photographs.

23.5.65 Earthworks present in the same field represent disused field boundaries and possible platforms that are presently undated (**60**).

23.5.66 A small stone utilitarian bridge (**31**), of possible 19th century date, spans the drainage ditch separating two fields in the Built Development Area West.

23.5.67 Holford Stream, which runs through the Southern Construction Phase Area and the second water meadow system (**12**) has been canalised (**56**). It is not shown on the tithe map (Ref. 23.31), but is recorded on the 1st Edition Ordnance Survey (Ref. 23.32).

23.5.68 The site of a former lime kiln (**14**) in the north of the HPC Development Site (Built Development Area West) is described as a damaged mound 20m across in the Somerset Historic Environment Record (HER). The location was investigated during the field reconnaissance survey, but the mound had disappeared during erosion of the coastal cliff. A small mound of stone rubble survives at the top of the cliff. This site will therefore not be discussed further.

23.5.69 The site of a deserted farm (**50**) is recorded in the Southern Construction Phase Area. The earliest record of this is on the 1841 tithe map where it is referred to as "Corners" and includes a "house, barton and garden" and two orchards (Ref. 23.31).

23.5.70 Few signs of the deserted farm survive above ground; there are minor earthworks and crop differentiation and the geophysical survey identified magnetic anomalies that are probably related to the farmstead and orchards (Ref. 23.18).

23.5.71 A short stretch of stone wall (**53**) has been built along a section of the north bank of Bum Brook on the southern boundary of the Southern Construction Phase Area.

This was constructed to prevent further erosion of the bank at this point and may be of 20th century date.

23.5.72 An accommodation camp associated with the construction of Hinkley Point A and B (**54**); but which no longer survives, was situated on the Built Development Area East (Ref. 23.33). The northern half of this site is now a car park, but the field containing the southern half has earthworks that are probably the remains of former construction activity. As a result it is not anticipated that any archaeological resource remains in this area.

x. Undated Features

23.5.73 Possible archaeological features, identified through previous fieldwork within the HPC Development Site boundary, were investigated during the programme of trial trenching.

23.5.74 No evidence of a possible doubled-ditched enclosure (**64**) identified from the geophysical survey (Ref. 23.17), located in the north of the Built Development Area West, was recorded during the trial trenching (Ref. 23.19). A single undated ditch was uncovered in the east of this area.

23.5.75 No evidence was uncovered during the trial trenching (Ref. 23.19) of the possible enclosures (**35** and **65**) identified from the geophysical survey (Ref. 23.17), recorded to the east and south-west of the Romano-British settlement (**4**), in the Built Development Area West.

23.5.76 Similarly, there was little or no trace of the possible enclosures (**66**), interpreted as medieval field systems with a possible drove way leading to Wick Moor Drove.

23.5.77 The sites described above, and other undated features detected within the HPC Development Site boundary during the field reconnaissance surveys (Ref. 23.15) have been excluded from the assessment. Trial trenching and further investigation, suggests that they either did not survive or that they are geological rather than archaeological in origin. These include sites (**20**, **26**, **27**, **29**, **30**, **32**, **33**, **34**, **59**, **61**, **62 and 63**), see **Appendix 23A**.

e) Historic Buildings

23.5.78 There are three historic buildings within the HPC Development Site boundary on the Built Development Area West (**Table 23.5**).

Table 23.5: Historic Buildings within the Site Boundary

ID	Name and Description	Designation	Importance
10	Benhole Farm and Barn – Site of post-medieval farmstead largely destroyed in 1950s. Only a heavily altered barn remains north of Knighton, Stogursey	Undesignated	Low
22	Langborough Barn and linhay – Farm complex of two buildings, one of which is a substantial barn, within a courtyard	Undesignated	Low
23	Sidwell Barn – Extant barn and adjacent features relating to a now demolished barn	Undesignated	Low

23.5.79 The surviving historic buildings are Benhole Barn (**10**), Langborough Barn and linhay complex (**22**), and Sidwell Barn (**23**). None of these buildings are designated and are all considered to be of local importance (Ref. 23.15).

23.5.80 These buildings were the subject of the historic buildings assessment (Ref. 23.16) which concluded that:

> *'All three buildings are vernacular structures of late 18th or early 19th century date, displaying varying degrees of modification and historic survival. Visual inspection of the architectural details indicates that they were originally designed as cattle sheds.'*

23.5.81 The full description of the historic buildings on the HPC Development Site can be found in the Historic Building Assessment, Hinkley Point (Ref. 23.16).

23.5.82 Benhole Barn (**10**) is the only surviving building of a farm complex that was destroyed by fire in 1952 (see **Plate 23.2**).

Plate 23.2: Benhole Barn

23.5.83 Benhole Farm is referred to on the 1794 Chilcott map as Penhole, but the extant barn is not shown (Ref. 23.29). The barn is first depicted on the 1841 tithe map (Ref. 23.31). It was heavily altered in the 20th Century by the insertion of a milking parlour at its western end.

23.5.84 The original roof has been lost and Benhole Barn now has a corrugated asbestos roof supported by 60mm galvanised steel piping forming king post trusses placed upon an Ordinary Portland Cement (OPC) concrete lift at eaves level (Ref. 23.16).

23.5.85 Langborough Barn and linhay form a small complex of two farm buildings (**22**) arranged around a walled courtyard. Both buildings are constructed of lias rubble with timber-framed roof structures covered by Bridgwater pantiles (see **Plate 23.3**).

23.5.86 A substantial open fronted lean-to extension has been built in stone along the south elevation of the larger building. The western third of the roof of Langborough Barn has collapsed as has the eastern two-thirds of the lean-to.

23.5.87 The larger Langborough Barn is visible on both the 1794 Chilcott map of Stogursey (Ref. 23.29) and the 1841 tithe map (Ref. 23.31). Both the barn and linhay are visible on the 1st Edition Ordnance Survey (Ref. 23.32).

Plate 23.3: Langborough Barn

23.5.88 Sidwell Barn (**23**) is constructed of lias with a half-hipped, timber framed, pan-tiled roof that has an asymmetrical pitch (Ref. 23.16) (**Plate 23.4**).

23.5.89 Sidwell Barn is shown on the 1841 tithe map (Ref. 23.31), but on the 1st and 2nd Edition Ordnance Survey maps (Ref. 23.32 and Ref. 23.34), there is a second building adjoining the first with both standing within a compound.

Plate 23.4: Sidwell Barn

f) Historic Landscape

23.5.90 The HPC Development Site lies within Landscape Character Area 146: Vale of Taunton and Quantock Fringes (Ref. 23.35), described as lowland, mixed farming landscape, with dense hedges, sparse woodland and scattered villages, hamlets and farmsteads linked by winding lanes.

23.5.91 The historic landscape of the wider study area extends from the Quantock Hills to the west and encompasses the mouth of the River Parrett to the east.

23.5.92 Surviving earthwork monuments, including barrows, cairns and hillforts attest to intensive utilisation of the Quantocks during the prehistoric period. Scheduled Monuments located further to the east, including Wick Barrow (**2**, Pixies Mound) and Cynwit Castle hillfort (Cannington Camp, **D1**) indicate that prehistoric settlement and ritual activity was not confined to the higher ground of the Quantocks.

23.5.93 The mixed farming landscape described above preserves elements of the medieval landscape. Stogursey, Shurton, Knighton, Burton, Wick and Stolford, are all mentioned in the Domesday Book of 1086. The remains of the motte and bailey castle (**D20**) dominate the settlement at Nether Stowey. There are also surviving earthwork remains of the medieval castle at Stogursey (**D13**) and just beyond the 10km study area to the east of the River Parrett at Down End. The remains of the medieval manor house at Kilve, (known as Kilve Chantry) and the medieval remains of the chapel at Adscombe (**D24**) are also Scheduled Monuments.

23.5.94 Three large estates – Fairfield, East Quantoxhead and, just beyond the 10km boundary, Orchard Wyndham, dominate much of the landholding to the west of the HPC Development Site. Within the 10km study area there is a substantial amount of land owned by the Fairfield and East Quantoxhead estates which has been designated as land of outstanding scenic interest, including land immediately to the west of the HPC Development Site.

23.5.95 The earliest record of a manor house at Fairfield dates to the 12th century. Fairfield House (**D18**), a Grade II* Listed Building dating from the 16th century, lies at the centre of the Fairfield Estate, which occupies a large part of the area between the HPC Development Site and the Quantocks. The house sits within a Registered Park and Garden (**D19**) comprising gardens, parkland and woodland known as the Great Plantation. There are parcels of Ancient Woodland within the estate to the west of the HPC Development Site.

23.5.96 There are 75 Grade II Listed Buildings within the 5km study area, many of which date from the 18th-19th centuries. Many of these are located within the Conservation Areas at Spaxton and Four Forks (**D10**), Stogursey (**D17**) Nether Stowey (**D23**) and Holford (**D38**).

23.5.97 Elements of the medieval landscape, including strip fields and ridge and furrow earthworks, survive within the study area. Traces of the medieval field pattern are discernible in surviving hedgerows, field boundaries and green lanes, but the majority of the field pattern reflects agricultural intensification during the 19th and 20th centuries following the Inclosure Act of 1800. The small hamlets in the vicinity of the site, including Stolford, Wick and Otterhampton to the east and south-east, and Shurton, Burton and Knighton to the south and west, preserve elements of post-medieval estate planning.

23.5.98 The existing Hinkley Point Power Station Complex, built in the 1950s and 1960s, introduces an industrial element into the predominantly rural landscape. This occupies an area of *c.*60ha, and lies immediately to the east of the HPC Development Site boundary.

23.5.99 The HPC Development Site itself is made up of recently enclosed irregular arable fields broken by anciently enclosed, low-lying meadow land cut by streams.

23.5.100 The Somerset Historic Landscape Characterisation (HLC) (**Figure 23.6**) describes the majority of fields within the site boundary as recently enclosed land of a 17th – 18th century date (**HLC3**-**HLC5**). The 1614 map (Ref. 23.28) indicates that the fields in area **HLC4** in the Built Development Area West were already enclosed by the early 17th Century and could possibly be described as anciently enclosed pre-17th Century fields.

23.5.101 An east to west band of fields across the southern part of the Built Development Area West has been identified as anciently enclosed land pre-17th century (**HLC2**). The northern boundary of this HLC is the east to west trackway, Green Lane (**25**). The southern boundary is formed of a second east to west boundary running parallel to the first. **HLC2** is reminiscent of co-axial field systems found elsewhere in the South West and may possibly date to the Bronze Age (Ref. 23.36).

23.5.102 The Somerset HLC indicates that there has been 25-50% boundary loss within the HPC Development Site boundary with over 50% in some areas presumably as a result of agricultural intensification. Some of these lost field boundaries (**32** and **33**) are visible as slight earthwork banks.

23.5.103 Surviving field boundaries within the site boundary are usually formed of a hedge on a bank commonly with a drainage ditch. Many of these boundaries are shown on the 1614 and 1794 maps (Ref. 23.28 and Ref. 23.29), indicating that they pre-date the official Stogursey Inclosure Act of 1800.

23.5.104 Under the Hedgerow Regulations 1997 all the surviving hedgerows shown on the 1614 and 1794 maps are deemed 'important' hedgerows (**Figure 23.5**).

23.5.105 The most prominent historic landscape feature is an east-west trackway, Green Lane (**25**) that is depicted on all historic maps of the study area dating back to 1614 (**Plate 23.5**).

23.5.106 Green Lane follows a sinuous course for over 2.5km (1.5 miles), crossing the Built Development Area West, and terminating as a field boundary at ST 184 453. The section of Green Lane crossing the HPC Development Site is *c.* 1.1km (*c.* ¾ of a mile) and occupies a well defined ridge at *c.* 30m AOD to a maximum of 35m AOD.

23.5.107 A substantial hedge survives along most of the southern side of Green Lane and there is a shorter stretch of hedge along its northern edge that continues for approximately 200m.

Plate 23.5: The Trackway, 'Green Lane', from the West

23.5.108 The hedges have been removed at the eastern end of the Green Lane, which appears to have been re-laid along a slightly different alignment during the 20th century (Ref. 23.37).

23.5.109 North Lane (**41**) is a probable drove way that no longer exists, but once ran north-south through the Southern Construction Phase Area from Shurton onto the meadowland surrounding the canalised stream (**56**). This is shown on the tithe map (Ref. 23.31) and on Ordnance Survey maps into the late 20th and early 21st centuries (Ref. 23.37).

23.5.110 North Lane survives only as a section of 4m wide ditch (**41**) contained in a field boundary and as a linear depression which was detected by geophysical survey (Ref. 23.18).

g) Setting of Designated Heritage Assets

23.5.111 It was identified that 70 designated heritage assets lie within the 10km ZTV comprising: 37 Scheduled Monuments; five Grade I Listed Buildings; 22 Grade II* Listed Buildings; two registered parks and gardens; and four Conservation Areas. In addition, 75 Grade II Listed Buildings lie within the 5km ZTV (**Appendix 23B**). Five of the Scheduled Monuments are also Grade II* Listed Buildings.

23.5.112 The setting of a heritage asset is not considered important in its own right. The importance of setting is the contribution it makes to the significance (value) of a heritage asset.

23.5.113 It has been assessed that of the 145 designated heritage assets considered, the settings of two Scheduled Monuments and two Grade II Listed Buildings do not contribute to the significance (value) of the heritage asset. These are the settlement south-east of Cannington Park (**D2**); the chapel east of Adscombe farm (**D24**); St. Andrew's Well in Stogursey (**D104**); and the dovecote in Stogursey (**D105**). They would have the same significance (value) whatever their setting was. Therefore these four heritage assets will not be discussed further.

23.5.114 Of the remaining 141 designated heritage assets, it has been determined that for 109 assets the HPC Development Site does not form part of that setting, for a number of reasons.

23.5.115 The HPC Development Site does not form part of setting for many of these assets due to the ZTV being based on a bare earth model without trees and buildings. During the site visits to certain heritage assets it was identified that such above ground features prevent the HPC Development Site from being a part of the setting. This was the reason why the HPC Development Site is not a part of the setting for Cynwit Castle (Cannington Camp, **D1**), and Church of All Saints, Otterhampton (**D3**). The other heritage assets where the HPC Development Site does not form a part of their setting are: **D5**; **D7**-**D16**; **D21**-**D23**; **D25**-**33**; **D35**-**D38**; **D40**-**D42**; **D71**; **D79**; **D80**; **D83**; **D87**-**D103**; **D106**-**D116**; **D132**-**136**; and **D138**-**D145**.

23.5.116 A number of heritage assets are on the boundary of the ZTV. In this situation the heritage assets were included within the site visits as a precaution. However, site visits subsequently showed that the HPC Development Site was not a part of the setting for a number of barrows and cairns in the Quantock Hills, including: **D44**-**D46**; **D54**; **D58**; **D59**; **D64**-**D66**; and **D69**.

23.5.117 While the HPC Development Site is visible from a number of the heritage assets, it does not form a part of their setting in the same way that the existing Hinkley Point Power Stations are not a part of their setting. This is generally because their setting is more localised or is focussed away from Hinkley Point. These include: **D4**; **D6**; **D20**; **D34**; **D72**-**78**; **D81**, **D82**; **D84**-**D86**; **D117**-**D121**; and **D137**.

23.5.118 As the HPC Development Site does not form part of the setting of these 109 heritage assets, they will not be discussed further.

23.5.119 The remaining 32 designated heritage assets within the 10km ZTV do have the HPC Development Site as a part of their setting, and their setting does contribute to their significance (value).

23.5.120 Wick Barrow (**2**, Pixies' Mound) is discussed in the Statutory Constraints section above, only its setting is discussed here.

23.5.121 Wick Barrow is located within 500m of the existing Hinkley Point Power Station Complex. The main access road to the Complex (Wick Moor Drove) is less than 100m away and separates the monument from the farmland to the west.

23.5.122 The monument is located below the ridgeline of a south-facing slope overlooking Wick Moor, which is crossed by overhead power lines leading from the Hinkley Point Nuclear Power Station Complex to the north of the monument. Wick Barrow would have been designed to be visible from the south, south-west and south-east, but the current boundary treatments, with the County Wildlife Site to the north and east, effectively encloses the monument on these sides.

23.5.123 The agricultural landscape to the west of Wick Moor Drove retains elements of an earlier medieval landscape but the majority of fields within the site are described as recently enclosed land of 17^{th} to 18^{th} century date in the Somerset Historic Landscape Characterisation (HLC). The current setting of Wick Barrow reflects post-medieval agricultural practices associated with the development of the Fairfield Estate to the west. The immediate setting of Pixies Mound is dominated by the industrial development of the existing Hinkley Point Power Station Complex to the north, but the monument retains its connection with Wick Moor to the south-east (**Plate 23.6**).

Plate 23.6: Wick Barrow from the North with Wick Moor in the Background.

23.5.124 Eight Grade II Listed Buildings **(42-49**) are located in Shurton and are described in **Table 23.3**. Shurton is a small settlement in a rural location. All of the Listed Buildings in Shurton are located on the southern side of the settlement. The Hinkley Point Power Station Complex is visible to the north-east across the arable fields of the HPC Development Site and low-level operational noise is occasionally audible.

23.5.125 The Baptist Chapel (**D130**) and the adjoining Manse (**D131**) are both Grade II Listed Buildings set in the quiet rural hamlet of Burton. The Manse dates from the late 18th century while the chapel was built in 1833.

23.5.126 Burton comprises scattered buildings laid out along either side of a no-through road. The hamlet is surrounded by agricultural fields with Honibere Wood to the west and small, scattered plantations on the rising land to the north-west. The rolling landscape to the north and north-east extends to the Bristol Channel coastline.

23.5.127 The local topography and thick hedges mask views of the existing Hinkley Point Power Station Complex at ground level from a number of locations along the track through Burton, but the Hinkley Point Power Station Complex is a feature on the horizon across the fields to the north-east. Low-level operational noise is occasionally audible from Burton.

23.5.128 Stogursey Conservation Area (**D17**) covers the centre of Stogursey Village (**Plate 23.7**). It is a rural village containing numerous Grade II Listed Buildings as well as the Grade I Listed Church and the scheduled village cross. These buildings are all in a rural village setting with appropriate noise and air quality levels to such a situation.

Plate 23.7: Stogursey High Street, the Core of the Conservation Area (**D17**) from the East

23.5.129 Views from buildings facing into the village are predominantly of other buildings, gardens and the nearby roads. Views from buildings looking out into the wider landscape beyond the village are of rolling fields with small patches of woodland crossed by hedgerows and country lanes.

23.5.130 Views to the coast are largely obscured by low hills, but there are restricted views of the Hinkley Point Power Station Complex from certain locations along Shurton Lane in the north of the village.

23.5.131 Fairfield House (**D18**) is a Grade II* Listed manor house with medieval origins set within extensive grounds that are Grade II on the National Register of Parks and Gardens (**D19**) (**Plate 23.8**). The house was rebuilt in the late 16th century when much of the earlier building was demolished. Further additions and alterations were made during the late 18th and early 20th centuries.

Plate 23.8: Fairfield House (**D18**) and Park (**D19**) from the South-East

23.5.132 Fairfield House is set within a planned landscape in a rural setting that has been developed and altered over centuries by the owners. The grounds contain a variety of gardens, parkland and areas of woodland that eventually lead into an agricultural landscape.

23.5.133 There are extensive views from the house and grounds into the wider area with views towards the nearby village of Stogursey, Stogursey School, the Quantocks and to the coast.

23.5.134 Certain outlooks to the north-east from the house and grounds contain views of the Hinkley Point Power Station Complex. There are glimpsed views of the Hinkley Point Power Station Complex through gaps in the hedgerows alongside the approach to the house from the east. Low-level operational noise and occasional alarms can also be heard at Fairfield.

23.5.135 Court House (**D39**) at East Quantoxhead is a Grade I Listed Manor House situated in a quiet rural setting close to a small village with nearby footpaths leading northwards through a rolling landscape to the coast (**Plate 23.9**).

Plate 23.9: Court House (**D39**) at East Quantoxhead from the North-East

23.5.136 Court House occupies a prominent position with grounds extending beyond the immediate environs of the house. Certain outlooks from the gardens, in particular from the tennis lawn, look out across the coast to the east with far-reaching views that include the Hinkley Point Power Station Complex.

23.5.137 The Quantocks are the location of many prehistoric sites, in particular barrows and cairns that have been dated to the Bronze Age. Not all of these are positioned on the highest points of the hills as there are numerous examples of burial mounds located on the hill slopes facing both to the east and the west.

23.5.138 The Quantock Hills are relatively remote from modern settlements and are generally quiet and peaceful. On clear days it is possible to have views over the River Parrett floodplain, Bridgwater Bay and the Bristol Channel that stretch across to south Wales. On other days, dense fog can severely limit the ability to see any distance at all from the Quantock Hills.

23.5.139 The Quantock Hills are predominantly open heathland with some woodland. The heathland is used for grazing sheep and occasionally horses. The land is open-access meaning that people can walk freely across the area. There are usually very few motorised vehicles using the heathland tracks on the Quantock Hills. However, on certain occasions, such as drag hunts, there can be a large number of off-road cars on the heathland slopes.

23.5.140 A number of these cairns and barrows have views towards the coast to the north-east which include Hinkley Point. These include Hurley Beacon (**D43**); two barrows or cairns (**D47**) positioned on the northern arm of Longstone Hill; four Bronze Age bowl barrows and a small cairn (**D48**-**D52**) on the slopes of Thorncombe Hill; a cairn located at the western end of Longstone Hill (**D53**); three cairns on Beacon Hill (**D55**-**D57**); two cairns on Thorncombe Hill (**D60**, **D61**); two barrow groups on Black Hill (**D62**, **D63**); and a large platform cairn on Higher Hare Knap (**D67**).

23.5.141 The earthwork remains of an Iron Age hillfort, known as Dowsborough Camp, and an associated Bronze Age bowl barrow (**D68**) are recorded on Dowsborough Hill. The hillfort is described as a univallate hillfort with a nearly complete counterscarp bank. The rampart and ditch encloses an oval area of approximately 2 hectares at the summit of the hill with an entrance at the eastern end.

23.5.142 The dense woodland planting on the slopes and summit of the hill disguise the nature of the monument and overwhelm the interior of the hillfort. There is little or no impression of the power of place from the interior of the hillfort. Its commanding position is more easily discernible from the hills to the west.

23.5.143 There are limited views out from Dowsborough Camp. A viewing platform, created by a small clearing at the north-western end of the earthworks, allows limited views to the north. The Hinkley Point Power Station Complex is clearly visible on the horizon.

h) Foreshore and Intertidal Zone (see also Chapter 24)

23.5.144 Bridgwater Bay, especially the Steart Point mudflats, contains a large number of wooden stake fish weirs, some of which have been dated by dendrochronology to the end of the early-medieval period. Fish weirs continued to be used on the intertidal mudflats during the medieval period.

23.5.145 Increased use of fertilizers, from the later 16th century onwards, had an increasing effect on the local area as coal was imported from Wales in order to fuel the lime kilns necessary for fertilizer production. A possible coal landing point was located to the east of the HPC Development Site at Burton Quay.

23.5.146 A dry dock, *c.* 80 to 100m wide and surrounded by sheet piles, was excavated on the foreshore area in the late 1950s to allow construction of the water intake structure for Hinkley Point A. The water intake structure was floated out to sea on a high tide to its current location. The dock was then backfilled with unknown materials (Ref. 23.38).

23.5.147 A foreshore survey (undertaken in June 2010) confirmed that there are no archaeological remains above the Mean High Water Springs (MHWS) (Ref. 23.39).

i) Washford Cross Highway Improvements

23.5.148 Within the Washford Cross proposed site boundary there are three recorded heritage assets (**Figure 23.9**). Two of these are records of the 18th century Minehead to Nether Stowey turnpike road (**H6**) and the Watchet to Skilgate turnpike road (**H7**). These were on the same alignment as the modern A39 and B3190 roads. Due to the modernisation of these roads little, if anything, remains of the original turnpike roads other than the route.

23.5.149 A late 18th century milestone (**H5**) has been recorded in a ditch adjacent to the modern junction of the A39 and B3190. This milestone is constructed of sandstone and cast iron and had been broken prior to 1989 when it was recorded in the HER. The milestone is not in its original position.

23.5.150 Within the study area for Washford Cross there are nine designated heritage assets and five undesignated heritage assets (**Figure 23.9**).

23.5.151 Cleeve Abbey, a Scheduled Monument and Grade I Listed Building (**H1**), is located at the south-western extent of the study area. This Cistercian abbey, founded in AD

1198, has been described as the best preserved and most complete example of its type in southern England. Notable features include the 15th century oak roof of the refectory and the 13th century recess within the central cloister. The church is the oldest stone building on the abbey site, begun in 1200 and completed by the middle of the 13th century.

23.5.152 A medieval to post-medieval deserted settlement (**H2**) is located east of Lower Washford village. Fragmentary remains of possible tofts appear on the north and south of the modern road while ridge and furrow, bounded to the south by a possible hollow way, is visible surrounding Washford Farm. An associated quarry is sited along the ridge to the south-east of High Washford Farm and may be linked by a hollow way.

23.5.153 Bardon Farmhouse (**H3**) is a Grade II Listed Building dating from the 16th century located to the south-west of the Washford Cross site.

23.5.154 A Grade II Listed milestone (**H4**) dating to the late 18th to early 19th century is located alongside the A39 (which, as described above, was originally the 18th century turnpike road between Minehead and Nether Stowey).

23.5.155 Other Grade II Listed Buildings within the study area include the stables and granary (**H8**), a range of farmbuildings (**H9**), and a barn (**H10**) at Washford Farm. A Methodist chapel (**H11**) and a linhay (**H12**) are also Grade II Listed. These five buildings all date to the 18th or 19th century and are located in Washford on the western edge of the study area.

23.5.156 The BBC radio transmitter centre building (**H13**) dates to 1933 and is Grade II Listed. The radio station was designed by architects Wimperis, Simpson and Guthrie. The land surrounding the transmitter centre building, which is now occupied by the Tropiquaria amusement park, is also recorded in the HER (**H14**).

23.5.157 Various undated cropmark enclosures (**H15**, **H16**, **H17**) have been identified in the fields surrounding the proposed site.

23.5.158 The Somerset HLC has classified the majority of the proposed site and the land to the south, east and north-east as 'Anciently Enclosed Land pre-17th century' and the area to the north-west as 'Recently Enclosed Land 17th to 18th century'. Neither of these HLC areas would be impacted by the highway improvements and therefore they will not be discussed further.

j) Sandford Hill Highway Improvements

23.5.159 Within the Sandford Hill proposed site boundary there are two recorded heritage assets (**Figure 23.10**). The 18th century Nether Stowey to Ashcott turnpike road (**H24**) is recorded as running through Cannington, along the A39 to the Sandford Hill junction and then along Sandford Hill to Wembdon. Due to modernisation, little, if anything, remains of the original turnpike road other than the alignment.

23.5.160 The second record is the site of a tollhouse (**H23**) associated with the turnpike road and originally located at the western corner of the junction. There are no identifiable remains of this building.

23.5.161 Within the 1km study area for the Sandford Hill highway improvements, there is one Scheduled Monument, a deserted medieval settlement (**H22**), and two Grade II Listed Buildings, Cokerhurst Farmhouse (**H25**) and Sandford Manor (**H26**). There are also nine undesignated heritage assets recorded (**Figure 23.10**).

23.5.162 The Scheduled Monument is a deserted medieval village (**H22**) approximately 250m south of the Sandford roundabout, along the A39 Quantock Road. The settlement, comprising a village, is believed to have existed at the time of the Norman Conquest. It is mentioned in the Domesday Survey as the land of Roger de Corcelle, tenanted by Ralph, and worth 30 shillings. Investigations of the earthworks suggest a street remaining as a hollow-way, several house platforms or farm sites and a large ditched enclosure, probably the manorial site. There is also a large bank and ditch in surrounding fields, interpreted as the village boundary bank. The decline and desertion of the village is considered to be due to economic reasons.

23.5.163 Cokerhurst Farmhouse (**H25**), a Grade II Listed Building, is situated at Wembdon Hill on the eastern boundary of the Sandford Hill study area. It is believed to date from the 15th century with later 16th, 19th and 20th century alterations.

23.5.164 Sandford Manor House (**H26**), also Grade II Listed, is situated approximately 150m south of the Sandford Hill junction. The manor house is 16th century in origin (inscribed 1570) with some 19th century alterations. It is believed to be the former manor house of the Manor of Sandford.

23.5.165 To the north-west of the Sandford Hill site, the Somerset HER indicates that a number of archaeological features were identified in close proximity to one another. A possible Mesolithic flint core and other worked flints (**H18**), of Mesolithic to Early Neolithic date, were recovered from a large north-west to south-east aligned ditch. A curvilinear ditch (**H19**), dating to the middle Bronze Age may have formed a circular enclosure. It was cut by two parallel ditches defining a north-south aligned trackway. A singular sub-circular pit in the vicinity produced a moderately large quantity of middle Bronze Age pottery, a number of worked flints and charred plant remains, identified as barley, wheat and grass seed. An Iron Age to Roman post hole and a truncated section of ditch (**H20**) were found close to the Bronze Age ditch.

23.5.166 An early medieval inhumation cemetery (**H21**) was excavated in Wembdon, on the easternmost edge of the Sandford Hill study area.

23.5.167 Chilton Trivett Park (**H27**) encompasses the central northern portion of the Sandford Hill study area. It is believed to have originated in the post-medieval period.

23.5.168 There are four cropmark sites within the Sandford Hill study area which remain undated. These include two sites in the vicinity of Perry Green in the north of the study area. The cropmarks south-west of Perry Green comprise a rectangular, single ditched enclosure (**H28**) and those to the west may be another enclosure (**H29**).

23.5.169 Another undated cropmark enclosure has been recorded at Sandford Hill (**H30**) in the east of the Sandford Hill study area and near Cannington on the northern edge (**H31**) is a cropmark of a sub-rectangular enclosure joined at the corner to a triangular enclosure.

23.5.170 The Somerset Historic Landscape Characterisation (HLC) has classified the majority of the landscape in the south and east of the Sandford Hill study area as Recently

Enclosed Land. This is land that has been predominantly enclosed during the 18th to 21st centuries, sometimes as early as the 17th century. Generally it has been determined that there has been less than 50% boundary loss across this area during the last 100 years. This HLC area would not be impacted by the highway improvements proposed at Sandford Hill and therefore it will not be discussed further.

k) Previous Impacts

23.5.171 The Built Development Area East was altered in 1957 when work began on the Hinkley Point A power station. Further alteration occurred in 1967 when work commenced on Hinkley Point B power station.

23.5.172 The construction of the power stations greatly affected the immediate area surrounding the two facilities. Temporary works, including an accommodation camp, installations of lifting equipment and an off-shore loading facility, would have impacted upon any archaeological remains in these areas.

23.5.173 During the construction phase for the Hinkley Point A power station, part of the Built Development Area East was used for an accommodation camp (**54**) (Ref. 23.33).

23.5.174 Construction of the dry dock, to allow construction of the water intake structure for Hinkley Point A, would have removed a large part of the foreshore area (Ref. 23.38).

23.5.175 Other areas to the west of Hinkley Point A power station were used during its construction phase and subsequently as a waste transfer station (Ref. 23.40).

23.5.176 These activities have resulted in the removal of historic field boundaries and would have destroyed any remains of archaeological interest that were present.

23.5.177 Some of the wooded areas in the Built Development Area East appear to have been left untouched by the construction possibly allowing archaeological remains to survive in these areas.

23.5.178 The majority of the Built Development Area West and Southern Construction Phase Area have remained in agricultural use. Therefore, successive phases of ploughing would have impacted upon earthworks above ground and shallow archaeological features close to the ground surface.

23.5.179 Agricultural intensification has resulted in significant boundary loss during the last 100 years, although a number of historic landscape features survive within the site boundary.

23.5.180 Other impacts include the fire that destroyed Benhole Farm (**10**) in 1952, the alterations to the eastern end of the track way (**25**) and the creation of a compound adjacent to Wick Moor Drove for use during the geotechnical site investigations undertaken in 2008.

23.6 Assessment of Impacts

a) Construction Impacts

23.6.1 This section describes the impacts on the historic environment that would occur during the construction phase of the HPC Development both within the site boundary and in the ZTV up to 10km. A general description of the construction phase is contained in **Chapter 3** of this Volume. A summary of the assessment of impacts and their significance is provided in **Table 23.6**.

i. On-site Heritage Assets

23.6.2 Topsoil stripping, site levelling, fencing, vegetation clearance and planting would take place across the site during the construction phase. These activities would impact adversely on any surviving sub-surface archaeological remains.

23.6.3 All topsoil and up to 500mm subsoil (where present) would be removed from areas to be used for excavations, levelling or stockpiling during the construction phase.

23.6.4 Topsoil stripping would expose archaeological remains below ground within the HPC Development Site. Rutting and ground compaction, arising from vehicle movements, would also result in a permanent impact of high magnitude to any buried archaeological remains prior to the implementation of mitigation.

23.6.5 The Romano-British settlement (**4**) to the south of Benhole Farm and the earlier Romano-British settlement (**67**) in the east of the HPC Development Site are considered to be of medium importance. Topsoil stripping and site levelling would result in the destruction of these heritage assets. The impact magnitude is therefore assessed as high, permanent and the impact significance is **major adverse**.

23.6.6 Boundary ditches and features associated with the Romano-British settlement (**4**) may extend beneath a rectangular plantation to the east of the settlement in the centre of the Built Development Area West. The removal of the trees would impact any archaeological features in this plantation, but this would be of lower magnitude and significance than the major adverse significance of impact caused by the topsoil stripping.

23.6.7 The Romano-British settlement (**67**) would also be impacted by the construction of the fencing installed to enclose and secure the HPC Development Site. These fences, a simple timber post and rail fence and an inner 2.14m high chain link construction (security) fence, would run along the southern edge of the settlement. The works to auger the post-holes and erect the fence would impact the buried archaeology along this line. However these works would be of lower magnitude and significance than the major adverse significance of impact caused by the topsoil stripping.

23.6.8 The Bronze Age pottery assemblage in a charcoal rich matrix (**69**) in the centre of the HPC Development Site is considered to be of medium importance. Topsoil stripping and site levelling would result in the destruction of this asset. Consequently, the impact is assessed as high, permanent magnitude and is of **major adverse** significance.

23.6.9 The middle to late Bronze Age enclosure (**68**) and the early Bronze Age cremation (**70**) in the southernmost part of the HPC Development Site are also considered to be of medium importance. Topsoil stripping and site levelling would result in the destruction of these heritage assets and has therefore been assessed as high, permanent magnitude with **major adverse** significance.

23.6.10 The possible burnt mound (**71**) in the west of the HPC Development Site is considered to be of low importance. Topsoil stripping and site levelling would result in the destruction of this asset. The impact magnitude is assessed as high, permanent and the impact significance **moderate adverse**.

23.6.11 This burnt mound (**71**) would also be potentially impacted by the construction of the fencing installed to enclose and secure the HPC Development Site. The fence would run near to the western edge of the heritage asset. Works to auger the post-holes and excavate the threshold have the potential to impact on any buried archaeological remains along the alignment of the security fence. However these works would be of lower magnitude and significance than the moderate adverse significance of impact caused by the topsoil stripping.

23.6.12 The mid-late Iron Age ring ditch and ditched enclosure (**72**) and the heavily disturbed medieval settlement remains (**73**) recorded in the south-east of the SCPA had been truncated by later disturbance including the post-medieval Corner Farm (**50**), see below. Topsoil stripping and site levelling would result in the destruction of these assets, which are both considered to be of low importance. The impact magnitude is assessed as high, permanent and the impact significance **moderate adverse**.

23.6.13 The water meadow features (**9**, **11** and **12**) and the small stone bridge (**31**) are of low importance. The topsoil stripping and site levelling would result in the removal of these assets which has been assessed as high, permanent magnitude with an overall impact significance of **moderate adverse**.

23.6.14 The deserted farm "Corner" (**50**), the remains of North Lane (**41**), the stone wall along Bum Brook (**53**) and the canalised stream (**56**) are considered to be of very low importance. Topsoil stripping and site levelling would also result in the destruction of these heritage assets, but while the magnitude would still be high, permanent, the overall impact would be of **minor adverse** significance.

23.6.15 It has been assumed that there will be no surviving remains of the Hinkley Point A accommodation Camp (**54**) and therefore there will be **no impact** on this recorded heritage asset.

23.6.16 It will be necessary for the three barns within the HPC Development Site boundary to be demolished and all material to be removed. None of these three barns, Benhole Barn (**10**), Langborough Barn complex (**22**) and Sidwell Barn (**23**) are designated, but they are of local historic interest. They are therefore of low importance. It has been identified that the impact would be of permanent, high magnitude with a **moderate adverse** significance.

23.6.17 The historic trackway, Green Lane (**25**), is an averagely well-preserved historic landscape feature. The central section of the trackway is flanked by a hedgebank on both sides; but to the west the northern hedgebank has been lost and to the east the hedgebanks have been removed and the alignment of the trackway has been altered. Therefore, the trackway is considered to be of medium importance.

23.6.18 A section of the trackway, approximately 700m long and flanked by hedgerows on both sides, would be retained within the development.

23.6.19 A haul road would cross Green Lane (**25**) at its western end. This crossing would sit over the lane preserving the track underneath, which is considered to be of medium importance. Short sections of hedgerow would be removed but the majority of the trackway would be unaffected.

23.6.20 Approximately, 400m of the trackway would be removed to achieve required site levels. The eastern section of the trackway that would be lost has already been partially modified. Approximately 120m of hedge bank at the very eastern end of the trackway has previously been grubbed out and the trackway re-laid on a different alignment leading to Wick Moor Drove.

23.6.21 It is assessed that the magnitude of impact for the removal of the sections of trackway would be medium, permanent resulting in an impact of **moderate adverse** significance.

23.6.22 A number of hedges require removal as part of the construction phase. Hedgerows around the perimeter of the HPC Development Site boundary, including the historic hedgerow alongside Benhole Lane, would be retained. The major portion of the hedges located alongside Green Lane, including the section of parallel hedgerows, would also be retained.

23.6.23 Hedges that are to be removed would be cut to stump level and then the undergrowth and roots of the shrubs would be grubbed out with a mechanical excavator.

23.6.24 The majority of the hedgerows to be removed meet the criteria of archaeological or historical importance defined in the Hedgerow Regulations 1997. However, although these historic hedgerows contribute to the historic landscape of the study area, they are individually of limited importance beyond the local area and therefore they are considered to be of low importance in this assessment (see **Table 23.1**). Removal of historic hedgerows would comprise a high magnitude of permanent impact to these specific hedgerows. The overall impact would be of **moderate adverse** significance due to their low (local) importance.

23.6.25 The Historic Landscape Characterisation (HLC) for Somerset defines the majority of the land within the HPC Development Site as 'recently enclosed land' (**HLC3**-**HLC5**) (Ref. 23.15). This is land that has been enclosed during 17th-18th century, though there has been 25-50% field boundary loss. These HLC areas are considered to be of very low importance because of their date and the proportion of boundaries lost. Removing the field boundaries of these areas would be a medium magnitude permanent impact of **minor adverse** significance as only part of these HLC areas will be removed.

23.6.26 The east to west band of fields that have been identified as anciently enclosed land pre-17th century (**HLC2**) have less than 25% boundary loss (Ref. 23.15). This HLC area has been assessed as being of medium importance because of the level of survival and its earlier date. Removing the boundaries of this HLC area will be a permanent impact of medium magnitude of **moderate adverse** significance as only part of **HLC2** will be removed.

ii. Off-site Heritage Assets within 500m of the HPC Development Site

23.6.27 Heritage assets may be affected not only by a direct physical change, but also by a change to their setting. It is accepted that the setting of a designated site would include elements of the landscape that are of importance to it (Ref. 23.41). 'Setting' does not merely relate to views to and from a designated site, but also includes elements that may contribute to the amenity value of a site (Ref. 23.42).

23.6.28 There are nine designated heritage assets within 500m of the HPC Development Site boundary. The setting of each of these assets contributes to that asset's significance (value) and will also be impacted upon by the construction of Hinkley Point C.

23.6.29 The Scheduled Monument, Wick Barrow (**2**), is located less than 500m to the east of the HPC Development Site boundary (**Figure 23.1**). Wick Barrow would be affected during the proposed works as the area immediately to the west would become a construction site. A new roundabout and access road would be constructed off line from the existing Wick Moor Drove approximately 100m to the west of the monument. There will be an increase in traffic along Wick Moor Drove (**Chapter 10** of this volume) and the additional lighting required at the roundabout and across the HPC Development Site generally (**Chapter 3** of this volume) would also be visible and intrude upon the monument's setting.

23.6.30 This partial transformation of the setting of the monument, and potential increases in noise levels (see **Chapter 11** of this volume) and also, potentially, dust (see **Chapter 12** of this volume) are assessed as comprising a temporary impact of medium magnitude. Given the high importance of the Scheduled Monument, this would result in an overall impact of **major adverse** significance.

23.6.31 The development may result in a minor change to the setting of the Listed Buildings (**42**-**49**) in Shurton. Although the general character of the village would be retained, visual intrusions (see **Chapter 22** of this volume), coupled with minor increases in noise levels (see **Chapter 11** of this volume) during the construction phase, would have a low magnitude temporary impact on the setting of these buildings. As the buildings are considered to be of medium importance, the significance of this temporary impact is assessed as being **minor adverse**.

iii. Off-site Heritage Assets within the 10km Zone of Theoretical Visibility (ZTV)

23.6.32 There are 32 designated heritage assets within the 10km Zone of Theoretical Visibility (ZTV) (see **Chapter 22** of this volume) that include the HPC Development Site as part of their setting, which in turn, contributes to their significance (value). Disturbances due to noise and air quality impacts are not expected to extend beyond 500m of the HPC Development Site boundary and would therefore not affect the majority of assets.

23.6.33 In considering the heritage assets within the 10km ZTV as a whole, the construction phase would not have an impact on the spatial associations or the historic relationships between any heritage assets, nor between heritage assets and the coast. This is due to the location of the HPC Development Site in relation to heritage assets and the presence of the existing Hinkley Point Power Station Complex.

23.6.34 For most of the 32 heritage assets, any impact on setting would be visual. The impact to the setting of Wick Barrow and the eight Grade II Listed Buildings in Shurton during the construction phase has been assessed above as they are within 500m of the HPC Development Site boundary. The impacts to the remaining 23 designated heritage assets are assessed below.

23.6.35 The Baptist Chapel (**D130**) and the adjoining Manse (**D131**) are both Grade II Listed Buildings set in the quiet rural hamlet of Burton. As with the designated heritage assets in nearby Shurton, there would be minor visual intrusions coupled with very minor increases in noise levels (see **Chapter 11** of this volume), though the general character of the hamlet would be retained. This would lead to a low magnitude impact on the setting of these buildings. As the buildings are considered to be of medium importance, the significance of this temporary impact is assessed as being **minor adverse**.

Plate 23.10: View Towards Hinkley Point from the Northern Edge of Burton Looking North-East

23.6.36 Fairfield House (**D18**) is a Grade II* Listed manor house with medieval origins set in extensive grounds (**D19**) that are Grade II on the National Register of Parks and Gardens.

23.6.37 The rural setting and landscape views to the south and south-east would be unaffected by the construction phase. Certain outlooks to the north-east from the house and grounds contain restricted views of the Hinkley Point Power Station Complex. Hinkley Point B also creates some industrial noise that can occasionally be heard at Fairfield.

23.6.38 The construction phase would result in changes to the setting of Fairfield House and Park. The rural landscape to the north-east would be altered by changes to ground levels, the removal of hedgerows and trees, and the addition of temporary cranes on the skyline. Additional visual and lighting impacts would arise from the new site compounds and associated infrastructure.

23.6.39 The associated infrastructure, including a temporary 11kV electricity substation, concrete batching plant and storage silos would be installed on the HPC Development Site during the construction phase. The layout and massing of these features, especially the batching plant and the silos, would have a temporary impact on the settings of Fairfield House (**D18**), and its associated Registered Park (**D19**), to the west.

23.6.40 These changes would comprise a medium magnitude of impact on the setting of Fairfield House and Park, which are considered to be heritage assets of high importance. This would result in an overall, temporary impact of **major adverse** significance.

23.6.41 Stogursey Conservation Area (**D17**) lies to the south of the HPC Development Site. While the settings of the individual designated heritage assets within the Conservation Area would not be impacted upon, the Conservation Area as a larger entity will be indirectly impacted.

23.6.42 At present an industrial area already exists to the north of Stogursey in the form of the Hinkley Point Power Station Complex. During the construction phase for Hinkley Point C this industrial area would be enlarged. While there would be a minor visual impact to Stogursey Conservation Area's setting, the presence of a larger industrial complex nearby would impact on its setting as a rural village.

23.6.43 It has been assessed that these minor changes to Stogursey Conservation Area's setting would result in a very low magnitude of impact. As Conservation Areas are managed at a local level by the District Council, the value of the asset has been assessed as being of medium importance. This results in an overall, temporary impact of **minor adverse** significance.

23.6.44 Court House (**D39**) at East Quantoxhead is a Grade I Listed manor house situated in a quiet rural setting close to a small village. Hinkley Point Power Station Complex is a prominent visual marker in the landscape.

23.6.45 Earthmoving activities and temporary lighting during the proposed construction phase works would change the appearance of the HPC Development Site. This would comprise a very low magnitude of impact on the setting of Court House, a heritage asset of high importance. This would result in an overall, temporary impact of **minor adverse** significance.

23.6.46 The heritage assets in the Quantock Hills, where the HPC Development Site is a part of the setting and where the setting contributes to the significance (value) of each asset, are: Hurley Beacon (**D43**, **Plate 23.11**); two barrows or cairns (**D47**) positioned on the northern arm of Longstone Hill; four Bronze Age bowl barrows and a small cairn (**D48**-**D52**) on the slopes of Thorncombe Hill; a cairn located at the western end of Longstone Hill (**D53**); three cairns on Beacon Hill (**D55**-**D57**); two cairns on Thorncombe Hill (**D60**, **D61**); two barrow groups on Black Hill (**D62**, **D63**); a large platform cairn on Higher Hare Knap (**D67**); and the Iron Age hillfort, Dowsborough Camp (**D68**).

23.6.47 The Hinkley Point Power Station Complex acts as a strong visual influence, drawing the eye and foreshortening the appearance of the distance to the coast.

Plate 23.11: View Towards Hinkley Point Power Station Complex from Hurley Beacon Barrow (**D43**)

23.6.48 Earthmoving activities, building construction and lighting (see Lighting Strategy contained in **Chapter 3** of this volume) associated with the construction phase would change the appearance of the HPC Development Site as seen from the Quantock Hills. However, given that these activities would be adjacent to a pre-existing industrial complex, it has been assessed that the construction phase activities would comprise a very low magnitude of impact. As these heritage assets are Scheduled Monuments with a high importance, this would result in an overall impact of **minor adverse** significance.

iv. Washford Cross Highway Improvements

23.6.49 The proposed construction of a roundabout at Washford Cross on the A39 west of Williton would create localised impacts at the junction and immediately adjacent to it. These would include removal of the existing road, topsoil stripping, relaying of the tarmac, signage and lighting.

23.6.50 Within the proposed site three heritage assets would be affected by the proposed works. The milestone (**H5**) would be moved from its present location. However it is not in its original location and has been broken into pieces. Therefore it has been given a very low importance and moving it would be a permanent, very low impact of **negligible** significance.

23.6.51 The two turnpike roads (**H6** and **H7**) have previously been modernised and improved and little survives of the original road besides the alignment. These are therefore considered to be of very low importance. Construction of the proposed roundabout would only impact them to a permanent very low magnitude and be of **negligible** significance.

23.6.52 The Washford Cross junction does not form part of the setting of the designated heritage assets within 1km of the proposed works. Therefore, there would be **no impact** to the settings of designated heritage assets arising from the construction of the proposed roundabout at Washford Cross.

v. Sandford Hill Highway Improvements

23.6.53 The proposed construction of a roundabout at Sandford Hill on the A39 south-east of Cannington would create localised impacts at and immediately adjacent to the junction. These would include removal of the existing road, topsoil stripping, relaying of the tarmac, signage and lighting.

23.6.54 Within the proposed site there are the records of two heritage assets. The toll house (**H23**) is no longer standing and there is no evidence of it above ground. The site of the toll house immediately adjacent to the junction would be affected, but at most this would result in a very minor loss to any below ground remains that might survive. This would be a very low magnitude of impact to an asset of very low importance resulting in **negligible** significance.

23.6.55 The turnpike road (**H24**) has been modernised and improved and little survives of the original road besides the alignment. It is therefore considered to be of very low importance. The construction of the proposed roundabout would only impact the historic aspects of the road to a very low magnitude and of **negligible** significance.

23.6.56 The construction of the roundabout would affect the settings of the Scheduled medieval settlement (**H22**) of high importance and the Grade II Listed Sandford Manor (**H26**) of medium importance, both to the south-east. The additional noise and lighting required on a temporary basis would create a very low magnitude of impact to these heritage assets resulting in an overall impact to each of **minor adverse** significance.

b) Cumulative Construction Impacts

23.6.57 A temporal overlap in the construction phases of the HPC site preparation works, temporary jetty and HPC Development Site may result in increased impacts to the settings of designated heritage assets beyond the HPC Development Site boundary.

23.6.58 The setting of the Scheduled Monument, Wick Barrow (Pixies Mound) would be affected during the proposed site preparation works. A new roundabout and access road would be constructed approximately 100m to the west of the monument and the area to the west would become a construction site with potential increases in noise levels.

23.6.59 The majority of the onshore infrastructure associated with the temporary jetty would be screened from the Scheduled Monument, by existing topography and planting. However, the rock extraction area immediately to the west of Wick Barrow would result in a minor change to the setting of the monument.

23.6.60 Construction of HPC Development Site would result in a medium magnitude of impact on the setting of Wick Barrow. The site preparation works would result in a medium magnitude of impact and the temporary jetty development would result in a low magnitude of impact on the setting of Wick Barrow.

23.6.61 The cumulative effect of the three developments will not result in an increase in the overall impact; the low - medium magnitude of the impacts on an asset of high importance would result in an overall impact of **major adverse** significance.

23.6.62 Construction of HPC Development Site may result in a minor change to the setting of the Listed Buildings (**42**-**49**) in Shurton. Although the general character of the village would be retained, visual intrusions (see **Chapter 22** of this volume), coupled with minor increases in noise levels (see **Chapter 11** of this volume) during the construction phase, would have a low magnitude temporary impact on the setting of these buildings. Similarly, site preparation works would have a low magnitude temporary impact on the setting of the Listed Buildings in Shurton. Construction of the temporary jetty would have a very low magnitude of impact.

23.6.63 Thus, the cumulative effect of the three developments will not result in an increase in the overall impact; the very low - low magnitude of the impacts on assets of medium importance would result in an overall impact of **minor adverse** significance.

23.6.64 The site preparation works would result in a minor change to the setting of Fairfield House and Park. The rural landscape to the north-west would be altered by changes to ground levels and the removal of hedgerows and trees. Additional visual impacts would arise from the new site compounds and associated infrastructure.

23.6.65 The temporary jetty development would result in a change to the setting of Fairfield House and Park. The rural landscape to the north-west would be altered by erection of the site compound, haul road and soil storage. However, the jetty development's construction would largely be screened by existing vegetation and topography, see **Chapter 21**, of this volume).

23.6.66 Construction of HPC Development Site would result in a medium magnitude of impact on the setting of Fairfield House and Park. The site preparation works would result in a medium magnitude of impact and the temporary jetty development would result in a low magnitude of impact on the setting of Fairfield House and Park.

23.6.67 Thus, the cumulative effect of the three developments will not result in an increase in the overall impact; the low - medium magnitude of the impacts on an asset of high importance would result in an overall impact of **major adverse** significance.

23.6.68 Construction of HPC Development Site would result in a very low magnitude of impact on the setting of Court House. Earthmoving activities and temporary lighting during site preparation works would change the appearance of the application site, and comprise a very low magnitude of impact on the setting of Court House. Temporary lighting during construction of the jetty would have a very low impact on the setting of Court House.

23.6.69 The cumulative effect of the three developments will not result in an increase in the overall impact; the very low magnitude of the impacts on an asset of high importance would result in an overall impact of **minor adverse** significance.

23.6.70 The HPC Development Site forms a part of the setting of a number of designated heritage assets in the Quantock Hills, including Hurley Beacon (**D43**); two barrows or cairns (**D47**) on Longstone Hill; four Bronze Age bowl barrows and a small cairn (**D48**-**D52**) on Thorncombe Hill; a cairn on Longstone Hill (**D53**); three cairns on Beacon Hill (**D55-D57**); two cairns on Thorncombe Hill (**D60, D61**); two barrow groups on Black Hill (**D62**, **D63**); a large platform cairn on Higher Hare Knap (**D67**); and the Iron Age hillfort, Dowsborough Camp (**D68**).

23.6.71 Earthmoving activities, building construction and lighting during the construction phase would change the appearance of the HPC Development Site as seen from the Quantock Hills and result in a very low magnitude of impact on the settings of these Scheduled Monuments. Similarly, site preparation works and construction of the temporary jetty would result in a very low magnitude of impact on the settings of these Scheduled Monuments.

23.6.72 The cumulative effect of the three developments will not result in an increase in the overall impact on the settings of these Scheduled Monuments; the very low magnitude of the impacts on assets of high importance would result in an overall impact of **minor adverse** significance.

23.6.73 Operation of the temporary jetty, for a period of up to eight years, would coincide with the construction phase of the HPC Development Site, Temporary impacts to the settings of designated assets would be the same as those described for the jetty development's construction phase.

23.6.74 Thus, the cumulative effect of construction of the HPC Development Site and operation of the temporary jetty will not result in an increase in the overall impact on the settings of designated assets.

23.6.75 Where the setting of a heritage asset would be affected by multiple topic specific impacts, such as: noise; air quality; lighting and visual, the combined impact of these on setting has been assessed in the Construction Impacts Section above.

c) Operational Impacts

23.6.76 This section describes the impacts on the historic environment that will arise during the operational phase of Hinkley Point C Power Station both within the HPC Development Site boundary and beyond it. A general description of the operational phase is contained in **Chapter 4** of this volume. A summary of the assessment of impacts and their significance is provided in **Table 23.6**.

i. On-site Heritage Assets

23.6.77 All impacts to on-site heritage assets would have taken place during the construction phase. There would be **no impact** to on-site heritage assets.

23.6.78 The on-site portions of the HLC areas (**HLC2**, **HLC3-5**) that are on-site would already have been lost during the construction phase and therefore **no impact** would occur during the operational phase.

ii. Off-site Heritage Assets within 500m of the HPC Development Site

23.6.79 During the operational phase of Hinkley Point C there will continue to be an impact to the settings of the designated heritage assets within 500m of the HPC Development Site boundary.

23.6.80 Wick Barrow (**2**) will be affected by the increased traffic leading to Hinkley Point C Power Station, although this impact would be less than during the construction phase and more similar to current levels (**Chapter 10** of this volume). There would be additional lighting across the HPC Development Site generally, with lighting of the roundabout to the west of Wick Barrow having the most impact on the Scheduled Monument. The visual impact would be substantial with numerous buildings visible to the north-west of Wick Barrow (**Chapter 22** of this volume).

23.6.81 These impacts would result in a partial transformation of setting where the existing industrial area would be considerably enlarged to occupy the present agricultural land to the north-east of Wick Barrow. This has been assessed as being an adverse permanent impact of medium magnitude. As Wick Barrow is a heritage asset of high importance, this impact would be of **major adverse** significance.

23.6.82 The settings of the eight Listed Buildings in Shurton (**42**-**49**) would be affected during the operational phase by occasional alarms and noise (**Chapter 11** of this volume), general lighting across the Built Development Area East and Built Development Area West, and the visual impact of the buildings in these areas of the HPC Development Site (**Chapter 22** of this volume). The natural topography, trees along Green Lane and other houses in Shurton will provide some shielding against car parks and low buildings, though taller buildings, such as the reactors would be visible.

23.6.83 The setting of the Listed Buildings would be largely unchanged as the general character of the village would be retained, though with minor visual intrusions. The operation of Hinkley Point C would have a low adverse permanent magnitude impact on the setting of these buildings. As the buildings are considered to be of medium importance, the significance of this impact is **minor adverse**.

iii. Off-site Heritage Assets within the 10km Zone of Theoretical Visibility (ZTV)

23.6.84 There are 32 designated heritage assets within the 10km ZTV (see **Chapter 22** of this volume) for which the HPC Development Site is a part of their setting and for which their setting contributes to their significance (value). Nine of these designated heritage assets lie within 500m of the HPC Development Site boundary and have been considered above.

23.6.85 Disturbance due to noise and air quality impacts is not expected to extend beyond 500m of the HPC Development Site boundary and would therefore not affect the majority of the remaining 23 heritage assets, although assets very near to the boundary of the 500m boundary may experience occasional noise disturbance.

23.6.86 The operational phase of Hinkley Point C would not have an impact on the spatial associations or the historic relationships between any heritage assets, nor between heritage assets and the coast.

23.6.87 Fairfield House (**D18**) is a Grade II* Listed manor house set into extensive grounds (**D19**) that are Grade II on the National Register of Parks and Gardens.

23.6.88 During the operational phase certain views to the north-east from the house and grounds would contain restricted views of Hinkley Point C (**Chapter 22** of this volume) though the rural character of the immediate area and the landscape views to the south and south-east would be unaffected.

23.6.89 The views to the north-east would include general lighting across the Built Development Area East and Built Development Area West. This would increase the visibility of the HPC Development Site during periods of low-light levels and darkness.

23.6.90 It is expected that some industrial noise would occasionally be heard at Fairfield House, but probably no more than at present.

23.6.91 These changes constitute an impact of medium adverse permanent magnitude to heritage assets of high importance. This would be of **major adverse** significance.

23.6.92 Stogursey Conservation Area (**D17**) lies to the south of the HPC Development Site. During the operational phase of Hinkley Point C the industrial area would form a large complex to the north. There will be a minor visual impact to Stogursey Conservation Area's setting, and the expansion of the current industrial complex onto what was previously an area of agricultural land.

23.6.93 These minor changes to Stogursey Conservation Area's setting would result in a very low, adverse, permanent magnitude of impact. The Conservation Area is of medium importance resulting in an overall impact of **minor adverse** significance.

23.6.94 Court House (**D39**) at East Quantoxhead is a Grade I Listed Manor House situated in a quiet rural setting close to a small village. The existing Hinkley Point Power Station Complex is a prominent visual marker in the landscape. The HPC Development would enlarge the whole industrial area making it more prominent. The additional lighting would increase the visibility of the HPC Development Site during periods of low light and darkness. These would be a low adverse permanent magnitude of impact on a high importance heritage asset, which would be of **moderate adverse** significance.

23.6.95 The HPC Development would be a strong visual influence on the 17 heritage assets (**D43**, **D47**, **D48**-**D53**, **D55**-**D57**, **D60**-**D63**, **D67** and **D68**) in the Quantock Hills during its operational phase. Like the existing Hinkley Point Power Stations, it would draw the eye towards it and would appear prominent on the horizon (**Chapter 22** of this volume). The lighting of the HPC Development Site would cause the complex to be visible from a distance during periods of low light and darkness. It has been assessed that the operation phase activities would be a low magnitude of permanent adverse impact. As these assets are all Scheduled Monuments of high importance, this would result in impacts of **moderate adverse** significance.

23.6.96 The Baptist Chapel (**D130**) and the adjoining Manse (**D131**) are both Grade II Listed Buildings set in the quiet rural hamlet of Burton. During the operational phase there would be minor visual intrusions (see **Chapter 22** of this volume) coupled with very minor increases in noise levels (see **Chapter 11** of this volume), though the general character of the hamlet would be retained.

23.6.97 These changes would lead to a low adverse permanent magnitude impact on the setting of these buildings. The buildings are considered to be of medium importance, and the significance of this impact is **minor adverse**.

iv. Impacts due to Washford Cross Highway Improvements

23.6.98 All impacts to on-site heritage assets would have taken place during the construction phase. There would be **no impact** to on-site heritage assets during operation.

23.6.99 There would be **no impact** to off-site heritage assets during the operational phase of the proposed Washford Cross roundabout.

v. Impacts due to Sandford Hill Highway Improvements

23.6.100 All impacts to on-site heritage assets would take place during the construction phase. There would be **no impact** to on-site heritage assets during the operational phase of the proposed Sandford Hill roundabout.

23.6.101 During the operational phase the settings of the Scheduled medieval settlement (**H22**) of high importance and the Grade II Listed Sandford Manor (**H26**) of medium importance would be affected to a very minor degree by the additional lighting required. This would be a very low magnitude of impact to both assets of **minor adverse** significance.

d) Cumulative Operational Impacts

23.6.102 The cumulative effect of construction of the HPC Development Site and operation of the temporary jetty will not result in an increase in the overall impact on the settings of designated assets (see Cumulative Construction Impacts section, above).

23.6.103 Where the setting of a heritage asset would be affected by multiple topic specific impacts, such as: noise; air quality; lighting; and visual, the combined impact of these on setting has been assessed in the Operational Impacts Section above.

23.7 Mitigation of Impacts

a) Introduction

23.7.1 This section describes the proposed mitigation measures to manage and reduce the identified impacts on the historic environment within, and in the vicinity of, the proposed development.

23.7.2 For the purpose of this assessment, mitigation measures have been proposed where there is an adverse impact of greater than minor significance and the impact magnitude, spatial scope and temporal nature make it appropriate to do so.

23.7.3 Following discussion with English Heritage and SCC, the following mitigation is proposed.

b) Mitigation of Impacts within the HPC Development Site Boundary

23.7.4 It is proposed that part of the trackway (Green Lane) (**25**) would be preserved in-situ. The section of trackway that would be retained is the central section where the hedgerow is preserved on both sides.

23.7.5 The eastern section of the track that is to be removed would be preserved by record (see below). Excavation and recording would also take place across the western section of the track where the track would be crossed by a temporary haul road. It is proposed that, where it is appropriate, optically stimulated luminescence (OSL) dating shall be used. The hedgerow and track way would be reinstated once the haul road has been removed. The details of the excavation and recording of both ends of the trackway have been agreed with SCC HES.

23.7.6 Due to the nature of the proposed development, the preservation in-situ of the remainder of heritage sites and features within the HPC Development Site would not be an option.

23.7.7 The majority of the heritage assets would experience a high adverse permanent magnitude of impact, with either a moderate or major adverse significance during the construction phase. Due to the nature of the development and the medium to low importance of the archaeological remains, suitable mitigation would entail preservation by record as described in PPS 5 Policy HE 12: Policy Principles Guiding the Recording of Information Related to Heritage Assets (Ref. 23.5).

23.7.8 Preservation by record would comprise archaeological investigation and recording of specified site areas. This would adhere to the IfA Standards and Guidance for Archaeological Field Evaluation (Ref 23.14), IfA Standards and Guidance for Excavation (Ref. 23.43) and SCC Heritage Service Archaeological Handbook (Ref. 23.44).

23.7.9 The following sites would be subject to set-piece excavation: the Romano-British settlements (**4**) and (**67**); the middle-late Bronze Age enclosure (**68**); Bronze Age pottery assemblage (**69**); early Bronze Age cremation (**70**); possible burnt mound (**71**); the mid-late Iron Age settlement (**72**); and the medieval settlement (**73**). The areas to be excavated have been agreed with SCC HES and are shown in **Figure 23.8**.

23.7.10 Benhole Barn (**10**), Langborough Barn complex (**22**) and Sidwell Barn (**23**) would not be retained, but would be preserved by record. This would adhere to the IfA Standards and guidance for the archaeological investigation and recording of standing buildings or structures (Ref. 23.45) and would take the form of a brief written record and photographic survey of appropriate architectural features by a specialist. It has also been agreed with SCC HES that the reusable stone from the barns will be provided to Fairfield Estate for reuse as appropriate.

23.7.11 The programme of archaeological investigation and recording would be designed to mitigate the impacts of the proposed development on historic landscape features. This would include field boundaries and the sections of the track way that would not be preserved in situ.

23.7.12 The historic hedgerows would be investigated with profile sections to be excavated and recorded as appropriate. The number and location of the profile sections have been agreed with SCC HES and are shown in **Figure 23.7.**

23.7.13 Archaeological excavation and recording would be followed by an appropriate programme of post-excavation works; comprising assessment, analysis, publication and archiving.

23.7.14 Written Schemes of Investigation for the work detailed above have been agreed with SCC HES (Ref. 23.46, Ref. 23.47 and Ref. 23.48).

c) Mitigation of Impacts Outside the Site Boundary

23.7.15 The setting of the Scheduled Monument, Wick Barrow (**2**), will be altered by the proposed development. Following discussion with English Heritage and SCC HES, a

Monument Management Plan (MMP) would be implemented to ensure the long-term conservation, and enhancement, of the monument and its immediate setting.

23.7.16 The MMP establishes the baseline condition of the monument and proposes to: clear the vegetation; remove the fence; place geotextile and wire mesh over the mound; cover the mound with topsoil; and restore the grass cover. These measures will help to protect and preserve the surviving parts of the Scheduled Monument from long-term gradual deterioration.

23.7.17 The interpretation of the monument will also be improved and it will be more fully integrated within the existing and proposed land management proposals as part of the nature trail and, longer term, as part of the public information centre. The long-term management, monitoring and maintenance of the monument would also be improved.

23.7.18 Landscaping, including hedgerow and screen planting, is proposed along the western edge of the barrow field. This landscaping will help to shield Wick Barrow from Hinkley Point C to the north-west and west, while keeping the important views open to the south and south-east across Wick Moor. The full details of the proposed landscaping are provided in **Chapter 22,** of this volume.

23.7.19 Details of proposals to mitigate noise, air quality, lighting and visual impacts that could impact on the settings of designated sites are included in **Chapter 11**, **Chapter 12**, and **Chapter 22**, respectively.

23.7.20 These mitigation measures include advance planting of blocks of woodland and scattered trees along the southern HPC Development Site boundary to provide visual screening during the construction phase. This will help reduce the visual impacts to the eight Listed Buildings in Shurton.

23.7.21 Retention of HPC Development Site boundary hedgerows, including Benhole Lane, and off-site planting on the Fairfield Estate to the south-west of the HPC Development Site will reduce visual impacts to Fairfield House and Park (**D18**, **D19**).

23.7.22 No specific mitigation is proposed for the heritage assets on the Quantock Hills 10km to the west of the HPC Development Site. The implementation of the proposed Lighting Strategy (see **Chapter 3** of this volume), including directional lighting and reduction of glare at night, will minimise the impact of light pollution.

23.7.23 More substantial areas of woodland will be planted once the construction areas in the south and west of the HPC Development Site are available for restoration. These areas will provide ecological mitigation, enhance the biodiversity value of this area (**Chapter 20** of this volume), and add amenity value (**Chapter 25** of this volume) as well as providing mitigation for visual impact (**Chapter 22** of this volume) and impact on the settings of offset heritage assets.

23.7.24 These areas of woodland will reduce the impact on the settings of the Listed Buildings in Shurton (**42**-**49**) and Burton (**D130**, **D131**), Fairfield House and Park (**D18**, **D19**); and Court House (**D39**).

23.7.25 The historic landscape has been taken into account as part of the landscape restoration plans (**Chapter 22** of this volume), by replacing hedgerows along their existing lines where possible and by shaping the woodland using recommendations presented in the Fairfield Historic Landscape Assessment (Ref. 23.23). This will also partially mitigate the impact of the works on the historic landscape character.

d) Mitigation of Impacts at Washford Cross Highway Improvements

23.7.26 No mitigation is proposed for impacts to heritage assets at Washford Cross as only impacts of negligible significance have been identified.

e) Mitigation of Impacts at Sandford Hill Highway Improvements

23.7.27 No mitigation is proposed for impacts to heritage assets at Sandford Hill as only impacts of minor and negligible significance have been identified.

f) Mitigation of Cumulative Impacts

23.7.28 As the cumulative construction impacts on the settings of designated assets are assessed as being of no greater significance than that assessed for the proposed HPC Development Site, no further mitigation measures are proposed beyond those described above.

23.8 Residual Impacts

a) Construction Impacts

23.8.1 The implementation of the mitigation measures would ensure that the impacts on buried archaeological remains and other heritage assets on-site would be adequately reduced through investigation and recording, in accordance with the requirements of PPS 5 Policy HE 12 (Ref. 23.5).

23.8.2 Following mitigation, the construction phase would result in a residual impact of **minor adverse** significance on buried archaeological remains within the HPC Development Site boundary.

23.8.3 The mitigation for the trackway means that part of this feature would be retained. This partial in-situ preservation and the investigation and recording of the parts to be removed would ensure that the residual impact on this feature would be of **minor adverse** significance.

23.8.4 The MMP is designed to ensure the long-term conservation of Wick Barrow (**2**). The residual impact on the Scheduled Monument would be of **minor adverse** significance.

23.8.5 The impact to the setting of Fairfield House and Park (**D18**, **D19**) would be mitigated by advanced on-site tree planting as well as off-site planting on the Fairfield Estate. Proposals to mitigate temporary noise, air quality, lighting and visual impacts are included in **Chapter 10**, **Chapter 11**, and **Chapter 22** of this volume and these would also help to mitigate the settings impact. These measures would ensure that the residual impact is of **minor adverse** significance.

23.8.6 The advanced on-site tree planting and visual, noise, air quality and lighting proposals would also help to mitigate the impact to the remaining off-site designated heritage assets, but the residual impact to these assets would remain of **minor adverse** significance.

b) Cumulative Construction Impacts

23.8.7 The residual cumulative impacts on the settings of designated assets are no more significant than was assessed for the construction of the proposed HPC development. The predicted residual impact would be **minor adverse**.

c) Operational Impacts

23.8.8 The MMP produced to ensure the long-term conservation of Wick Barrow (**2**), and the proposed landscaping agreed with English Heritage and SCC, would ensure that the residual impact on the Scheduled Monument during the operational phase would be of **minor adverse** significance.

23.8.9 The landscaping and planting that would take place to the south and west of the HPC Development Site once the construction phase is completed, would reduce the impact on the settings of the Listed Buildings in Shurton (**42**-**49**), Burton (**D130**, **D131**), Fairfield House (**D18**, **D19**), and Court House (**D39**). The noise, air quality, lighting and visual mitigation (**Chapter 10**, **Chapter 11**, and **Chapter 22** of this volume) would also help to reduce the impact to these designated heritage assets. This would result in a residual impact of **minor adverse** significance.

23.8.10 The Scheduled Monuments on the Quantock Hills are at an elevation where it would be difficult to negate the visual impact to their setting. The proposed operational lighting (see **Chapter 4** of this volume), with directional lighting and reduction of glare at night, would minimise the impact of light pollution. The HPC Development Site would not be fully screened, but the landscaping and planting mitigation would soften the visual impact. For these reasons the residual impact to these Scheduled Monuments would be of **minor adverse** significance.

d) Cumulative Operational Impacts

23.8.11 There are no residual cumulative operational impacts to heritage assets.

23.9 Summary of Impacts

23.9.1 **Table 23.6** provides a summary of assessed impacts prior to mitigation and residual impacts with mitigation in place. No mitigation is required where impacts are assessed as of negligible or minor significance.

23.9.2 Heritage assets not affected by the works are not considered in this table.

Table 23.6: Summary of the Potential Impacts

ID	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
Construction Phase								
2	Wick Barrow (Pixies Mound)	Partial transformation of setting	Medium	Indirect Adverse Permanent	High	Major Adverse	**Monument Management Plan** and enhancements to immediate setting	Minor Adverse
4	Romano-British settlement	Loss to construction	High	Direct Adverse Permanent	Medium	Major Adverse	Preservation by record	Minor Adverse
9	Water meadows and drainage features	Loss to construction	High	Direct Adverse Permanent	Low	Moderate Adverse	Preservation by record	Minor Adverse
10	Benhole Farm and Barn	Loss to construction	High	Direct Adverse Permanent	Low	Moderate Adverse	Preservation by record	Minor Adverse
11	Possible water meadow system	Loss to construction	High	Direct Adverse Permanent	Low	Moderate Adverse	Preservation by record	Minor Adverse
12	Water meadow system	Loss to construction	High	Direct Adverse Permanent	Low	Moderate Adverse	Preservation by record	Minor Adverse
22	Langborough Barns	Loss to construction	High	Direct Adverse Permanent	Low	Moderate Adverse	Preservation by record	Minor Adverse
23	Sidwell Barn	Loss to construction	High	Direct Adverse Permanent	Low	Moderate Adverse	Preservation by record	Minor Adverse

ID	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
25	East-west trackway, Green Lane	Partial loss to construction	Medium	Direct Adverse Permanent	Medium	Moderate Adverse	Preservation by record for lost section. Preservation in-situ for the majority of the trackway	Minor Adverse
31	Small stone bridge	Loss to construction	High	Direct Adverse Permanent	Low	Moderate Adverse	Preservation by record	Minor Adverse
41	Remains of North Lane	Loss to construction	High	Direct Adverse Permanent	Very Low	Minor Adverse	None Required	Minor Adverse
42	Thatch End	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse
43	Footbridge	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse
44	Fishers and Brookside	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse
45	Shurton Lodge and outbuilding	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse
46	Cottage	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse
47	Shurton Court and No.2 Shurton Court	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse

ID	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
48	Ash Cottage and Little Ash	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse
49	Shurton Mills	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse
50	Deserted farm, Corner, N of Shurton	Loss to construction	High	Direct Adverse Permanent	Very Low	Minor Adverse	None Required	Minor Adverse
53	Stone wall built along Bum Brook	Loss to construction	High	Direct Adverse Permanent	Very Low	Minor Adverse	None Required	Minor Adverse
54	Remains of accommodation camp	Loss to construction	No Impact	N/A	Very Low	N/A	None Required	No Impact
56	Canalised stream	Loss to construction	High	Direct Adverse Permanent	Very Low	Minor Adverse	None Required	Minor Adverse
67	Romano-British settlement	Loss to construction	High	Direct Adverse Permanent	Medium	Major Adverse	Preservation by record	Minor Adverse
68	Middle-Late Bronze Age Enclosure	Loss to construction	High	Direct Adverse Permanent	Medium	Major Adverse	Preservation by record	Minor Adverse
69	Middle-Late Bronze Age deposit	Loss to construction	High	Direct Adverse Permanent	Medium	Major Adverse	Preservation by record	Minor Adverse

ID	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
70	Early Bronze Age Cremation	Loss to construction	High	Direct Adverse Permanent	Medium	Major Adverse	Preservation by record	Minor Adverse
71	Possible Burnt Mound	Loss to construction	High	Direct Adverse Permanent	Low	Moderate Adverse	Preservation by record	Minor Adverse
72	Mid-Late Iron Age Settlement	Loss to construction	High	Direct Adverse Permanent	Low	Moderate Adverse	Preservation by record	Minor Adverse
73	Medieval Settlement	Loss to construction	High	Direct Adverse Permanent	Low	Moderate Adverse	Preservation by record	Minor Adverse
	Historic hedgerows	Loss to construction	High	Direct Adverse Permanent	Low	Moderate Adverse	Preservation by record	Minor Adverse
HLC2	Anciently enclosed land	Loss to construction	Medium	Direct Adverse Permanent	Medium	Moderate Adverse	Preservation by record	Minor Adverse
HLC3 HLC4 HLC5	Recently enclosed land	Loss to construction	Medium	Direct Adverse Permanent	Very Low	Minor Adverse	None Required	Minor Adverse
D17	Stogursey Conservation Area	Minor change to setting	Very Low	Indirect Adverse Temporary	Medium	Minor Adverse	None Required	Minor Adverse
D18 D19	Fairfield House and Garden	Partial transformation of setting	Medium	Indirect Adverse Temporary	High	Major Adverse	Landscaping and screen planting to reduce visual impacts	Minor Adverse

ID	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
D39	Court House, East Quantoxhead	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D43	Four cairns on Hurley Beacon	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D47	Barrows on Longstone Hill	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D48	Bowl barrow 100m north-west of Halsway Post	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D49	Bowl barrow 80m north of Halsway Post	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D50	Bowl barrow 122m NNW of Halsway Post	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D51	Bowl barrow on Thorncombe Hill 500m north-west of Halsway Post	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D52	Bowl barrow 225m north-west of Halsway Post	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse

ID	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
D53	Bowl barrow on Longstone Hill, 270m NNE of Bicknoller Post	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D55	Cairn 150m SSE of the OS survey triangulate-on point on Beacon Hill	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D56	Two bowl barrows on Beacon Hill	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D57	Cairn 90m SSE of the OS triangulate-on point on Beacon Hill	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D60	Cairn on Thorncombe Hill, 990m north-west of Halsway Post	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D61	Bowl barrow on Thorncombe Hill	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D62	Barrow and cairn cemetery on Black Hill	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse

ID	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
D63	Three bowl barrows on Black Hill	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D67	Ruined Cairn on Higher Hare Knap	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D68	Dowsborough Camp hillfort and associated round barrow	Minor change to setting	Very Low	Indirect Adverse Temporary	High	Minor Adverse	None Required	Minor Adverse
D130	Baptist Chapel, Burton	Minor change to setting	Low	Indirect Adverse Temporary	Medium	Minor Adverse	None Required	Minor Adverse
D131	The Manse, Burton	Minor change to setting	Low	Indirect Adverse Temporary	Medium	Minor Adverse	None Required	Minor Adverse
H5	Milestone at Washford Cross	Minor change in location	Very Low	Direct Adverse Permanent	Very Low	Negligible	None Required	Negligible
H6	Minehead to Nether Stowey turnpike road	Very minor loss to construction	Very Low	Direct Adverse Permanent	Very Low	Negligible	None Required	Negligible
H7	Watchet to Skilgate turnpike road	Very minor loss to construction	Very Low	Direct Adverse Permanent	Very Low	Negligible	None Required	Negligible
H22	Medieval settlement	Very minor change to setting	Very Low	Indirect Adverse Permanent	High	Minor Adverse	None Required	Minor Adverse

ID	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
H23	Toll House site	Very minor loss to construction	Very Low	Direct Adverse Permanent	Very Low	Negligible	None Required	Negligible
H24	Nether Stowey to Ashcott turnpike road	Very minor loss to construction	Very Low	Direct Adverse Permanent	Very Low	Negligible	None Required	Negligible
H26	Sandford Manor	Very minor change to setting	Very Low	Indirect Adverse Permanent	Medium	Minor Adverse	None Required	Minor Adverse
Operational Phase								
2	Wick Barrow (Pixies Mound)	Partial transformation of setting	Medium	Indirect Adverse Permanent	High	Major Adverse	**Monument Management Plan** and enhancements to immediate setting	Minor Adverse
42	Thatch End	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse
43	Footbridge	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse
44	Fishers and Brookside	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse
45	Shurton Lodge and outbuilding	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse

ID	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
46	Cottage	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse
47	Shurton Court and No.2 Shurton Court	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse
48	Ash Cottage and Little Ash	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse
49	Shurton Mills	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and screen planting	Minor Adverse
D17	Stogursey Conservation Area	Minor change to setting	Very Low	Indirect Adverse Permanent	Medium	Minor Adverse	None Required	Minor Adverse
D18 D19	Fairfield House and Garden	Partial transformation of setting	Medium	Indirect Adverse Permanent	High	Major Adverse	Landscaping and on-site and off-site screen planting to reduce visual impacts	Minor Adverse
D39	Court House, East Quantoxhead	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D43	Four cairns on Hurley Beacon	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D47	Barrows on Longstone Hill	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse

ID	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
D48	Bowl barrow 100m north-west of Halsway Post	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D49	Bowl barrow 80m north of Halsway Post	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D50	Bowl barrow 122m NNW of Halsway Post	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D51	Bowl barrow on Thorncombe Hill 500m north-west of Halsway Post	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D52	Bowl barrow 225m north-west of Halsway Post	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D53	Bowl barrow on Longstone Hill, 270m NNE of Bicknoller Post	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D55	Cairn 150m sse of the OS survey triangulate-on point on Beacon Hill	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D56	Two bowl barrows on Beacon Hill	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse

ID	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
D57	Cairn 90m sse of the OS triangulation point on Beacon Hill	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D60	Cairn on Thorncombe Hill, 990m north-west of Halsway Post	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D61	Bowl barrow on Thorncombe Hill	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D62	Barrow and cairn cemetery on Black Hill	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D63	Three bowl barrows on Black Hill	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D67	Ruined Cairn on Higher Hare Knap	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D68	Dowsborough hillfort and associated round barrow	Minor change to setting	Low	Indirect Adverse Permanent	High	Moderate Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
D130	Baptist Chapel, Burton	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse

ID	Receptor	Potential Impact	Magnitude	Description	Value/ Sensitivity	Significance	Proposed Mitigation	Residual Impact
D131	The Manse, Burton	Minor change to setting	Low	Indirect Adverse Permanent	Medium	Minor Adverse	Landscaping and on-site screen planting to reduce visual impacts	Minor Adverse
H22	Medieval settlement	Very minor change to setting	Very Low	Indirect Adverse Permanent	High	Minor Adverse	None Required	Minor Adverse
H26	Sandford Manor	Very minor change to setting	Very Low	Indirect Adverse Permanent	Medium	Minor Adverse	None Required	Minor Adverse

References

23.1 Ancient Monuments and Archaeological Areas Act. HMSO, 1979.

23.2 Planning (Listed Buildings and Conservation Areas) Act. HMSO, 1990.

23.3 Hedgerow Regulations (SI 1997/1160). HMSO, 1997.

23.4 ODPM. Planning Policy Statement 1: Delivering Sustainable Development. HMSO, 2005.

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CHAPTER 24: OFFSHORE AND INTERTIDAL ARCHAEOLOGY

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TABLES

FIGURES

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24. OFFSHORE AND INTERTIDAL ARCHAEOLOGY

24.1 Introduction

24.1.1 This chapter of the Environmental Statement (ES) provides an assessment of the potential impacts to submerged and intertidal archaeology during the construction and operational phases of Hinkley Point C (HPC). A detailed description of the proposed development is provided in **Chapters 2, 3 and 4 of** this volume. Where required, mitigation measures are identified to prevent, reduce and where possible, off-set any potential adverse impacts that are identified to be of significance.

24.2 Scope of Assessment

24.2.1 The scope of this assessment has been determined through a formal Environmental Impact Assessment (EIA) scoping process undertaken with the Infrastructure Planning Commission (IPC). It has also been informed by ongoing consultation with statutory consultees (including Somerset County Council (SCC), English Heritage, West Somerset Council (WSC) and Sedgemoor District Council (SDC)) and the local community and the general public in response to the Stage 1, Stage 2, Stage 2 Update and M5 Junction 24 and Highway Improvements consultations.

24.2.2 The assessment of the construction and operational impacts on the submerged and inter-tidal archaeology arising from the proposed development has been undertaken adopting the methodologies described in Section 24.4 of this chapter. The existing baseline conditions, against which the likely environmental effects of the development are assessed, are described in Section 24.5.

24.2.3 **Figure 24.1** shows the location of the proposed HPC Development Site and the wider study area discussed within this report.

24.2.4 Section 24.6 of this chapter assesses the potential construction and operational impacts on the offshore and intertidal archaeology. Appropriate mitigation measures aimed at preventing, reducing or off-setting any potential adverse impacts, identified to be of significance, of the proposed development on offshore and intertidal archaeology are identified in Section 24.7 of this chapter. The assessment of residual impacts following implementation of the mitigation measures is presented in Section 24.8 of this chapter.

24.2.5 The assessment of cumulative impacts on offshore and intertidal archaeology arising from the proposed development in combination with other components of the HPC Project is made in this chapter. Cumulative impacts arising from the proposed development in combination with other relevant projects are assessed in **Volume 11** of the ES.

24.2.6 The objectives of this assessment were to:

- identify all known heritage assets within the study area boundary below the Mean High Water Springs (MHWS) that may potentially be affected by the proposed HPC development;
- assess the potential for submerged and buried archaeological remains and their likely level of preservation;
- assess the likely extent of previous impacts on submerged and buried archaeological remains;
- assess the impact of construction and operation on submerged and buried archaeological remains;
- recommend mitigation strategies aimed at preventing, reducing or off-setting any potential adverse impacts that are identified to be of significance in respect of the proposed development, if necessary; and
- identify any residual impacts.

24.3 Legislation, Policy and Guidance

24.3.1 This section identifies and describes legislation, policy and guidance of relevance to the assessment of potential impacts to the historic environment associated with the construction, operation and post-operational phases of the proposed development.

24.3.2 As stated in **Volume 1, Chapter 4**, the Overarching National Policy Statement (NPS) for Energy (NPS EN-1) when combined with the NPS for Nuclear Power Generation (NPS EN-6) provides the primary basis for decisions by the IPC on applications for nuclear power generation developments that fall within the scope of the NPSs.

24.3.3 Notwithstanding this, the IPC may consider other matters that are both important and relevant to its decision-making. This could include Planning Policy Statements (PPSs), Planning Policy Guidance Notes (PPGs), regional and local policy documents, although, if there is a conflict between these and the NPS, the NPS prevails for the purposes of IPC decision making.

24.3.4 Further, the Planning Act 2008 provides that the IPC must, in making its decision on an application, have regard to any Local Impact Report (LIR) prepared by relevant local authorities. It is anticipated that the LIRs will rely in part on PPSs, PPGs, regional and local policy to provide a context for their assessment. On this basis, regard has been given to these documents (where relevant to the technical assessment) since they are likely to inform the LIRs prepared by the relevant local authorities.

a) International Legislation

i. United Nations Convention on the Law of the Sea (UNCLOS) 1982

24.3.5 UNCLOS (Ref. 24.1) became recognised as international law in 1982 and was ratified by the UK on 25 July 1997. Article 303(1) states that: *"States have the duty* *to protect objects of an archaeological and historical nature found at sea and shall cooperate for this purpose."*

ii. European Convention on the Protection of the Archaeological Heritage (Revised) (The Valetta Convention), 1992

24.3.6 The European Convention on the Protection of the Archaeological Heritage (Revised) 1992, (Ref. 24.2) was ratified by the UK Government in 2000 and came into force on 21 March 2001.

24.3.7 The Convention clearly defines archaeological heritage as comprising "*all remains and objects and any other traces of mankind from past epochs*". This is said to include "*structures, constructions, groups of buildings, developed sites, moveable objects, monuments of other kinds as well as their context, whether situated on land or under water.*"

24.3.8 Article 2 of the Convention addresses inventorying and protection of sites and areas, the mandatory reporting of chance finds and provides for the creation of "*archaeological reserves*" on land or underwater. Article 3 promotes high standards for all archaeological work which should be carried out by suitably qualified people and Article 4 requires the conservation of excavated sites and the safe-keeping of finds. Article 5 is concerned with consultation that should take place between planning authorities and developers to reconcile and combine the respective requirements of archaeology and development. This convention binds the UK to implement protective measures regarding the archaeological heritage within its jurisdiction.

iii. UNESCO Convention on Underwater Cultural Heritage, 2001

24.3.9 The UNESCO Convention on Underwater Cultural Heritage (Ref. 24.3) was approved at the plenary session of the General Conference in 2001 and entered into force for those states that ratified it on 2 January 2009. Although the UK has not ratified it the Government has adopted the Annex to the Convention as best practice for archaeology. This Annex comprises a series of ethical rules concerning activities directed at underwater cultural heritage which provide objective standards by which to judge the appropriateness of actions in respect of archaeology underwater.

b) UK Legislation

i. Ancient Monuments and Archaeological Areas Act 1979

24.3.10 Under the terms of this act (Ref. 24.4) an archaeological site or historic building of national importance can be designated as a Scheduled Monument and is registered with the Department of Culture, Media and Sport (DCMS). This Act extends to monuments in, on or under the sea-bed in territorial waters excluding those designated under the Protection of Wrecks Act 1973 but no monuments below MHW have yet been designated in England.

24.3.11 Any development that might affect either a Scheduled Monument or its setting is subject to the granting of Scheduled Monument Consent. English Heritage (EH) advises the Government on individual cases for consent and offers advice on the management of Scheduled Monuments.

ii. The Protection of Wrecks Act (PWA) 1973

24.3.12 Under section 1 of the PWA (Ref. 24.5) wrecks and wreckage of historical, artistic and archaeological importance can be protected via designation. Once a wreck/area is designated it is an offence to carry out certain activities (e.g. survey, excavation) unless a licence is obtained. Section 2 of the Act provides for designation of wrecks that are considered dangerous due to their contents.

iii. Protection of Military Remains Act (PMRA) 1986

24.3.13 The PMRA (Ref. 24.6) automatically protects aircraft that have crashed as a part of military service. The Ministry of Defence may also choose to protect any vessel that was lost whilst serving the military.

iv. The Merchant Shipping Act (MSA) 1995

24.3.14 The MSA (Ref. 24.7) documents the procedures for determining ownership of flotsam, jetsam, derelict and lagan found in or on the shores of the sea or any tidal water. Ships, aircraft, hovercraft, cargo, equipment or any part of the above are covered by the Act. If any such material is encountered and recovered it must be reported to the Receiver of Wreck.

c) National Planning Policy

i. Planning Policy Statement 1: Delivering Sustainable Development (PPS1) (January 2005) (Ref. 24.8)

24.3.15 PPS1 sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system.

24.3.16 Paragraph 5 states that planning should facilitate and promote sustainable and inclusive patterns of urban and rural development by, amongst other things: protecting and enhancing the natural and historic environment, the quality and character of the countryside, and existing communities.

ii. Planning Policy Statement 5: Planning for the Historic Environment (PPS5) (March 2010) (Ref. 24.9)

24.3.17 PPS5 sets out planning policies on the conservation of the historic environment. It states that planning has a central role to play in conserving our heritage assets and utilising the historic environment in creating sustainable places. The policies contained within PPS5 will enable the Government's vision for the historic environment to be implemented through the planning system (page 2).

24.3.18 PPS5 introduces the concept of a "heritage asset", which is defined as those parts of the historic environment that have significance because of their historic, archaeological, architectural or artistic interest (page 5). Heritage assets include designated heritage assets (World Heritage Sites, Scheduled Monuments, Listed Buildings, Protected Wreck Sites, Registered Parks and Gardens, Registered

Battlefields and Conservation Areas) and assets identified by the local planning authority during the process of decision-making or through the plan-making process (including local listing) (page 13).

24.3.19 Policy HE1.3 states that, where conflict between climate change objectives and the conservation of heritage assets is unavoidable, the public benefit of mitigating the effects of climate change should be weighed against any harm to the significance of heritage assets in accordance with the development management principles in this PPS and national planning policy on climate change.

24.3.20 Policy HE6.1 states that local planning authorities should require an applicant to provide a description of the significance of the heritage assets affected and the contribution of their setting to that significance. The level of detail should be proportionate to the importance of the heritage asset and no more than is sufficient to understand the potential impact of the proposal on the significance of the heritage asset. Policy HE6.2 states that this information, together with an assessment of the impact of the proposal, should be set out in the application as part of the explanation of the design concept. Policy HE6.3 states that local planning authorities should not validate applications where the extent of the impact of the proposal on the significance of any heritage assets affected cannot adequately be understood from the application and supporting documents.

24.3.21 Policy HE7.2 states that, in considering the impact of a proposal on any heritage asset, local planning authorities should take into account the particular nature of the significance of the heritage asset and the value that it holds for this and future generations.

24.3.22 Policy HE7.7 states that, where loss of significance is justified on the merits of new development, local planning authorities should not permit the new development without taking all reasonable steps to ensure the new development will proceed after the loss has occurred by imposing appropriate planning conditions or securing obligations by agreement.

24.3.23 Policy HE8.1 considers non-designated heritage assets and states that the effect of an application on the significance of such a heritage asset or its setting is a material consideration in determining the application.

24.3.24 Policy HE9.1 states that there should be a presumption in favour of the conservation of designated heritage assets and the more significant the designated heritage asset, the greater the presumption in favour of its conservation should be. Significance can be harmed or lost through alteration or destruction of the heritage asset or development within its setting. Loss affecting any designated heritage asset should require clear and convincing justification.

24.3.25 Policy HE9.4 states that, where a proposal has a harmful impact on the significance of a designated heritage asset which is less than substantial harm, in all cases local planning authorities should:

"(i) weigh the public benefit of the proposal (for example, that it helps to secure the optimum viable use of the heritage asset in the interests of its long-term conservation) against the harm; and

(ii) recognise that the greater the harm to the significance of the heritage asset the greater the justification will be needed for any loss."

24.3.26 Policy HE9.6 states that there are many heritage assets with archaeological interest that are not currently designated as Scheduled Monuments, but which are demonstrably of equivalent significance. The absence of designation for such heritage assets does not indicate lower significance and they should be considered subject to the policies in HE9.1 to HE9.4 and HE10.

24.3.27 Policy HE10.1 states that, when considering applications for development that affect the setting of a heritage asset, local planning authorities should treat favourably applications that preserve those elements of the setting that make a positive contribution to or better reveal the significance of the asset. When considering applications that do not do this, local planning authorities should weigh any such harm against the wider benefits of the application. The greater the negative impact on the significance of the heritage asset, the greater the benefits that will be needed to justify approval.

24.3.28 Policy HE12.3 states that, where the loss of the whole or a material part of a heritage asset's significance is justified, local planning authorities should require the developer to record and advance understanding of the significance of the heritage asset before it is lost, using planning conditions or obligations as appropriate. The extent of the requirement should be proportionate to the nature and level of the asset's significance. Developers should publish this evidence and deposit copies of the reports with the relevant historic environment record.

iii. Planning and Policy Guidance 20: Coastal Planning (PPG20) (1992) (Ref. 24.10)

24.3.29 PPG20 is cancelled with the exception of paragraphs 2.9, 2.10, and 3.9, which concern development plans and large scale projects that require coastal locations.

24.3.30 Paragraph 2.9 states that, in the coastal zone, development plan policies should normally not provide for development which does not require a coastal location. Paragraph 2.10 goes on to state that the coast, particularly the undeveloped parts, will seldom be the most appropriate location for development. Few developments require a coastal location and, given both the physical and policy constraints in most parts of the undeveloped coast, it should not be expected to accommodate new development that could be located inland or in existing developed areas.

24.3.31 Paragraph 3.9 states that public access to the coast should be a basic principle, unless it can be demonstrated that this is damaging to nature conservation or impractical. This applies both to the developed and undeveloped coast.

iv. Consultation Paper on a New Planning Policy Statement – Planning for a Natural and Healthy Environment (2010) (Ref. 24.11)

24.3.32 In its final form, it is intended that this PPS will replace PPG20 in so far as it relates to coastal access, heritage coast and the undeveloped coast (paragraphs 2.9, 2.10 and 3.9 in PPG 20).

24.3.33 Policy NE7 (Local planning approach to the undeveloped coast and coastal access) states:

> *"Local planning authorities should maintain the natural character of the undeveloped coast, protecting and enhancing its distinctive landscapes, cultural, biodiversity and geodiversity interest. They should also seek to improve opportunities for public access and enjoyment of the coast. Particular attention should be given to areas defined as heritage coast. Policies should be consistent with their objectives, special qualities and management strategies.*
>
> *When considering suitable locations for development, local planning authorities should ensure, as far as reasonably practicable, that access to the coast and the integrity of coastal rights of way and National Trails is not constrained. Account should be taken of the likely impacts of climate and coastal change."*

v. Marine Policy Statement (MPS) March 2011 and Marine Plans drawn up under the Marine and Coastal Access Act 2009

24.3.34 The MPS (Ref. 24.12) is intended to be the first component of new systems of marine planning set to be introduced throughout the UK. The MPS provides the policy context within which Marine Plans will be developed and implemented, and establishes the direction for marine licensing and authorisation systems.

24.3.35 Paragraph 1.1.1 of the MPS states that:

> *"The MPS and Marine Plans form a new plan-led system for marine activities. They will provide for greater coherence in policy and a forward-looking, proactive and spatial planning approach to the management of the marine area, its resources, and the activities and interactions that take place within it. Marine Plans will be prepared and adopted in accordance with the relevant legislation. If appropriate, an Administration will provide guidance on the content, structure, context for and preparation of Marine Plans."*

d) National Guidance

i. England's Coastal Heritage: a statement on the management of coastal archaeology 1996

24.3.36 This document (Ref. 24.13) sets out principles for the management of coastal archaeology. It promotes the adoption of terrestrial standards to the sub-tidal area and a commitment to in situ preservation of material where possible.

ii. Code of Practice for Seabed Development, Joint Nautical Archaeology Policy Committee (JNAPC) 2006

24.3.37 This voluntary code (Ref. 24.14) provides a framework for seabed developers that is similar to current terrestrial policy and practice. The aim of the Code is to ensure best practice for seabed development, offering guidance to developers on issues ranging from risk management to legislative implications.

e) Regional Planning Policy

24.3.38 The Government's revocation of regional strategies was quashed in the High Court on 10 November 2010. However, on that same date the Government reiterated in a letter to Chief Planners its intention to revoke regional strategies through the Localism Bill. This letter was also challenged but, on 7 February 2011, the High Court held that the Government's advice to local authorities that the proposed revocation of regional strategies was to be regarded as a material consideration in their planning development control decisions should stand. The decision of the High Court was upheld by the Court of Appeal on 27 May 2011. Therefore, the regional strategies remain in place but in the case of development control decisions it is for planning decision makers to decide on the weight to attach to the strategies. **Volume 1, Chapter 4** of this ES provides a full summary of the position regarding the status of regional planning policy.

i. Regional Planning Guidance 10 for the South West (RPG10) 2001-2016 (2001) (Ref. 24.15)

24.3.39 RPG 10 sets out the broad development strategy for the period to 2016 and beyond. Policy EN3 (The Historic Environment) seeks the protection of historic and archaeological areas, sites and monuments of international, national and regional importance. This policy also advises that new development should preserve or enhance historic buildings and conservation areas and important archaeological features and their settings.

ii. The Draft Revised Regional Spatial Strategy (RSS) for the South West Incorporating the Secretary of States Proposed Changes 2008 – 2026 (July 2008) (Ref. 24.16)

24.3.40 The draft Revised Regional Spatial Strategy (RSS) looks forward to 2026 and sets out the Region's policies in relation to the development of land within the South West.

24.3.41 Policy SD3 (The Environment and Natural Resources) seeks to protect and enhance the region's environment and natural resources by, amongst other things, positive planning and design to set development within, and to enhance, local character (including setting development within the landscape of the historic environment).

24.3.42 Policy ENV1 (Protecting and Enhancing the Region's Natural and Historic Environment) states that, where development and changes in land use are planned which would affect the natural and historic environment, local authorities will first seek to avoid loss of or damage to the assets, then mitigate any unavoidable damage, and compensate for loss or damage through offsetting actions.

24.3.43 Policy ENV5 (Historic Environment) states that the historic environment of the South West will be preserved and enhanced.

iii. Somerset and Exmoor National Park Joint Structure Plan Review 1991-2011 (2000) (Policies 'saved' from 27 September 2007) (Ref. 24.17)

24.3.44 The Somerset and Exmoor National Park Joint Structure Plan was adopted in 2000 with relevant policies saved from 27 September 2007. All policies have been saved with the exception of Policy 53 which is unrelated to historic environment impacts. The Plan provides a strategic base for all land use planning within the plan area for the period up to 2011.

24.3.45 Policy 10 (Historic Landscapes) states that development proposals should take account of their impact on historic landscape character areas and registered historic landscapes (historic parks, gardens and battlefields).

24.3.46 Policy 11 (Areas of High Archaeological Potential) states that development proposals should take account of identified Areas of High Archaeological Potential or, elsewhere where there is reason to believe that important remains exist, so that appropriate assessment and necessary protection can be afforded to any archaeological remains identified.

24.3.47 Policy 12 (Nationally Important Archaeological Remains) states that there should be a presumption in favour of the physical preservation in situ of nationally important archaeological remains. The setting and amenity value of the archaeological remains should be protected.

24.3.48 Policy 13 (Locally Important Archaeological Remains) states that development proposals which affect locally important archaeological remains should take account of the relative importance of the remains. If the preservation in situ of the archaeological remains cannot be justified, arrangements should be sought to record those parts of the site that would be destroyed or altered.

24.3.49 Policy 15 (Coastal Development) states that, where any development requires an undeveloped coastal location, it should respect the natural beauty, biodiversity and geology of the coast. New coastal developments should minimise the risk of flooding, erosion and landslip.

f) Local Planning Policy

i. West Somerset Local Plan (2006) (Policies 'saved' from 17 April 2009) (Ref. 24.18)

24.3.50 The West Somerset Local Plan forms part of the Development Plan for the West Somerset. The Local Plan was adopted in April 2006 (with relevant policies ‘saved’ from 17 April 2009). The Proposals Map indicates that the HPC Development Site itself is not subject to any specific historic environment designations. The HPC Development Site lies outside of the defined Development Boundary.

24.3.51 The following policies are considered to be potentially relevant:

24.3.52 Policy AH/2 (Locally Important Archaeological Remains) states that development which is likely to damage archaeological remains of local importance will only be permitted where the importance of the development outweighs the intrinsic importance of the remains.

24.3.53 Policy AH/3 (Areas of High Archaeological Potential) states that within areas of high archaeological potential planning permission will not be granted unless an evaluation has been carried out to determine whether archaeological remains of local or national value exist on the site.

24.3.54 Policy CO/1 (The Coastal Zone) states that development proposals in any part of the Coastal Zone, including those areas of existing developed coast, will only be permitted where: the development and its associated activities are unlikely to have an adverse effect, either directly or indirectly on heritage features, landscape character areas, nature conservation interests, including sub-tidal and marine habitats, and residential amenities; the development is unlikely to have an adverse effect on the character of the coast and maintains and where possible, enhances, improves or upgrades the environment particularly in derelict and/or despoiled coastal areas; and the development requires a coastal location.

ii. West Somerset District Local Development Framework (LDF) Core Strategy (Options Paper) (January 2010) (Ref. 24.19)

24.3.55 The Core Strategy is at a preliminary stage of preparation and the Options Paper does not include any specific policies relating to offshore and intertidal archaeology impacts. The paper does however identify the types of policy that West Somerset Council (WSC) considers could be included in the Core Strategy. In relation to heritage, this includes: policies which recognise the historic character of settlements where development will be focused, and which will ensure that new development contributes positively to that character; and policies to manage the coastal zone in conjunction with the emerging **Shoreline Management Plan** (page 24).

iii. Supplementary Planning Guidance

24.3.56 Sedgemoor District Council and West Somerset Council have jointly prepared draft supplementary planning guidance in relation to the HPC Project. Box 19 in the draft HPC SPD sets out the approach to masterplanning and design of the HPC Development Site, and sets out a number of requirements that the County Council and District Councils will expect of the HPC project promoter.

24.3.57 The draft HPC SPD does not include any specific policies relating to offshore and intertidal archaeology impacts, however, in relation to general historic environment impacts at the HPC Development Site, Box 19 states that the HPC Promoter will be expected to:

> *"…minimise the individual and cumulative visual impacts on the landscape and setting of designated areas, buildings and monuments, including Exmoor National Park, AONBs, Conservation Areas, Outstanding Heritage Settlements, Listed Buildings and Scheduled Ancient Monuments and where it has been demonstrated by the HPC project promoter that the impacts are unavoidable provide appropriate levels of mitigation and compensation (page 36)".*

24.3.58 Further planning policy context is provided in the Legislative Planning Policy Context chapter (**Volume 1, Chapter 4**) and the Introduction chapter (**Volume 2, Chapter 1**).

24.4 Methodology

24.4.1 The baseline assessment and all supporting surveys have been undertaken in accordance with the published guidelines set out by the Institute for Archaeologists' (IfA) Standards and Guidance for Archaeological Desk-Based Assessment (Ref. 24.20).

24.4.2 There is, as yet, no standard or guidance published by the IfA or English Heritage specifically relating to EIAs for the historic environment. In the absence of this, therefore, use has been made (as appropriate) of guidance on assessing the effects of roads schemes on heritage, given in the Design Manual for Roads and Bridges (DMRB), Volume 11: Environmental Assessment, Section 3, Part 2, Cultural Heritage (Ref. 24.21).

24.4.3 Within this chapter, the generic descriptions used to define the level of significance and the likelihood of occurrence are those given in **Volume 1, Chapter 7** of this ES. This provides a matrix comparing the magnitude of an impact with the importance (value) of the receptor, to determine the level of significance of predicted impacts.

a) Study Area

24.4.4 The geographical extent of the study area comprises:

- the proposed jetty site located to the north of the HPC Development Site;
- the off-shore cooling water intake and outfall heads;
- the off-shore fish return outfall; and
- the onshore study area to identify terrestrial heritage assets.

24.4.5 The location of the proposed development at Hinkley Point and the wider study area is illustrated in **Figure 24.1.**

b) Baseline Assessment

24.4.6 Heritage assets were initially identified through:

- a search of the records held at the National Monuments Record (NMR) and the Somerset Historic Environment Record (HER);
- analysis of data provided by EMU, including multi-beam bathymetry, boomer data, side-scan sonar, magnetic anomalies, side-scan sonar anomalies and interpretation of boomer data;
- analysis of data provided by CEFAS/BEEMS including multi-beam bathymetry, single-beam bathymetry, side scan sonar mosaics, side scan sonar raw data and Light Detection and Ranging (LiDAR) and bathymetry merged for the River Parrett;

- analysis of bathymetry data provided by Seazone;
- examination of historical maps and Ordnance Survey Data;
- examination of LiDAR data and aerial photographs held by the Channel Coastal Observatory;
- examination of other data sources, including, the Hinkley Point Physical Sciences Report (Ref. 24.22), Scour Assessment (Ref. 24.23) and the report on Sediment Transport (Ref. 24.24) produced by CEFAS; and
- consultation with English Heritage.

24.4.7 Detailed deposit models were prepared using the borehole and vibrocore logs recovered by Fugro during the offshore geotechnical site investigation.

24.4.8 Detailed analysis of selected vibrocores was undertaken to determine the nature, date and extent of surficial deposits offshore of Hinkley Point (Ref. 24.25).

24.4.9 A summary of data sources used in this assessment is included in **Table 24.1**.

Table 24.1: Datasets reviewed as part of the Offshore and Intertidal Archaeology assessment

Originator	Data type	File type	Co-ordinate system and Datum
EMU	Multi-beam bathymetry	.txt	WGS84 UTM 30 N Chart Datum
	Boomer data	.cod	
	Side-scan sonar	.xtf	
	Magnetic anomalies	.txt	
	Side-scan sonar anomalies	.txt	
	Interpretation of boomer data	.adf	
CEFAS/BEEMS	Multi-beam bathymetry	.txt and .grd	OSGB36 Newlyn
	Single-beam bathymetry	.txt	
	Side scan sonar mosaics	.tiff	WGS84/OSGB36
	Side scan sonar raw data	.xtf	WGS84
	LiDAR and bathymetry merged for River Parrett	.grd	OSGB36 Newlyn
	Hinkley Point Physical Sciences Report	Text and figures	N/A
	Hinkley Point Site: Scour Assessment at Hinkley Point Structures TR118	Text and figures	
	TR060Hinkley Point Sediment Transport – potential impacts of and on new structures	Text and figures	
Seazone	Bathymetry	.txt	OSGB36 Newlyn

Originator	Data type	File type	Co-ordinate system and Datum
Fugro Alluvial Offshore	Borehole and Vibrocore reports	Text and photographs	OSGB36 Newlyn and Chart Datum
AMEC	Hinkley Point C: Archaeological Assessment of Offshore Vibrocores	Text and figures	OSGB36 Newlyn and Chart Datum
HR Wallingford	Hinkley Jetty Scour Assessment	Text and figures	N/A
National Monuments Record	Archaeological site location data	.shp and text	OSGB36
Somerset Sites and Monuments Record	Archaeological site location data	.shp and text	OSGB36
Ordnance Survey	Topographic and cartographic data	.shp	OSGB36
	Historic map data	.tiff	OSGB36
Channel Coastal Observatory	LiDAR data	.ascii	OSGB36 Newlyn
	Aerial photographs	.tiff	OSGB36

c) Consultation

24.4.10 Consultation has been undertaken throughout the EIA process and further information may be found in the **Consultation Report**.

24.4.11 Meetings were held with English Heritage throughout the EIA process to discuss and agree the scope of the assessment, identify potential impacts and inform the mitigation proposals.

24.4.12 It was agreed with English Heritage that an assessment of existing data would be undertaken to identify potential constraints and inform the siting of jack-up rigs, boreholes and vibrocores for the offshore geotechnical site investigation. The results of the assessment confirmed that there were no known submerged archaeological sites in the proposed borehole locations.

24.4.13 It was subsequently agreed that deposit modelling based on the core logs and data from the offshore geotechnical site investigation would be used to identify potential archaeological features and submerged landscapes. The results of the deposit modelling are summarised in Section 24.5 of this chapter.

24.4.14 Based on the results of the deposit modelling, it was agreed that a programme of specialist assessment should be undertaken on selected vibrocores to determine the nature, date and archaeological potential of surficial deposits identified in the core logs (Ref. 24.25). The results of the assessment are summarised in Section 24.5 of this chapter.

24.4.15 Following completion of the assessment it was agreed with English Heritage that a programme of further analysis and scientific dating would be undertaken on selected deposits, as recommended in the assessment report and that the dissemination of the results in appropriate, peer-reviewed, academic journals would offset the minor loss of deposits and comprise suitable mitigation of the impacts. The proposed mitigation is described in Section 24.7 of this chapter.

d) Assessment Methodology

24.4.16 **Volume 1, Chapter 7** of this ES describes the assessment methodology for this EIA. In addition the following specific methodology was applied for the historic environment in the determination of receptor importance (value) (see **Table 24.2**) and of impact magnitude (see **Table 24.3**).

i. Value and Sensitivity

24.4.17 All of the heritage assets that may be impacted by the proposed development have been assigned a level of importance in accordance with those definitions set out in **Volume 1, Chapter 7** and with the specific definitions given in **Table 24.2**.

24.4.18 PPS 5 uses the phrase "*significance of a heritage asset*" to mean "*the value of a heritage asset*" (Ref. 24.9). Assessment of the importance, or value, of heritage assets is based upon existing designations, the potential to contribute to the aims of the South West Archaeological Research Framework (SWARF) (Ref. 24.26) the Marine and Maritime Research Framework (Ref. 24.27) and the criteria described in **Table 24.2**, which is based on the DMRB (Ref. 24.21).

24.4.19 As there are no internationally important sites within the study area (e.g. World Heritage sites) the DMRB category of "Very High Importance" has not been applied.

24.4.20 Sensitivity, with regard to the historic environment, is a subjective term which describes the potential for a heritage asset to absorb change. It is generally applied to the setting of terrestrial heritage assets and is not used in this assessment.

Table 24.2: Criteria Used to Determine Importance (Value)

Importance	Description
High	Ancient monuments scheduled under the Ancient Monuments and Archaeological Areas Act 1979, or archaeological sites and remains of comparable quality, assessed with reference to the Secretary of State's non-statutory criteria, as set out in Department of Culture, Media and Sport (DCMS) Guidance on Scheduled Monuments, Annex 1 (Ref. 24.28). Sites protected under the Protection of Wrecks Act 1973. Wreckage covered by the Protection of Military Remains Act 1986. Well preserved sites/features not previously detected but considered to be of high importance based upon arguments made in relevant research frameworks.
Medium	Archaeological sites and remains which, while not of national importance, fulfil several of the Secretary of State's criteria and are important remains in their regional context.
Low	Archaeological sites and remains that are of low potential or minor importance.
Very low	Areas in which investigative techniques have produced negative or minimal evidence for archaeological remains, or where previous large-scale disturbance or removal of

Importance	Description
	deposits can be demonstrated.
Unknown	Areas that may contain potential for significant archaeological remains.

ii. Magnitude of Impacts

24.4.21 The magnitude of impacts has been based on the consequence that the proposed development would have upon the submerged archaeology resource and has been considered in terms of high, medium, low and very low (see **Table 24.3**, adapted from DMRB (Ref. 24.21)).

24.4.22 Potential impacts have also been considered in terms of permanent or temporary, adverse (negative) or beneficial (positive) and cumulative. The sources of impact may arise during construction and/or operation.

Table 24.3: Guidelines for the Assessment of Magnitude

Magnitude	Impact
High	Complete removal of an archaeological site. Severe transformation of the setting or context of a designated heritage asset or significant loss of key components in a monument group.
Medium	Removal of a major part of an archaeological site's area and loss of research potential. Partial transformation of the setting or context of a designated heritage asset or partial loss of key components in a monument group. Diminished capacity for understanding or appreciation (context) of a designated heritage asset.
Low	Removal of an archaeological site where a minor part of its total area is removed, but where the site retains a significant future research potential. Minor change to the setting of a designated heritage asset.
Very Low	No significant physical impact or change. No significant change in setting or context. No impact from changes in use, amenity or access.
Uncertain	The magnitude of the impact cannot be predicted.

iii. Significance of Impacts

24.4.23 The significance of the impact is judged on the relationship of the magnitude of impact to the assessed importance (value) of the resource. The approach taken to predict the significance of impacts, without mitigation, is outlined in **Volume 1 Chapter 7.**

24.4.24 The assessment of impact significance is the most important step in the EIA process, since it is this which is used to determine whether mitigation is required and also to determine whether mitigation measures have reduced the impact to an acceptable residual level.

24.4.25 For the purpose of this assessment, mitigation measures have been proposed where there is an impact of greater than minor adverse significance and are appropriate given their magnitude, spatial scope and temporal nature.

e) Cumulative Effects

24.4.26 **Volume 1, Chapter 7** refers to the methodology used to assess cumulative impacts. Additive and interactive effects between impacts generated within the site boundary are assessed within this chapter. Cumulative effects that consider activities and impacts generated at distance from the site are considered in **Volume 11**; this assesses the project-wide cumulative impacts and in-combination impacts with other proposed, or reasonably foreseeable projects.

f) Limitations, Constraints and Assumptions

24.4.27 Identification of buried archaeological remains offshore has been based on a staged approach comprising detailed desk-studies. The NMR, HER and core logs consulted in this chapter represent secondary data. These data are assumed to be accurate unless proven otherwise during the course of research.

24.4.28 The assessment of impacts has been based on indicative locations, existing design details and construction methodologies. It is assumed that the detailed design at construction will not substantially alter from the design described in Section 24.6.

24.4.29 Dates within the following section have been presented in three forms: prior to the Holocene, in thousand years before present (ka); for overview, date ranges in years BC/AD; and where robust calibrated radiocarbon dates are available in years cal BC/AD.

24.5 Baseline Environmental Characteristics

a) Introduction

24.5.1 This section presents the historic environment baseline for the offshore and intertidal area of the HPC Development Site and, in order to provide context, for the onshore study area. It also provides a brief summary of the geological history of the area and an account of pertinent marine processes. Further information may be found in the reports by Cefas (Ref. 24.22), EMU (Ref. 24.29) and AMEC (Ref. 24.30).

24.5.2 The heritage resource along shorelines, estuary river banks and within and below the tidal zone falls into three broad categories; sites exposed above MHWM, submerged terrestrially deposited archaeology and wrecks.

24.5.3 Throughout the Quaternary (*c.* 1.8 Million years ago (Mya) to present) the landscape of the north-west European peninsula was transformed by major cyclical changes in climate, most clearly represented by the growth and decay of continental ice sheets and the concomitant rise and fall of global and local sea levels. These fluctuations in sea level resulted in an ever changing landscape so that any one area (e.g. the Severn Estuary) could experience all physical environments from full terrestrial conditions to intertidal and even full marine conditions through a single glacial to interglacial cycle.

24.5.4 Despite these major changes Britain remained a peninsula of continental Europe for most of the Quaternary, with isolation occurring only during brief interglacial highstand events. Time transgressive separation from Europe last occurred between *c.* 14 ka (thousand years ago) and the start of the Holocene as sea levels rose in response to the deglaciation of the Last Glacial Maximum ice sheets. Unsurprisingly, considering this changing landscape history, the archaeological record of the UK shelf and its coastal margins provides essential data from the earliest occupation event (now placed at *c.* 900-800 ka (Ref. 24.31) from coastal deposits at Happisburgh in Norfolk) through to the 20th Century.

24.5.5 These dramatic changes also influenced the human colonisation of Britain such that its occupation was spatially and temporally discontinuous, marked by repeated episodes of inward migration and colonisation from Continental Europe interspersed with depopulation and localised extinction events. As such, when considering the potential of the historic environment resource, it is essential to carefully account for the submerged terrestrially deposited record. This allows for an assessment of the probability of encountering evidence for past hominin activity offshore.

b) Study Area Description

i. Topography and Bathymetry

24.5.6 The study area shown lies on the coast of Somerset, incorporating the southern and western edges of Bridgwater Bay, and comprising part of the Outer Severn Estuary (**Figure 24.1**). Bridgwater Bay lies on a bend of the Severn Estuary (**Figure 24.2**), with a deeper channel (maximum depth 42.18m Ordnance Datum (OD)) giving way to a relatively shallow and gently north-west/south-east sloping bay to the south (**Figure 24.3**).

24.5.7 Although folded and faulted bedrock dominates the seabed of the Severn Estuary, there is clear evidence of Quaternary lowstand terrestrial river systems – the “palaeo-Severn” (**Figure 24.2**). These are best defined in the northern part of the Estuary where an east-west trending main channel is fed by a number of north-south running tributaries between Porthkerry and Lavernock Point, on the South Wales coastline. On the southern margin of the Estuary the regional bathymetry only identifies two tributary systems: one running north for *c.* 9km from Porlock Bay; and a second *c.* 6.5km north-west of Hinkley Point.

24.5.8 In the higher resolution swath bathymetry data available in the immediate sub-tidal zone of the study area, no clear channel systems are present as the area is covered by unconsolidated sediments associated with the south-western margin of the Bridgwater Bay mudpatch. However, there is evidence of buried channel systems with a similar orientation to these outer exposed channels within the offshore study area.

24.5.9 **Figure 24.3** illustrates the steep nature of the eroding cliff edge at Hinkley Point, compared to the ridged, (reflecting exposed beds of limestone), yet predominantly gently sloping intertidal area below it. A clear rectangular cut (50m x 330m) oriented SSW-NNE can be identified at [GR: 321575, 146670] and is related to the construction of the existing Hinkley Point Power Station Complex.

24.5.10 The estuary of the River Parrett forms the southern part of Bridgwater Bay. LiDAR and bathymetric data supplied by CEFAS indicates a channel depth of *c.* -7mOD and width of *c.* 800m at its mouth.

ii. Geology and Marine Environment

Pre-Quaternary Geology

24.5.11 The Inner Bristol Channel and Severn Estuary area is floored by a folded and faulted succession of Carboniferous to Lower Jurassic limestones, mudstones and siltstones (**Figure 24.4**). This part of the Bristol Channel/Severn Estuary system is severely depleted in unconsolidated sediment, with large areas of the seafloor consisting of exposed bedrock (Ref. 24.32). During early Cretaceous deformation these sediments were folded into an east-west trending syncline (the Bristol Channel Basin). A comprehensive account of the geological evolution of the area is given by Tappin *et al.* (Ref. 24.33).

24.5.12 In the immediate vicinity of Hinkley Point, the exposed and partially buried bedrock is composed of a sequence of limestones, shales and mudstones, the Lower Jurassic, Blue Lias Formation.

24.5.13 At Hinkley Point tidal action has eroded the softer mudstone to leave wide rock platforms of the more competent limestone bands extending out from the cliff lines up to 500m offshore. An outlier of this erosion platform is also present offshore at Stolford, separated from Hinkley Point by the incision of a, now buried, lowstand river channel (Ref. 24.34).

Quaternary Geology

24.5.14 The Quaternary geology of the Bridgwater Bay area is dominated by cyclical changes in sea levels, through a combination of eustatic (global ocean volume) and isostatic (crustal movement) processes.

24.5.15 During the lowstand (lowest sea level) phases, fluvial incision and associated floodplain accumulation were the dominant sedimentological processes operating, whilst during the transgressions, deposition and erosion were controlled by rising base levels, leading first to estuarine and then full marine environments. During the penultimate interglacial, sea level was at approximately 70m above OD (Ref. 24.33), depositing marine and estuarine sediments inland of the present day coastline.

24.5.16 Although, these processes have been operating throughout the Quaternary, the remnant sedimentary record is probably dominated by sequences formed since the Last Glacial Maximum (*c.* 18 ka). Over this period the Bristol Channel has experienced a high rate of sea level rise through to the early Holocene, a period of deceleration during the mid Holocene and then a relatively steady increase in sea level right up to the present (Ref. 24.32). **Figure 24.5** shows (Ref. 24.32) a relative sea level curve for the Bridgwater Bay area, documenting the relatively rapid and dramatic rise in sea level through the earlier Holocene.

24.5.17 The stratigraphically earliest components of this landscape are the incised river channels identified both within the wider bathymetric data (**Figure 24.2**) and from the sub-bottom interpretation of data provided by EMU. The latter dataset describes fragments of relatively narrow (< 250m) ESE-WNW running channels that can be tentatively correlated with tributaries, exposed in the regional bathymetry, which ultimately join the main palaeo-Severn river channel system (**Figure 24.6**). These river cut features do not necessarily relate to incision during the last lowstand and could represent either a single or multiple phases of incision throughout the Quaternary.

24.5.18 During the deglaciation of the Last Glacial Maximum ice sheet and the climatic amelioration of the Holocene the area has experienced both inundation and exposure due to the complex interplay of rising sea levels, and highly differential sedimentation patterns. This complex sequence of environmental change has left a record of intercalated muds, sands and peats that describe the growth (and subsequent decay) of a major estuary in the region that extended to at least 25km inland.

24.5.19 These deposits express a broad tripartite lithostratigraphic division described as the Lower (silt dominated – deposition pre 5,000 cal BC (calibrated BC)), Middle (intercalated silts and peats – 5,000-1,500 cal BC) and Upper (silt dominated – post 1,500 cal BC) Somerset Levels Formation (Ref. 24.35), which corresponds to the Wentlooge Formation found on the Welsh coast.

24.5.20 Detailed work on the terrestrial sequences found throughout the Bridgwater Bay hinterland (broadly the Somerset Levels), demonstrates that this broad classification hides highly spatially heterogeneous sedimentary variations within these sequences.

24.5.21 Thin peat layers are found at depths between -26mOD to -8mOD with dates that range from *c.* 7,500 cal BC to c. 5,900 cal BC and are associated clearly with the Lower Somerset Levels Formation. This suggests the difference between the Lower and Middle Formations are not as different as has been previously suggested (Ref. 24.36).

24.5.22 The Middle Somerset Levels Formation corresponded to a decrease in sea level rise resulting in the sedimentation rate outstripping sea level rise, resulting in the regression of the coastline and the dominance of organic rich peat horizons within the stratigraphy. These peat horizons represent both freshwater and saltwater variants interspersed with alluvium and relate to a period of high intertidal and supra-tidal marsh and bog formation running from the late Mesolithic through to the late Bronze Age. Deposits of this Middle Somerset Levels Formation are again highly spatially heterogeneous and relatively poorly studied.

24.5.23 In addition to these natural changes, much of the land within the Somerset Levels has been repeatedly influenced by human intervention (Ref. 24.37). At least two major periods of enclosure and land reclamation have been identified, firstly during the Roman period with a second wave of reclamations beginning in the Saxon period (Ref. 24.38). Rippon reports that by the mid 3rd to mid 4th century AD, wholly freshwater conditions prevail in palaeoenvironmental studies of the Levels indicating that enclosure and reclamation had taken place (Ref. 24.39). Haslett *et al*. report a date for reclamation, based on the dated onset of Roman lead mining, of 130-221 AD (Ref. 24.40).

24.5.24 In the post-Roman period much of the area of Somerset Levels underwent a period of flooding (Ref. 24.41). The Levels were re-colonised with extensive enclosure following the Norman Conquest and the primary colonising settlements were established by the mid 12th century. A third period of flooding took place during the late Medieval period, with the levels becoming completely inundated by up to 3.5m of water during the flood of 1607 (Ref. 24.32).

24.5.25 The Somerset Levels Formation deposits are thought to be contiguous with the intertidal and subtidal zones of the Bridgwater Bay area, including the unconsolidated, muds, sands and gravels that intermittently cap the incised bedrock surface identified offshore of Hinkley Point.

24.5.26 The Steart Flats represent a significant area of the Middle Somerset Levels Formation, and are considered in more detail by Jordan (Ref. 24.42). Here, deep deposits of alluvium and freshwater peat, including the Stolford Submarine Forest, are to be found in close association with a small amount of Mesolithic archaeological material.

24.5.27 Of particular note, offshore of Hinkley Point, is the western margin of the Bridgwater Bay settled mud patch, a thin accumulation of intercalated sands and muds that are believed to have been deposited, below wave base, in response to human management of the adjacent Somerset Levels over the last two thousand years (Ref. 24.32).

c) Lithological and Stratigraphic Modelling of Deposits

24.5.28 Detailed lithological and stratigraphic modelling of coastal/offshore deposits in the region has been undertaken to extend current understanding of the pre-Quaternary geology and archaeology of the area.

24.5.29 This modelling has been based on the boreholes and vibrocores taken offshore of Hinkley between late 2009 and early 2010 by Fugro on behalf of EDF Energy.

24.5.30 In total, 23 boreholes and 64 vibrocores were recovered offshore from Hinkley Point. Fugro provided core logs and photographs for all cores, the data from which were entered into the geotechnical utilities package Rockworks 15 in order to carry out both lithological and stratigraphic modelling of these deposits (Ref. 24.30).

24.5.31 Six representative vibrocores were taken from across the offshore survey area for more detailed analysis including: detailed stratigraphic logging, photographic imaging, particle size analysis, x-radiography, pollen, microfossils (foraminifera, and diatoms) and macrofauna (shells), radiocarbon and palaeo-magnetic dating, and sediment geochemistry. Details of this work are presented in *Hinkley Point C: Archaeological Assessment of Offshore Vibrocores* (Ref. 24.25).

24.5.32 The stratigraphic model is shown in **Table 24.4** and described in detail below.

Table 24.4: Stratigraphic Sequence for the Assessed Cores

Unit	Interpretation	Somerset Level Formation Equivalent
Upper Marine sands, silts and gravels	Marine seabed sediments	Upper
Upper Peat and organic rich silts	Peat and organic rich silt deposits	Middle
Marine Silts II	Low energy intertidal/shallow water marine deposits	
Intercalated Peat	Intercalated Peat	
Marine Silts I	Low energy intertidal/shallow water marine deposit	
Lower Peat/Organic rich silts	Peat and organic rich peat deposits	Lower
Lower Silts/Clays	Freshwater and Estuarine Alluvium	
Lower Gravel	Lower Gravel	N/A
Blue Lias Bedrock	Reworked Quaternary gravels	

i. Lower Gravel

24.5.33 This unit comprised brown silty very coarse gravel. It was only recorded in the base of a sub-set of the cores and appears to rest directly on the top of bedrock. These deposits are interpreted as reworked Quaternary gravels, probably under fluvial conditions.

ii. Lower Silts and Clays

24.5.34 This unit comprised silts and gravelly silts and was recorded in the majority of cores. Where x-radiographs have been taken of this unit there is evidence of small millimetre scale density laminations. This would suggest rhythmic deposition of material in very low energy environments. In these coastal settings, such a signature is indicative of tidal rhythmites, suggesting connection with the open ocean. However, the pollen and micro-fossil assemblages suggest a freshwater origin for these and may be more akin to the varve like sequences seen commonly in lakes or still ponded water.

24.5.35 These sediments are barren of foraminifera and diatoms further supporting their deposition in a freshwater environment. Further, these sediments record low $\delta 13C$ values which is consistent with the interpretation that this is not a marine deposit, but instead is a terrestrial environment associated with a strong freshwater influence.

24.5.36 This unit is therefore interpreted as being a freshwater sequence, with the Lower Gravels, where found, indicating a higher energy potential base of the deposit.

iii. Lower Peat and Organic Rich Silt Deposits

24.5.37 The lower peat and associated organic rich clays are found throughout the area and in over 50% of the core logs. The base of this unit varies in height from *c.* -10.7mOD to a maximum recorded depth of -16 mOD.

24.5.38 The peat layers vary in thickness between 2 and 20cm in thickness, but they are heavily compacted by overlying sediment. Multiple samples have been radiocarbon dated with those from the strongest stratigraphic contexts giving consistent dates of between 7,040-6,700 cal BC.

24.5.39 The palynological data from this horizon supports the radiocarbon dates for the early Holocene and Boreal ages (Flandrian chronozone Ib and Ic). This represents a period of dynamic vegetation whereby, after the close of the last (Devensian) cold stage and thermal amelioration, flora was able to migrate from their glacial refugia. This saw the progressive establishment of warm/interglacial stage vegetation through a series of seral woodland vegetation changes. This occurred asynchronously across the country in response to ability/rate to colonise and associated edaphic (soil condition) changes (Ref. 24.43).

24.5.40 Typically, early establishment of *Juniperus* (juniper) and *Betula* (birch) as pioneer colonisers occurred at, and shortly after, c. 8,000 BC This was followed by *Corylus avellana* (hazel) and *Pinus* (pine) – the former early in south-east England – followed by *Quercus* (oak) and *Ulmus* (elm) which, as slower colonisers, ultimately ousted *Pinus* at different times during the Boreal period in southern Britain (and much later in northern parts of the country). Here, the period of pine importance/dominance was c. 6,550 BC. giving way to oak and elm domination by c. 6,050 BC. Other thermophiles (*Tilia, Fagus, Ilex*) arrived prior to c. 5,000 BC.

24.5.41 It is within this broad framework of change that the pollen data from Hinkley can be placed/correlated. The earliest phase recorded here is dominance of pine (*Pinus*) with hazel (*Corylus avellana* type). This gave the often described, Boreal, pine-hazel forest discussed in the early years of pollen analysis (Ref. 24.44; Ref. 24.45; Ref. 24.46). During this woodland phase, there are also small numbers of oak (*Quercus*) and elm (*Ulmus*). These represent the first traces after arrival of these trees into the region probably representing pollen coming from small stands in the vicinity or from more extensive, expanding woodland at greater distance from the site. Subsequently, their expansion to become the main woodland constituents is also seen.

24.5.42 Further expansion of woodland saw the arrival and expansion of other, more thermophilous taxa and those with slower migration rates. Thus, taxa such as *Hedera* (ivy) *Fagus* (beech), *Ilex* (holly) and *Alnus* (alder) are seen in the upper levels/zones.

24.5.43 Peat formation occurred under wet herb fen with evidence of grasses, sedges, reed mace, bur reed, arrowhead Royal Fern and other typical fen taxa. There is some evidence for standing water with cysts of algal *Pediastrum* and possibly pondweed (*Potamogeton*). Because of the early Holocene age of peat formation, *Alnus* (alder) carr woodland did not develop; it probably had not arrived at this location. It is, however, possible that hazel and some oak colonised drier areas of peat, especially in the latter stages of peat accumulation prior to transgression.

24.5.44 The peat horizons either contain low abundance, low diversity assemblages or are effectively barren suggestive of non-marine conditions. The effects of marine incursion are however seen in the pollen record with expansion of halophytes, predominantly *Chenopodiaceae* (goosefoots, oraches, and samphire) in the upper peat and overlying mineral sediment. Abundances do appear to increase towards the upper contacts. The species that are present are indicative of a range of environments including typical saltmarsh environments near the upper limit of marine influence; and brackish estuarine conditions with minor contributions of both high intertidal settings and open/high energy conditions.

24.5.45 Within one core (VC06) the lower peat deposit has a good transgressive contact and so represents a potential sea level index point. This interpretation is supported by the micro-fossil analysis and isotope analysis, which show progressive change within and between this and the overlying units which is suggestive of an unbroken sedimentary sequence.

24.5.46 This peat horizon would appear to be an offshore correlative of the oldest sections of the submerged forest peats identified at Stolford and in boreholes of the immediate hinterland (Ref. 24.47; Ref. 24.48).

iv. Marine Silts I

24.5.47 This unit comprised fine silts, varying in consistency between compact and soft. Marine shell fragments were found within infrequent bands.

24.5.48 This unit, along with the intercalated peat and Marine Silts II, represents part of the Middle Somerset Levels Formation. These sediments have a distinct foraminferal assemblage, more typical of brackish, low intertidal to subtidal environments with some evidence of fully marine species suggesting proximal connectivity to open marine conditions. In contrast, diatom assemblages are of rather low diversity but still contain diagnostic taxa associated with marine and brackish water conditions.

24.5.49 This unit is interpreted as a low energy marine/estuarine deposit, probably accumulating in a full subtidal condition but in close proximity to more extensive intertidal environments.

v. Intercalated Peat

24.5.50 This unit comprises very thin bands of intercalated peats. The unit has only been identified in a small number of cores, with the possibility remaining that the thin organic layers are re-deposited rather than being in-situ.

24.5.51 However, the contemporaneous Stolford stratigraphy has been interpreted as representing spatially and temporally heterogeneous progradation of the coastal zone in response to the combination of a lowering in the rate of sea level rise and hence an increased dominance of sediment accumulation. Therefore, it is more likely that they are in-situ (Ref. 24.47; Ref. 24.48).

vi. Marine Silts II

24.5.52 This unit comprises fine marine silts, identical to Marine Silts I and was also identified as a low energy marine/estuarine deposit.

vii. Upper Peat and Organic Rich Silts

24.5.53 This unit comprises organic rich silts and has been tentatively identified from Fugro geotechnical records. It is possible these relate to thin peat deposits belonging to the Middle Somerset Levels Formation.

viii. Upper Marine Sands, Silts and Gravels

24.5.54 This unit comprises the upper silt, sand and gravel deposits, potentially forming part of the Upper Somerset Level Formation. The x-radiographs for this layer show clear preservation of strong density laminations which in this location could represent tidal rhythmites. Such a tidal signal in a sedimentary sequence requires temporally or spatially restricted depositional conditions with a high sediment supply and adequate accommodation space (Ref. 24.49). This interpretation would suggest protection from the open inner shelf conditions prevalent today.

24.5.55 This unit is interpreted as marine sands, silts and gravels, forming the current seabed surface in the study area.

ix. Modern Environment

24.5.56 Bridgwater Bay is notable for its large tidal range (the mean spring tidal range is 10.74m and the mean neap tidal range is 4.8m) and extensive mudflats stretching up to 4 kilometres wide. These mudflats developed as a result of a change in sediment regime, from sand dominated to mud dominated, brought about by human land reclamation practices over the last 2,000 years.

24.5.57 The mudflats accrete during periods of calm weather, especially in summer when helped by algal binding. This forms a blanket or drape of fine sediment over the underlying more consolidated Holocene deposits. During storm events this surface blanket is eroded away, the fossil clays are exposed and are themselves weathered (Ref. 24.50).

24.5.58 The relatively raised position of Hinkley Point compared to the lower lying ground to the east, combined with the solid nature of the limestone cliffs, has ensured that changes in coastline throughout the late Holocene have had minimal impact upon the immediate area of the present Hinkley Point Power Station Complex.

24.5.59 The developmental configuration of the mouth off the Parrett, with its islands and sandbanks, has changed considerably over the last few hundred years (Ref. 24.51; Ref. 24.52; Ref. 24.53; Ref. 24.54; Ref. 24.55). Between Hinkley Point and the Parrett, Holocene deposits are mostly overlain by storm shingle ridges whilst sand beaches with dune formations stretch northwards from the Parrett up to Brean Down (Ref. 24.32).

d) Archaeological and Historical Background

24.5.60 A total of 3,235 heritage assets were identified from the records consulted for the broader study area (**Figure 24.7**). In addition three sites of archaeological interest that had not previously been recorded were located after examination of side-scan sonar and bathymetric data. The full data sets associated with this search are available within the desk based assessment (Ref. 24.30).

24.5.61 The purpose of the very broad search area was to inform the baseline assessment and therefore not all sites are commented on directly here. Those sites that are of particular significance, or that lie in close proximity to proposed areas of work are discussed. It should be noted that no sites were recorded offshore in the 'Hinkley Point Area' described in **Figure 24.1**, but that three new potential sites were found within the broader study area.

24.5.62 The period summaries below provide the broader context for the Hinkley Point study area. This is essential in order to allow determination of archaeological potential below the MHWS.

i. Palaeolithic (c. 700 ka- 9,700 BC)

24.5.63 In Britain the Palaeolithic stretched from the first recorded human arrival up to the end of the last ice age. During the colder periods of ice sheet advance *homo heidelbergensis* and *homo neanderthalensis* populations, and later *homo sapiens sapiens* appear to have retreated out of the land mass that corresponds to the British Isles and returned at warmer times. Most Palaeolithic evidence comes from the east and south of Britain and primarily from the context of caves or the generally more re-worked secondary context of river gravels.

24.5.64 There are no recorded Palaeolithic remains in the study area. However, mammoth tusks and flint assemblages have been found at St Audries Bay *c.* 10km to the west (Ref. 24.36), and Uphill c.17km to the north-east (Ref.24.26). Recent work at Doniford, 13km west of Hinkley Point, recorded a stretch of the cliffs from which Palaeolithic material was recovered (Ref. 24.56). The gravel deposits themselves varied from those which were complex and disturbed, to ones which appeared to be intact and well-bedded. This is significant as it points to the potential for primary context, or minimally moved material to be recovered from fluvial gravels even in areas which have until recently been considered of 'very low potential' for Palaeolithic archaeology. Thus, although the overall chance of encountering Palaeolithic material is seen to be low, this points to the importance of carefully considering offshore deposits for potential data pertaining to submerged land surfaces.

ii. Mesolithic (9,700 - c. 4,500 BC)

24.5.65 The end of the last ice age in the late Palaeolithic gave way to the warmer temperatures and sea level rise associated with the Holocene. Britain became separated from mainland Europe at *c.* 6,000 BC and a grassland environment was established that eventually became dense forest interspersed with freshwater lakes.

24.5.66 Sea level changes between 7,000 BC and 5,000 BC affected the upper Severn Estuary, with the marine transgression drowning the coastal woodlands and low lying landscape. The sedimentary sequences are indicative of a landscape changing between saltwater estuary, reed beds and a drier bog forming environment within which Mesolithic populations existed and adapted (Ref. 24.57).

24.5.67 Mesolithic life was characterised by seasonal rhythms and movement, a hunter gatherer lifestyle based upon the exploitation of a wide range of resources. This was achieved using a sophisticated toolkit of worked bone, antler and composite tools constructed using small blades or microliths. Coastal and riverine environments were heavily exploited by Mesolithic populations and, whilst no remains have been found, may have incorporated the use of skin and hide based watercraft (Ref. 24.58; Ref. 24.59).

24.5.68 Mesolithic flint scatters are recorded to the immediate west of Hinkley Point and also to the south of Stolford. These were found during field walking in the northern part of the site in 1992, but no evidence for Mesolithic activity was recovered during trial trenching in this area (Ref. 24.60). Portions of the offshore peat deposits and submerged forest at Stolford date to the late Mesolithic. Similar submerged forests and peat deposits at Minehead and Porlock have produced large amounts of Mesolithic material, as have the Gwent levels on the other side of the Severn Estuary (Ref. 24.61). Major Mesolithic sites in the wider area are located at Hay Wood Cave 5km to the east of Brean Down, and further inland at Avelaes Hole and Goughs Cave (Ref. 24.26).

24.5.69 Vibrocore samples and the modelling described above indicate the presence of buried peat horizons below the soft sediments offshore of Hinkley Point. Archaeologically this data provides information on the environment of the early Mesolithic. Although, no sound evidence of human effect on the vegetation has been found, micro-charcoal has been found in some of the peat. It is not possible to determine whether this is derived from anthropogenic or natural causes.

iii. Neolithic (c. 4,500- 2,000 BC)

24.5.70 The Neolithic in Britain was a period of considerable change away from the previously established Mesolithic way of life. The domestication of animals, the adoption of agriculture and at times a sedentary settled lifestyle, with land clearance for grazing and cultivation, resulted in gradual deforestation. An increase in material culture was produced by the adoption of pottery and funerary monuments began to be constructed in the landscape.

24.5.71 There has been no Neolithic material recorded in the offshore zone at Hinkley Point. Wick Barrow (also known as Pixies Mound), a scheduled round barrow with origins in the Neolithic period, is located 50m to the east of the HPC Development Site. (Ref. 24.62). Neolithic settlement evidence has been excavated in the local area to the north, at Brean Down.

24.5.72 During the early Neolithic, extensive coastal organic peat deposits were formed and preserved beneath the silty clays of subsequent mid-Holocene flooding events. These peat deposits and the environmental information contained with them are given a high priority for archaeological investigation (Ref. 24.26; Ref. 24.36; Ref. 24.63).

iv. Bronze Age (2,000 - 700 BC)

24.5.73 The Bronze Age was characterised by the adoption from the continent of metalworking, notably copper and then, with the alloying of copper and tin, bronze.

Exploitation of the environment become more intensive following this development and scattered farming settlements loosely formed into chiefdoms. The Bronze Age is notable for a marked increase in funerary monument building due to a shift away from communal burial towards single inhumations and cremation. This transition from the Neolithic into the Bronze Age is also associated with a material culture complex most readily identified with Beaker Ware pottery. Archaeological remains of Bronze Age date were recorded across the HPC Development Site (Ref. 24.60. Middle to Late Bronze Age pottery was recovered from a shallow, linear feature in the north of the HPC Development Site. The charcoal rich deposit also contained animal bone and shell. Although the nature of the deposited material suggests domestic activity no structures were identified in the vicinity of this feature. The remains of a possible prehistoric burnt mound were uncovered further to the west.

24.5.74 A substantial ditched enclosure, approximately 50m in diameter, appears to have been built and occupied during the Middle to Late Bronze Age in the south of the HPC site. In addition the truncated remains of an Early Bronze Age cremation were recorded in an area of later archaeological features spanning the Iron Age, Roman and medieval periods, to the east of the enclosure.

24.5.75 Wick Barrow was enlarged to over 25m in diameter during this period. Three crouched secondary burials were interred in the enlarged mound. In a break from earlier Neolithic practices grave goods including beaker pottery were also interred with the bodies. A large hoard of Bronze Age metalwork recovered from Wick Park in 1870 included a significant number of weapons that have led to speculations of a ritual deposit in a watery environment (Ref. 24.64).

24.5.76 A large amount of Bronze Age material has been recorded within the area along the Welsh side of the Severn Estuary (Ref. 24.60). This spatial bias is in part due to the work of Upton and Bell on the Gwent Levels (Ref. 24.36).

24.5.77 Partial remains of Bronze Age boats have been recovered from along the opposite bank of the Severn Estuary to the study area at Gold Cliff and Caldicot (Ref. 24.36). Remains, probably from Bronze Age wreck sites, have been located off Moor Sands and Langdon Bay on the south Devon coast (Ref. 24.65; Ref. 24.66; Ref. 24.67).

v. Iron Age (700 BC-AD 43)

24.5.78 The Iron Age is identified with the adoption of iron working, and greater agricultural output, in part linked to the exploitation of new varieties of barley and wheat along with other crops such as peas and beans. Settlement consisted of round houses that varied in levels of enclosure, ranging from open houses through to large defended hillforts.

24.5.79 Marine transgression during the Iron Age meant that much of the low lying study area was flooded saltmarsh (Ref. 24.32). Occupation was located on raised ground associated with outcrops of underlying geology (Ref. 24.41).

24.5.80 Residual Iron Age pottery and possible features of later prehistoric date were recorded within two later Romano-British settlements located within the HPC development site. A possible ring ditch of Mid-Late Iron Age date and a possible ditched enclosure were recorded in the south-east of the HPC development site, but the full extent of these features was obscured by later disturbance (Ref 24.60).

24.5.81 The local area contains hillforts, at Dowsborough c.8km to the south-west, Cannington, 6km to the south, Brent Knoll landward of Burnham-on-sea c.13km to the north-east, and at Brean Down 15km to the north-east.

24.5.82 An Iron Age lake settlement was located at Alstone 10km east of Hinkley Point. An Iron Age log boat has been recovered from the Somerset levels at Shapwick and shows the use of river systems and lakes as a means of transport.

vi. Roman (AD 43-450)

24.5.83 The Roman invasion in AD43 brought with it a series of sweeping changes that are visible in the archaeological record through the varied adoption of Roman material culture, building types and settlement patterns.

24.5.84 A 1st to 3rd century Romano-British settlement and a later 3rd to 4th century Romano-British settlement were identified during archaeological investigations on the HPC development site (Ref 24.60).

24.5.85 Evidence of Roman period salt production has been uncovered at Burnham and also possibly at Combwich. The discovery of over 167 salt production related sites in the area, a number that is likely an underestimate due to burial by post Roman flooding, highlights the extent of these activities (Ref. 24.41).

vii. Early medieval (AD 450-1066)

24.5.86 After the end of Roman rule there was some continuity of settlement through to the 6th and 7th centuries. Most of the evidence for the development of early medieval (Saxon) landscape comes from documentary sources and surviving landscape features such as boundaries, field divisions and place names. Drove ways were established to move livestock between pastures and settlements, open fields were divided into strips for cultivation and waterlogged land began to be reclaimed.

24.5.87 No finds or features of this date were recorded during the trial trenching or watching briefs on the HPC site (Ref 24.60).

24.5.88 Bridgwater Bay, especially the Steart mudflats, contains a large number of wooden stake fish weirs, some of which have been dated by dendrochronology to the end of the early medieval period (Ref. 24.68). These surviving structures indicate the local populations’ exploitation of marine resources and are considered to be of regional if not national importance (Ref. 24.69).

viii. Medieval (1066 – 1540 AD)

24.5.89 The medieval period built upon the already established rural landscape and agricultural systems, based upon feudal land ownership. The Norman invasion in 1066 produced a significant change in overall land ownership, along with the increasing influence of the monasteries until their dissolution between 1536 and 1541.

24.5.90 Medieval pottery fragments, of 12th to 14th century date, were recovered from heavily truncated pits and ditches close to the southern Hinkley Point C development site boundary. Fish weirs continued to be used on the intertidal mudflats through the medieval period (Ref. 24.70).

ix. Post medieval (1540-1899 AD)

24.5.91 The post medieval period saw an increase in trade and the increased growth of Bridgwater as an economic centre. Land use changed as field systems began to be enclosed, a process that started in the early medieval period before becoming almost complete by 1850.

24.5.92 Water meadows were constructed in low lying areas to further increase the productivity of pasture land. This was coupled with the increased use of fertilisers from the later 16th century onwards. This had an increasing effect on the local area as coal was imported from Wales in order to fuel the lime kilns necessary for fertiliser production. Lime kilns dot the coastline and may also be an indicator of coal landing points, with Burton Quay as an example. Stolford is recorded as being an important coal landing point, and surrounding parishioners are recorded as investing in local shipping.

24.5.93 The Severn Estuary became a major shipping channel as trade with Europe, and later the New World flourished. A number of wrecks dating from this period are present within Bridgwater Bay, ten of them positively identified (*Auckland, Edward, Endeavour, Favourite, Friends, Frances and Mary, Hope, Halcyon, Merioneth and Molly*).

x. Modern (1900 AD – present day)

24.5.94 The twentieth century again saw a change in landscape use with a loss of field boundaries due to the mechanisation of farming methods, and substantial appropriation of the area for first military and then energy generation purposes. Large offshore areas at Hinkley Point and Stolford were used by the military, with a variety of different ordnance dropped or fired into them.

24.5.95 A number of modern wrecks are identified on the mud banks of Bridgwater Bay (Ref. 24.71). Five are reported in this area within the NMR (*Providence*, *Diana*, *Borderdene* and the remains of two unidentified craft).

24.5.96 Thirteen aircraft crash sites are located within the area of Bridgwater Bay. The majority of these are either military target aircraft from the offshore firing range or losses from the Second World War, for example a German Heinkel He-111 bomber (1400154 NMR).

24.5.97 A search of the United Kingdom Hydrographic Office (UKHO) wreck record for the area shown in **Figure 24.7** produced 14 results (**Table 24.5**). Only one of these results (Wreck_ID 67535) lies close to the area of the proposed HPC development works. This is classified within UKHO records as a diffuser and was reported by the British Nuclear Group. This relates to the existing Hinkley Point nuclear plant's outfall diffuser and as such has been registered with the UKHO as a navigation hazard, rather than the remains of a wrecked vessel.

24.5.98 No protected wrecks were identified in the study area.

Table 24.5: UKHO search results for the study area (with NMR equivalency shown where available)

Wreck ID	NMR	State	Accuracy	Latitude N	Longitude W	Category	Date sunk	Type and Name
12421		Live	Precisely known	51 19'.167	003 16'.450	Foul ground	1940	S. Trawler HMS Oswalidan
12419		Live	Precisely known	51 18'.400	003 10'.133	Foul ground	1941	MV Diana
58693		Live	25m	51 18'.354	003 14'.450	Non-dangerous wreck	Not known	Not known
12418		Live	Surveyed	51 18'.100	003 03'.050	Wreck showing hull/structure	1942	SS Borderdene
12558		Live	Unreliable	51 18'.000	003 02'.000	Undefined	1996	Not known
12414		Live	Precisely known	51 16'.217	003 01'.400	Wreck showing hull/structure	1897	SV Nornen
12413		Live	Precisely known	51 15'.733	003 21'.150	Foul ground	1944	Phoenix Unit NO. 194 AX
12526		Live	Precisely known	51 14'.917	003 05'.250	Wreck showing hull/structure	1880	Wooden Sail Ketch James and Sarah
71601		Live	Approx.	51 13'.700	003 01'.000	Undefined/ obstruction	Not known	Drying ground
67535		Live	Precisely known	51 12'.930	003 08'.120	Diffuser	Not known	Not known
12527		Live	Precisely known	51 12'.733	003 03'.283	Wreck showing hull/structure	Not known	Not known
12529	1002582	Live	Unreliable	51 11'.500	003 02'.833	Undefined	Not known	Not known
59074		Live	Precisely known	51 11'.190	003 19'.740	Undefined	Not known	Not known
12528	1002981	Live	Unreliable	51 11'.000	003 03'.167	Undefined	Not known	Not known

24.5.99 A full archaeological assessment of the bathymetric and side-scan sonar datasets identified in **Table 24.1** has been undertaken to look for wreck or associated material. Thirty-eight anomalies were detected (**Table 24.6**). Of these, two are considered to be of potential archaeological significance (ID 1 and ID 38) and two may warrant further investigation (ID 2 and ID 3). The remainder are believed to be of a geological origin or debris.

24.5.100 However, in all cases these anomalies lie outside of the areas of the proposed HPC development works.

24.5.101 Geophysical anomaly ID 1 (**Figure 24.8**) represents the most significant potential wreck site identified. This is due to its previously unrecorded nature (there is no associated UKHO record), size, visibility and proximity to planned HPC development works. This anomaly lies 210m north-west of the proposed location of Intake 2.

24.5.102 The anomaly is 35m long, 15m wide, oriented NNW-SSE and resides in a scour pit oriented sub-parallel to the major tidal current direction. Although data quality is good over the anomaly, it is not possible to offer a definitive interpretation of the type of wreck/wreckage this feature represents.

24.5.103 Geophysical anomalies ID 2 and ID 3 are a pair of *c.* 10m x 10m upstanding (*c.* 0.5m relief) rectangular blocks 30m apart. They both sit within their own scour pits and are located 260m to the north-east of the diffuser target (ID 7) described above. These blocks probably relate to the construction of the existing Hinkley Point Power Station Complex.

24.5.104 A diffuser, identified in the UKHO records 600m offshore of Hinkley Point, was reported by the British Nuclear Group. These relate to the existing nuclear plant's outfall diffuser and as such have been registered with the UKHO as a navigation hazard, rather than the remains of a wrecked vessel.

24.5.105 In association with UKHO ID 67535 (which correlates with geophysical anomaly ID 7), the nuclear plant's outfall diffuser, there is evidence of two buried and partially buried dry dock structures which relate to the initial construction of the existing Hinkley Power Station Complex in the late 1950s. The first lies *c.* 300m west of the existing complex and can be seen as a partially filled cut in the bedrock 60 – 70m wide and extending offshore. A short report by Jacobs (Ref. 24.72) has identified contemporary photographs of this structure and confidently identified it as a dry dock structure.

24.5.106 A similar feature is identified on the eastern margin of the existing Hinkley Point Power Station complex. It is also cut into the local bedrock but is slightly smaller (50m) with a more consistent width. There is no associated archive material with this so it cannot be as confidently described as a dry dock.

24.5.107 In addition, to the bathymetric and side scan data EMU (Ref. 24.73) also conducted a magnetometry survey along selected transects offshore of Hinkley Point. This data was not independently assessed but suggests there are 244 'significant' anomalies in the area. Significant being defined as all anomalies greater than 0.5 nanoTesla (nT) in water depths less than 8m and greater than 3nT elsewhere.

24.5.108 Of these 'significant' anomalies only three correspond with surface anomalies identified in the sonar and swath data. Two correspond with geophysical anomaly ID 1 and one with geophysical anomaly ID 19, which is a small (5m x 5m object, 0.1m high) sitting in a larger scour pit in the far west of the survey area.

24.5.109 As discussed in the EMU report (Ref. 24.73), and the archaeological assessment for the borehole locations (Ref. 24.30), the other anomalies are likely to be indicative of buried ferrous material (potentially unexploded ordnance (UXO) or potentially archaeology) near to the anomaly locations. Only three of these anomalies, EMU Mag ID 54 (15.9 nT), ID 66 (4.2 nT) and ID 223 (1 nT), fall within a 250m box centred on the proposed site of intake 2. There are no surface expressions for these anomalies in any of the other geophysical datasets.

Table 24.6: Anomalies identified during review of side-scan sonar and swath bathymetry data

Object ID	East (OSGB)	North (OSGB)	Dimensions	Relief (m)	EMU SSS ID	EMU Mag ID	Interpretation
ID 1	317,892.62	149,029.10	35 x 15m	3	1	51, 52	Possible wreck in scour pit
ID 2	321,026.09	147,054.55	10 x 12m	0.5			Two possible concrete blocks
ID 3	321,051.87	147,062.42	11 x 9m	0.6			Two possible concrete blocks
ID 4	321,195.27	146,925.28	7 x 7m	0.4			Debris/or possible UXO
ID 5	321,184.27	146,901.01	7 x 5m	0.6			Possible oildrum
ID 6	321,260.67	146,950.01					Possible cobbles
ID 7	320,875.34	146,860.55	40 x 40m				Nuclear plant water intake
ID 8	320,258.38	147,367.56	342 x380m	2			Possible sand and gravel outcrop
ID 9	319,613.91	147,997.47	150 x 80m	0.8			Sand dune
ID 10	318,642.52	148,472.81	415 x 230m	2			Cobbler patch on chart, sand and gravel
ID 11	318,913.85	148,803.90	50 x 60m	1			Scour pit
ID 12	320,627.39	147,039.49	16 x 18m	0.7			Concrete block
ID 13	317,758.59	149,729.38	24m lines and scars				Trawl scars, anchor drags
ID 14	317,899.45	149,648.86		0.8			Scour pits, anchor drags, debris
ID 15	317,953.18	149,552.02	5 x 6	0.2			Scour pit
ID 16	316,541.32	148,998.49	16 x 3m	0.5			Scour pits
ID 17	316,120.09	148,886.85	145 x 58	0.3			Debris, possible trawl net scoop
ID 18	316,097.36	148,507.63	90m	1.2			Scour pit
ID 19	315,450.05	148,893.22	5 x 5m	0.1		190	Scour pits with objects in bottom
ID 20	317,332.83	148,741.44	80 x 40m	0.8			Probable sand bank
ID 21	316,335.70	148,782.64	5 x 3m	0.2			Small scour pits
ID 22	317,628.16	147,709.97	60 x 50m	0.1			Mound with low relief, sand and gravel detected on side scan sonar

Object ID	East (OSGB)	North (OSGB)	Dimensions	Relief (m)	EMU SSS ID	EMU Mag ID	Interpretation
ID 23	318,394.08	148,454.09	10 x 10m	0.7			Scour and raised feature
ID 24	322,374.55	148,721.38	30 x 40m	0.4			Shallow pit
ID 25	324,595.88	150,007.79	25 x 29m	0.6			Shallow pit
ID 26	318,322.12	148,362.33	7 x 7m	0.2			3 x 7m diameter objects with scour
ID 27	313,716.94	147,984.56	7 x 8m	0.5			Object with 40m of scour
ID 28	315,286.04	147,100.60	5 x 5m	0.4			Object within shallow scour
ID 29	315,696.77	147,791.05	7m across	0.2			Three possible scour features, though faint
ID 30	318,019.75	149,362.58	10 x 6m	0.3			Shallow scour pit
ID 31	324,693.42	147,871.42	21 x 9m	0.4			Pit with object
ID 32	324,830.47	149,995.31	5 x 5m	0.3			Pit with object
ID 33	322,664.62	155,550.38	24 x 8m	0.6			Pit
ID 34	324,354.83	147,607.71	5 x 5m	0.3			Pit
ID 35	321,886.15	147,431.08	18 x 5m	0.3			Pit
ID 36	324,977.50	150,674.46	2 x 2m	0.5			Raised object with pit
ID 37	327,692.56	143,965.47	26 x 23m	0.2			Unknown possible debris

e) Previous Impacts

24.5.110 Previous impacts on the known and potential submerged archaeology within the offshore area at Hinkley Point shown on **Figure 24.1** include dredging for shellfish (trawl marks visible on side-scan sonar), military use of the area, the construction of the existing Hinkley Point Power Station Complex and borehole/vibrocore extraction carried out for the HPC Project design and feasibility studies.

24.5.111 Dredging for shellfish, military use of the area, and the construction of the original Hinkley Point Power Station Complex do not appear to have impacted directly on the submerged landscape deposits identified through the modelling process.

24.5.112 The boreholes/vibrocores excavated as part of the offshore geotechnical site investigation had a minimal impact on the submerged landscape. There is no evidence of impact on any submerged archaeological sites within the area.

24.6 Assessment of Impacts

a) Construction Impacts

24.6.1 This section describes the impacts on submerged and intertidal archaeology that would occur during the construction phase of HPC. Work offshore of Hinkley Point would comprise the construction of two cooling water intake tunnels and one outfall tunnel all drilled through bedrock and each with a structure protruding from the seabed surface; construction of a temporary jetty to facilitate the construction of HPC to be dismantled and removed at the end of construction; and a fish return system.

24.6.2 A general description of the construction phase is contained in **Chapter 3** of this volume. A summary of the assessment of impacts and their significance is provided in **Table 24.7**.

i. Removal of Holocene deposits during installation of the temporary jetty

24.6.3 The jetty head arrangement will comprise a main berthing island, a berthing dolphin to the west and two mooring dolphins positioned either side and set back from the berthing face. It is anticipated that the jetty deck would be a 1.5m thick reinforced concrete slab supported by a combination of both vertical and raking piles some of which will need to be anchored to withstand the berthing loads. It may not be feasible to drive the piles directly into the rock mass hence the installation method is anticipated to be either ‘drill and drive’ or pre-drill and concrete the pile into the socket.

24.6.4 With the drill and drive approach, the pile is seated onto the rock head, a drill is then inserted down the pile shaft and a hole drilled into the rock mass, the pile is then driven into the hole, the hole is then extended and the pile is driven further into the hole until the required penetration is achieved. This technique would generate a degree of piling noise but is not anticipated to create much in the way of bed disturbance.

24.6.5 The alternative pile installation approach is for the pile to be placed into a concrete filled rock socket. The pile is firstly driven to rock head, a drill is inserted down the pile and the rock socket is drilled then enlarged using the under-reaming blades to a diameter greater than the pile. Concrete is placed into the rock socket and the pile is driven into the wet concrete. Shear rings on the pile provide a degree of tension capacity. The steel tubular piles to support the jetty head and dolphins would be driven in a similar manner to those installed for the access bridge. Pile installation would be undertaken from a jack-up barge.

24.6.6 In constructing the jetty bridge, 45 to 55 steel tubular piles of c. 860mm diameter would be installed 4m to 5m into the bedrock layer. It is estimated that 70-90 piles of c. 910mm diameter would be installed to support the jetty head deck, dolphins and fendering. Tension anchors would be installed in selective piles or the piles could be concreted into rock sockets.

24.6.7 The jetty head deck and dolphins are anticipated to be cast in-situ reinforced concrete, with construction activities being undertaken from a jack up barge. During detailed design the use of pre-cast concrete elements will be considered.

24.6.8 Consideration has been given to using monopole construction for both the mooring and berthing dolphins. It is anticipated that such an installation would involve a pile of some 2.5m to 3.0m diameter for the berthing dolphin and 1.5m to 2.0m diameter for the mooring dolphin, grouted into a 12m deep pre-drilled rock socket. The preference is likely to be for multiple piles.

24.6.9 In order to retain cement vessels afloat during unloading it is proposed to form a dredged berth pocket, 160m long, 27m wide and 3m deep (4,320m^2), seaward of the berthing face (a level c. 4.5m Below Chart Datum (BCD)).

24.6.10 There are no recorded archaeological sites, or geophysical anomalies identified within the vicinity of the proposed temporary jetty location.

24.6.11 Piling would impact on the offshore unconsolidated deposits of sands, silts, gravels and clay that occur beyond the intertidal bedrock platform and include both basal and intercalated peats.

24.6.12 Dredging of the berthing pocket would also disturb the unconsolidated sediments described above. However, none of the three vibrocores (VCJ 18, VCJ19 and VCJ21) in the proposed pocket have any clearly identified organic horizons (only ‘possible’ organics were noted between 2.36m and 2.45m below bed in VCJ21).

24.6.13 The combined footprint of the berthing pocket and piles for the jetty structure would remove less than 1% of the area of submerged landscape recorded during the offshore surveys. Thus, although the importance of the deposits is high, installation of the structures would represent a permanent impact of low magnitude. This would result in an overall impact of **moderate adverse** significance.

ii. Removal of Holocene Deposits during Construction of The Intake Tunnels and Outfall Pipe

24.6.14 Construction of the tunnels, at depth through bedrock, would not impact directly on archaeological deposits.

24.6.15 Pre-construction seabed works and installation of the intake/outfall heads would cut through the unconsolidated sediments and break the seabed surface. There would also be an impact from the footprint/anchors of the installation vessels.

24.6.16 The current designs for the intake heads have a footprint of *c.* 35.5m x 10m and a height above seabed of 2.8m, whilst the outfall pipe has a foot print of *c.* 8.8m x 9.4m with a height above seabed of *c.* 5m. The vertical connecting pipes have diameters of *c.* 6m.

24.6.17 There are no known, or potential, archaeological sites within the area of the proposed development works offshore of Hinkley Point.

24.6.18 Three magnetic anomalies have been identified within the proximity of one of the intake heads (Unit 2, Intake 2; located NGR 318014, 148854). The nearest of these, a 1 nT magnetic anomaly (EMU ID 223), is 70m to the SSE of the installation point. The other two magnetic anomalies (EMU ID 54 and EMU ID 66) are in excess of 165m away. Consequently, there is no envisaged installation impact on these features unless a very large vessel is used. If this were to be the case, avoidance blocks should be placed around magnetic anomalies (EMU ID 54 and EMU ID 66) to ensure no direct impact from the vessel footprint.

24.6.19 Similarly, Unit 2 Intake 2 lies *c.* 210 m from the location of Geophysical Anomaly ID 1 and *c.* 185m from the southern edge of its scour pit. There are no envisaged installation impacts on Geophysical Anomaly ID 1 unless very large vessels (150 m+) are used.

24.6.20 The installation of the surface intake and outfall head structures and connecting vertical shafts would impact on the sediment stratigraphy including, at one locality, examples of the basal and intercalated peats.

24.6.21 Unit 1 Intake 2, coincides with the position of borehole CBH5, which records 4.8m of unconsolidated sediment above the Blue Lias bedrock. The stratigraphy here consists of interbedded silts and sands with three peat horizons at 1.37m, 2.6m and 3.7m beneath the seabed. Unit 2 Intake 2 coincides with CBH7 which describes 4.5m of unconsolidated intercalated clays and sands with a single peat horizon 1.75m beneath the seabed. The outfall structure coincides with CBH19 which describes 9m of clays with occasional sand horizons.

24.6.22 The combined footprint of the structures (*c.* 150m^2) would remove an insignificant volume of the identified extent of the peat horizons across the offshore area (at least 160,000m^2). Thus, although the importance of the deposits is high, installation of the structures would represent a permanent impact of low magnitude. This would result in an overall impact of **moderate adverse** significance.

iii. Changes to the Potential Wreck Site (ID 1)

24.6.23 There would be **no impact** on the potential wreck site (ID 1) as a result of construction. A preferred installation pattern will be agreed with English Heritage and the installation contractor, if required, to ensure that the jack-up rigs used during construction do not interfere with the site of ID1.

iv. Fish Recovery and Return System

24.6.24 The Fish Recovery and Return System discharge line would pass landward under the seawall and intertidal zone to a sea bed outfall. A tunnel (0.8m diameter) would be drilled through bedrock. A small headwork structure at its seaward end would be located below Lowest Astronomical Tide (LAT), on the exposed surface of the Blue Lias bedrock.

24.6.25 None of the structures associated with the proposed fish return system are in the vicinity of any known archaeological sites.

24.6.26 There is a cluster of magnetic anomalies immediately offshore of Hinkley Point (EMU ID1, ID6, ID8, ID9 and ID13), which range in size from 4.5 nT to 8.2 nT. The closest one of these anomalies is located over 60m away from the proposed tunnel and headwork.

24.6.27 It is not considered that the magnetic anomalies would be impacted during construction. There is assessed to be **no impact** on submerged and intertidal archaeology from the construction of the proposed fish return system.

b) Cumulative Construction Impacts

24.6.28 Construction of the temporary jetty structure and dredging of the berthing pocket would result in an overall impact of **moderate adverse** significance. Construction of the intake tunnels and outflow pipe would also result in an overall impact of **moderate adverse** significance. However, the combined footprint of all of these structures (*c.* 5,000m^2) would remove less than 1% of the area of submerged landscape recorded during the offshore surveys. Thus, the combined low magnitude impact on deposits of high importance would not increase the overall, permanent impact of **moderate adverse** significance.

c) Operational Impacts

24.6.29 This section describes the impacts on the historic environment that would arise during the operational phase of Hinkley Point C both within the site boundary and beyond it. A general description of the operational phase is contained in **Chapter 4**. A summary of the assessment of impacts and their significance is provided in **Table 24.7**.

i. Scour of Holocene Deposits associated with the Intake Tunnels and Outfall Pipe

24.6.30 A number of studies have been undertaken to assess the operational impacts of the intake tunnels and outfall pipe.

24.6.31 It is predicted that, in the worst case scenario, structural scour would occur to a depth of 0.6m at the intake structures and 2.2m at the outflow structure. Further, at the outflow site, scour from the discharge jet is predicted to range from 1.5m to 6m (Ref. 24.23). It has also been suggested that, although localised scour may occur, there is also the possibility of accumulation of fluid muds at these sites (Ref. 24.24).

24.6.32 The proposed location of Unit 1 Intake 2 corresponds to CBH5, which records 4.8m of unconsolidated sediment, with the first peat horizon occurring at 1.37m beneath the seabed. Unit 2 intake 2 coincides with CBH7, which records 4.5m of unconsolidated intercalated clays and sands with a single peat horizon 1.75m beneath the seabed. The proposed outfall location coincides with CBH19 which records 9m of clays with occasional sand horizons.

24.6.33 The spatial extent of scour development is always difficult to predict particularly in cohesive sediments such as occur at the seabed at all of these localities. Slopes greater than 40-45^{o} can be maintained which would result in scour extents of only a few metres (Ref. 24.30). Even if coarser material was encountered at depth and began to dominate the process the predictions would suggest scour up to a maximum extent of 10 metres. However, it is worth noting that at the site of geophysical anomaly ID_1 an object of roughly similar dimensions to the outfall structure has caused an east-west scour footprint of *c.* 100m a north south scour of 48m and a depth below ambient seabed of 1.4m. This is in an area of sands, as opposed to silts and clays, but it suggests that more extensive scour is possible.

24.6.34 Scour pits associated with the proposed structures, would be oriented parallel to tidal flow, which, from the bedform features alone is clearly in a broadly east to west direction. Consequently, there would be **no impact** on the potential wreck site (ID 1), or any of the offshore magnetic anomalies (EMU ID 54, ID 66 and ID 223) as a result of post installation scour.

ii. Scour and Maintenance Dredging of Holocene Deposits Associated with the Temporary Jetty

24.6.35 The scour assessment for the jetty (Ref. 24.23) suggests that scour would occur at depths of up to 1.3m based on an assumed side-by-side placement of piles which, for a single pile, would reduce to 1.1m deep. This would impact on the unconsolidated sediment stratigraphy and could potentially encounter peat horizons that occur at this depth beneath the seabed, although the majority of organic horizons in the general vicinity of the jetty and pier head occur at least 2m beneath the seabed.

24.6.36 The sediment transport studies (Ref. 24.24) suggest that the dredging pocket may silt up and it may require some form of maintenance dredging. Consequently, there are possible subsequent impacts that would occur due to post installation dredging.

24.6.37 Although the importance of the organic horizons is high, scour and maintenance dredging would represent a permanent impact of very low magnitude. This would result in an overall impact of **minor adverse** significance.

iii. Fish Recovery and Return System

24.6.38 The headwork structure for the proposed fish recovery and return system would be located below Lowest Astronomical Tide (LAT), on exposed Blue Lias bedrock surfaces. There are no recorded archaeological remains in the vicinity of the proposed locations. Consequently, there would be **no impact** on submerged or intertidal archaeology.

d) Cumulative Operational Impacts

24.6.39 There would be no cumulative operational impacts to heritage assets as no interacting offshore works in the vicinity of HPC will be required. There would be no cumulative operational impacts to heritage assets as a result of the onshore HPC development.

24.7 Mitigation of Impacts

a) Introduction

24.7.1 This section describes the proposed mitigation measures to manage and reduce, wherever possible, the impacts on the submerged and intertidal archaeology during the construction and operation of the site. Following consultation with English Heritage the following mitigation is proposed.

b) Mitigation of Impacts to Holocene Deposits

24.7.2 The most highly sensitive archaeological material offshore of Hinkley Point is represented by the submerged early Holocene landscapes buried at depth beneath the seabed. Following, extensive consultation with English Heritage, the proposed mitigation strategy is one of research and publication, to ensure preservation by record, through a two phase approach.

24.7.3 Phase 1 comprised the archaeological assessment of six of the vibrocores. These were chosen on the basis of spatial distribution, core recovery, presence of peat horizons across the full depth range and the overall stratigraphy of each core, as identified from the desk based assessment (Ref. 24.30).

24.7.4 The assessment was carried out by specialists attached to the University of Southampton led by Dr Justin Dix and Dr Fraser Sturt. The assessment comprised detailed stratigraphic logging, photographic imaging, particle size analysis, and x-radiography of the majority of the fine grained sections for each core.

24.7.5 Preliminary analysis was also undertaken to identify pollen, micro-fossils (foraminifera and diatoms) and macrofauna (shells). Radiocarbon dating was carried out on appropriate peat horizons and relative dating of part of the fine grained fraction was carried out through comparison with palaeomagnetic secular variation curves. Comparison of the sediment geochemistry against geochemical index curves of the Severn Estuary was also completed.

24.7.6 The results from this original phase, have further developed understanding of the offshore palaeo-landscapes as described in Section 24.5. Subsequently, Phase 2, will include further targeted analysis and ultimately publication of the results, in local, national and international journals.

24.7.7 Although no actual archaeological material has been identified within the proposed location for the temporary jetty, protocols for archaeological monitoring will be applied during dredging of the berth pocket.

24.7.8 Appropriate protocols for investigation and recording of suspected archaeological artefacts recovered during the construction phase, have been agreed with English Heritage. The dredge operator would observe the guidance note 'Marine Aggregate Dredging and the Historic Environment' (Ref. 24.74), and the related 'Protocol for Reporting Finds of Archaeological Interest' (Ref. 24.75).

24.7.9 These protocols would also include toolbox talks prior to commencement of works, briefing the dredge operatives on the potential for archaeological remains and provision of visual aids (posters and handouts) to assist in the identification of archaeological remains. An archaeological specialist will be on call to assist in the recovery of archaeological remains (if required).

24.7.10 If finds of archaeological interest were encountered in the course of dredging, the operator would comply with the provision of the Protocol (Ref 24.75) noted above and ensure that their discovery is reported to the Marine Management Organisation, English Heritage and SCC Historic Environment Service.

24.7.11 Provision will be made for consolidation, conservation and archiving of the remains in an appropriate museum, as well as publication of the results of appropriate assessment and analysis in a peer-reviewed, academic journal (if applicable).

24.8 Residual Impacts

a) Construction Impacts

24.8.1 The implementation of the mitigation measures would ensure that the impacts on submerged and intertidal archaeological remains would be adequately reduced through investigation and recording, in accordance with the requirements of PPS 5 Policy HE 12 (Ref. 24.9).

24.8.2 Following mitigation, the construction phase would result in a residual impact of **minor adverse** significance on Holocene deposits offshore of Hinkley Point.

b) Cumulative Construction Impacts

24.8.3 There would be no residual cumulative construction impacts to heritage assets as no interacting offshore works in the vicinity of HPC will be undertaken.

c) Operational Impacts

24.8.4 Following mitigation, the operational phase would result in a residual impact of **minor adverse** significance on Holocene deposits offshore of Hinkley Point.

d) Cumulative Operational Impacts

24.8.5 There would be no residual cumulative operational impacts to heritage assets as no interacting offshore works in the vicinity of HPC will be undertaken. There would be no cumulative operational impacts to heritage assets as a result of the onshore HPC development.

24.9 Summary of Impacts

24.9.1 **Table 24.7** provides a summary of assessed impacts prior to mitigation and residual impacts with mitigation in place.

24.9.2 Sites and features not affected by the works are not considered in this table.

Table 24.7: Summary of Impacts

ID	Receptor	Potential Impact	Magnitude	Description	Value/Sensitivity	Significance	Proposed Mitigation	Residual Impact
Construction Phase								
	Holocene deposits	Minor loss of research potential through construction activities	Low	Direct Adverse Permanent	High	Moderate adverse	Preservation by record comprising analysis and publication to address national and regional research aims	Minor adverse
Operational Phase								
	Holocene deposits	Minor loss of research potential through operational activities/scour	Very Low	Direct Adverse Permanent	High	Minor adverse	Preservation by record comprising analysis and publication to address national and regional research aims	Minor adverse

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CHAPTER 25: AMENITY AND RECREATION

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25. AMENITY AND RECREATION

25.1 Introduction

25.1.1 This chapter of the Environmental Statement (ES) provides an assessment of the potential amenity and recreation impacts associated with the construction and operational phases of the proposed development at Hinkley Point C (HPC) and the proposed highway improvement works (see **Chapters 2**, **3**, **4** and **5** of this volume for a description of the development).

25.2 Scope and Objectives of Assessment

25.2.1 The scope of this assessment has been determined through a formal Environmental Impact Assessment (EIA) scoping process undertaken with the Infrastructure Planning Commission (IPC). It has also been informed by ongoing consultation with statutory consultees, including Sedgemoor District Council (SDC), Somerset County Council (SCC) and West Somerset Council (WSC), the local community and the general public in response to the Stage 1, Stage 2, Stage 2 Update, Junction 24 and Highway Improvements consultations for the Hinkley Point C Project Development Consent Order (DCO) application.

25.2.2 The assessment of amenity and recreation impacts has been undertaken adopting the methodologies described in Section 25.4 of this chapter.

25.2.3 The existing baseline conditions, against which the likely environmental impacts of the proposed development are assessed, have been determined through desk-based data collation, field surveys and consultation with various sports and recreation organisations, and are described in Section 25.5 of this chapter. The study area for this assessment comprises:

- the HPC development site;
- the surrounding Public Rights of Way (PRoW) network (within a 1km radius of the HPC development site), including the West Somerset Coast Path (which follows the foreshore on the northern boundary of the HPC development site) and the footpaths and bridleways that extend to the east, south and west across the HPC development site to the settlements of Stogursey, Burton, Shurton, and Stolford;
- the foreshore of the Bristol Channel immediately north of the HPC development site boundary;
- a 500m wide corridor on either side of the C182 (Wick Moor Drove) running from Hinkley Point to the A39 at Cannington; and
- a 500m area around proposed off-site highway improvements works.

25.2.4 Section 25.6 of this chapter assesses the potential impacts to amenity and recreation, including:

- obstruction to PRoW;
- disturbance to users of PRoW from noise, dust, and landscape and visual changes;

- obstruction to sports and recreation facilities, open access land and public open space; and
- disturbance to sports and recreation facilities, open access land and public open space from noise, dust, and landscape and visual change during the various development stages.

25.2.5 The effects of the construction workforce are examined separately in **Chapter 9** of this volume.

25.2.6 Appropriate mitigation measures aimed at reducing the impact of the proposed development on amenity and recreation are presented in Section 25.7 of this chapter. The assessment of residual impacts following implementation of these mitigation measures is presented in Section 25.8 of this chapter.

25.2.7 The assessment of cumulative impacts with other proposed and reasonably foreseeable projects are considered in **Volume 11** of the ES.

25.2.8 The objectives of the assessment were to:

- identify the location and importance of the existing amenity and recreation resource within the study area;
- assess the effects of the proposed development during the construction and operational phases on the amenity and recreation resource;
- recommend mitigation strategies, if determined necessary, to reduce the impacts of the proposed development on the amenity and recreation resource; and
- assess the residual effects of the proposed development during the construction and operational phases on the amenity and recreation resource after implementation of the proposed mitigation measures.

25.3 Legislation, Policy and Guidance

25.3.1 This section identifies and describes legislation, policy and guidance of relevance to the assessment of potential amenity and recreation impacts associated with the construction and operational phases of the proposed development.

25.3.2 As stated in **Volume 1**, **Chapter 4**, the Overarching National Policy Statement (NPS) for Energy (NPS EN-1) when combined with the NPS for Nuclear Power Generation (NPS EN-6) provides the primary basis for decisions by the IPC on applications for nuclear power generation developments that fall within the scope of the NPSs.

25.3.3 Notwithstanding this, the IPC may consider other matters that are both important and relevant to its decision-making. These could include Planning Policy Statements (PPSs), Planning Policy Guidance Notes (PPGs), regional and local policy documents, although, if there is a conflict between these and the NPS, the NPS prevails for the purposes of IPC decision making.

25.3.4 Further, the Planning Act 2008 provides that the IPC must, in making its decision on an application, have regard to any Local Impact Report (LIR) prepared by relevant local authorities. It is anticipated that the LIRs will rely in part on PPSs, PPGs, regional and local policy to provide a context for their assessment. On this basis, regard has been given to these documents (where relevant to the technical assessment) since they are likely to inform the LIRs prepared by the relevant local authorities.

a) International Legislation

25.3.5 The scope of this assessment is not affected by European or other international legislation.

b) UK Legislation

i. The Marine and Coastal Access Act 2009 (Ref. 25.1)

25.3.6 The Marine and Coastal Access Act 2009 aims to improve public access to, and enjoyment of the English coastline, by creating a coastal margin that is available for access around the coast of England.

25.3.7 The Marine and Coastal Access Act 2009 amends the Countryside and Rights of Way (CRoW) Act 2000 (Ref. 25.2) to ensure that a two-metre wide strip of land on either side of the new route (the coastal margin that will be created through this legislation), all land seaward of the route and any of the classic coastal land types (such as dunes and cliffs to the landward side of the route) would normally be accessible to the public. Consequently, identifying the line of the route will have consequences not only for the route itself, but would lead to access being given to land around the route.

ii. The Countryside and Rights of Way (CRoW) Act 2000 (Ref. 25.2)

25.3.8 Part I of the CRoW Act is intended to give greater freedom for people to explore open countryside. It contains provisions to introduce a new statutory right of access for open-air recreation to mountain, moor, heath, down and registered common land. It also includes a power to extend the right to coastal land by order, and enables landowners voluntarily to dedicate irrevocably any land to public access.

25.3.9 Part II of the CRoW Act contains provisions designed to reform and improve rights of way. It introduces measures for the strategic review, planning and reporting of improvements to rights of way, and the promotion of increased access for people with mobility problems. A new category of right of way – restricted byway – having rights for walkers, cyclists, horse riders and horse drawn vehicles, is provided which replaces the previous category of Roads Used as Public Paths. Under Section 69, local authorities are required to have regard to the needs of disabled people when authorising the erection of gates and other barriers across rights of way to control livestock. There is also provision for occupiers of any land to temporarily divert a footpath or bridleway which passes over that land where works are likely to cause danger to users of the right of way.

iii. The Highways Act 1980 (Ref. 17.3)

25.3.10 The statutory provisions for creating, diverting and extinguishing public rights of way are enshrined in the 1980 Act, in order to protect both the public's rights and the interests of owners and occupiers. The Act also protects the interests of bodies such as statutory undertakers. The requirements for making, confirming and publicising orders are set out in Schedule 6 to the 1980 Act.

25.3.11 The duty to maintain highways rests with local highway authorities under the 1980 Act, though the authorities may also maintain public rights of way that are not publicly maintainable. Maintenance should be such that ways are capable of meeting the use that is made of them by ordinary traffic at all times of the year (Ref. 17.4), and this can include surfacing.

25.3.12 Under the Act, landowners are responsible for any structures across the public rights of way, including gates, stiles, and other structures, as well as ensuring that trees, shrubs and hedges do not overhang or obstruct the passage of pedestrians, horse-riders, and vehicles subject to the status of the public right of way.

iv. The Wildlife and Countryside Act 1981 (Ref. 25.5)

25.3.13 Part III of the Wildlife and Countryside Act 1981 places a duty on surveying authorities to keep the definitive map and statement under continuous review and to modify the map, for example, if it becomes known to the surveying authority that a right of way being a public path not shown on the map subsists over land in the area to which the map relates. The Act also contains other elements of protection of PRoW, such as the prohibition against keeping bulls on land crossed by PRoW and the appointment of wardens for PRoW.

25.3.14 The Act also includes enactment for making and confirmation of certain orders creating, extinguishing or diverting footpaths and bridleways.

v. Equality Act 2010 (Ref. 25.6)

25.3.15 The purpose of the Act is to harmonise discrimination law and to strengthen the law to support progress on equality. The Act brings together and re-states domestic discrimination law as contained in a number of pieces of legislation, including the Disability Discrimination Act 1995. The Equality Act 2010 provides that every public authority shall, in carrying out any of its functions, have due regard to the provisions of this Act. It must therefore be taken into account by public authorities when exercising their functions in respect of the provision of public footpaths and other rights of way.

25.3.16 Whilst there are no mandatory specifications laid down in the Equality Act 2010 for structures such as gaps, gates and stiles, the British Standards Institute has developed a comprehensive standard, the current version of which has been published as BS5709:2006 (Ref. 25.7).

c) National Planning Policy

i. Planning Policy Statement 1: Delivering Sustainable Development (PPS1) (2005) (Ref. 25.8)

25.3.17 PPS1 sets out the Government's overarching planning policies on the delivery of sustainable development through the planning system.

25.3.18 Paragraph 5 states that planning should facilitate and promote sustainable and inclusive patterns of urban and rural development by, amongst other things: protecting and enhancing the natural and historic environment, the quality and character of the countryside, and existing communities.

ii. Planning Policy Guidance 17: Planning for Open Space, Sport and Recreation (PPG17) (2002) (Ref. 25.9)

25.3.19 PPG17 sets out the role of the planning system in assessing opportunities and needs for open space, sports and recreation provision in development proposals. It also describes the necessity of safeguarding open space which has recreational value.

25.3.20 Paragraph 10 of PPG17 states that existing open space, sports and recreational buildings and land should not be built on unless an assessment has been undertaken which has clearly shown the open space or the buildings and land to be surplus to requirements.

25.3.21 In respect of planning applications, either within or adjoining open space, paragraph 16 of PPG17 states that local authorities should weigh any benefits being offered to the community against the loss of open space that will occur. It states that planning authorities may wish to allow small scale structures where these would support the existing recreational uses, or would provide facilities for new recreational uses.

25.3.22 Paragraph 32 of PPG17 states that recreational rights of way are an important resource and local authorities should seek opportunities to provide better facilities for walkers, cyclists and horse-riders (for example by adding links to existing rights of way networks); and to protect and enhance those parts of the rights of way network that might benefit open space.

iii. Planning and Policy Guidance Note 20: Coastal Planning (PPG 20) (1992) (Ref. 25.10)

25.3.23 PPG20 sets out the planning policies for the coast. PPG20 has been cancelled with the exception of paragraphs 2.9, 2.10 and 3.9, which concern development plans and large scale projects that require coastal locations. Paragraph 3.9 states that public access to the coast should be a basic principle, unless it can be demonstrated that this is damaging to nature conservation or impractical. This applies to both the developed and undeveloped coast.

25.3.24 Paragraphs 2.9 and 2.10 set out policies in relation to development which does not require a coastal location and are therefore not considered relevant.

iv. Planning Policy Statement 25 Supplement: Development and Coastal Change (DCC) (March 2010) (Ref. 25.11)

25.3.25 This PPS supplement sets out the Government's objectives for development and coastal change. The Government's aim is to ensure that coastal communities continue to prosper and adapt to coastal change.

25.3.26 Development Management Policy DCC5 (Policy principles guiding the consideration of applications for development in Coastal Change Management Areas) specifically states that applications for development should be considered appropriate where, following the outcome of consultation with relevant agencies and bodies, particularly the Environment Agency and local communities, it can be demonstrated, amongst other things, that the development does not hinder the creation and maintenance of a continuous signed and managed route around the coast.

v. Consultation Paper on a New Planning Policy Statement – Planning for a Natural and Healthy Environment (2010) (Ref. 25.12)

25.3.27 In its final form, it is intended that this PPS will replace PPG17. A key objective of this PPS is to bring together related policies on the natural environment and on open space and green spaces in rural and urban areas. This is to ensure that the planning system delivers healthy sustainable communities which adapt to and are resilient to climate change and gives the appropriate level of protection to the natural environment (page 10).

25.3.28 The consultation document explains that the Government continues to support the need to make adequate provision of land and facilities for sport, recreation and children's play, and intends to maintain the existing policies in PPG17. Local planning authorities will continue to be required to protect from development existing land and facilities unless it can be demonstrated that they are surplus to requirements. Where deficits are identified, local planning authorities should identify opportunities to improve provision either by providing new facilities or by making better use of existing ones (page 11).

25.3.29 The proposed PPS will also incorporate policies dealing with coastal access, heritage coasts and the undeveloped coast policies currently set out in PPG20 (page 41).

d) Regional Planning Policy

25.3.30 The Government's revocation of regional strategies was quashed in the High Court on 10 November 2010. However, on that same date the Government reiterated in a letter to Chief Planners its intention to revoke regional strategies through the Localism Bill. This letter was also challenged but, on 7 February 2011, the High Court held that the Government's advice to local authorities that the proposed revocation of regional strategies was to be regarded as a material consideration in their planning development control decisions should stand. The decision of the High Court was upheld by the Court of Appeal on 27 May 2011. Therefore, the regional strategies remain in place but in the case of development control decisions it is for planning decision makers to decide on the weight to attach to the strategies (see **Volume 1, Chapter 4** for a full summary of the position regarding the status of regional planning policy).

i. Regional Planning Guidance 10 for the South West 2001 – 2016 (2001) (RPG10) (Ref. 25.13)

25.3.31 RPG10 sets out the broad development strategy for the period to 2016 and beyond. Policy TCS2 (Culture, Leisure and Sport) states that local authorities and other agencies in their plans, policies and proposals should, amongst other things: identify and protect recreational open spaces and playing fields; identify sites and opportunities for the provision of new cultural, leisure and community sports facilities; ensure that new facilities are readily accessible by sustainable modes of transport; and encourage less intensive recreation in other areas such as river valleys and coastal areas by providing essential facilities, such as toilets, bus stops, footpaths and cycleways in appropriate sustainable locations.

ii. The Draft Revised Regional Spatial Strategy for the South West Incorporating the Secretary of State's Proposed Changes 2008 – 2026 (RSS) (July 2008) (Ref. 25.14)

25.3.32 The draft revised Regional Spatial Strategy (RSS) looks forward to 2026 and sets out the Government's policies in relation to the development of land within the region. Policy SD4 (Sustainable Communities) states that growth and development will be planned and managed positively to create and maintain sustainable communities throughout the region by, amongst other things, providing networks of accessible green space for people to enjoy.

25.3.33 Policy D (Infrastructure) states that the planning and delivery of development should ensure efficient and effective use of existing infrastructure and should provide for the delivery of new or improved transport, education, health, culture, sports and recreation, and green infrastructure in step with development.

iii. Somerset and Exmoor National Park Joint Structure Plan Review 1991-2011 (2000) (Policies 'saved' from 27 September 2007) (Ref. 25.15)

25.3.34 The Somerset and Exmoor National Park Joint Structure Plan was adopted in 2000 with relevant policies saved from 27 September 2007. All policies have been saved with the exception of Policy 53 which is unrelated to amenity and recreation impacts. The Plan provides a strategic base for all land use planning within the plan area for the period up to 2011.

25.3.35 Policy 37 (Facilities for Sport and Recreation within Settlements) states that provision should be made for the protection, maintenance and improvement of the range of facilities for sports and recreation, where they are compatible with the size and function of the settlement involved. New developments which would generate substantial transport movements should be accessible by public transport.

25.3.36 Policy 38 (Sport and Recreation in the Countryside) states that, outside of settlements, provision may be made for sport and recreation facilities, provided that they are compatible with the amenity, landscape and environment of the area. Additionally, protection should be afforded to land accessible to the public and associated public access routes, including bridleways and green lanes. New developments which would generate substantial transport movements should be accessible by public transport.

25.3.37 Policy 42 (Walking) states that facilities for pedestrians should be improved by maintaining and extending the footpath network, particularly between residential areas, shops, community facilities, workplaces and schools and by ensuring that improvements to the highway provide for safe use.

iv. Somerset's Future Transport Plan 2011- 2026 (2011)

25.3.38 The Somerset's Future Transport Plan sets out SCC's long term strategy for delivering the County's transport priorities for the period between 2011 and 2026.

25.3.39 The document recognises the value of Somerset's PRoW network and commits to maintain it and to improve the information available for people to use it. The document also states that it will seek to help people make more trips on foot and help people see the benefits of walking.

v. Somerset County Council Rights of Way Improvement Plan (2006) (Ref. 25.16)

25.3.40 The SCC Rights of Way Improvement Plan (RoWIP) sets out SCC's proposals to improve the provision of PRoW in Somerset for walkers, cyclists, equestrians and those with visual or mobility impairments. The RoWIP is based on the following six key aims which are supported by policy statements and prioritised actions (RoWIP, Section 9):

- raise the strategic profile of the PRoW network;
- improve how the PRoW network is maintained;
- improve how Definitive Map Modification and Public Path Orders are processed;
- improve access information provision;
- work in partnership with key organisations; and
- develop a safe access network.

25.3.41 The RoWIP recognises that walking is the most popular reason for the general public to visit the countryside in Somerset (page 26).

e) Local Planning Policy

i. The West Somerset District Local Plan (Adopted April 2006) (Ref. 25.17)

25.3.42 The West Somerset Local Plan forms part of the development plan for West Somerset. The Local Plan was adopted in April 2006 (with relevant policies 'saved' from 17 April 2009). The Proposals Map indicates that the HPC development site itself is not subject to any specific amenity or recreation designations.

25.3.43 The following saved policy is considered to be potentially relevant:

> *"Development proposals which would facilitate and enhance informal recreational activities and access related to the enjoyment and interpretation of the countryside will be permitted where they would:*
>
> *(i) be integrated with the PRoW system or public transport network;*
>
> *(ii) not adversely affect the character of the area; and*
>
> *(iii) not be likely to have an adverse affect on other land uses in the vicinity.""*

ii. West Somerset District Local Development Framework Core Strategy (Options Paper) (January 2010) (Ref. 25.18)

25.3.44 The Core Strategy is at a preliminary stage of preparation and the Options Paper does not include any specific policies relating to amenity and recreation impacts. The paper does however identify the types of policy that WSC considers could be included in the Core Strategy, including a policy to protect and enhance natural networks through developer contributions and the Nature Map and policies to encourage multifunctional Green Infrastructure and the creation of/improvement of access to the countryside (page 24).

iii. Supplementary Planning Guidance

25.3.45 Sedgemoor District Council and West Somerset Council have jointly prepared draft supplementary planning guidance in relation to the HPC Project. Public consultation on the Consultation Draft version of the HPC Project Supplementary Planning Document (the draft HPC SPD) commenced on 1 March 2011 and concluded on 12 April 2011. EDF Energy has submitted representations which object to the draft HPC SPD. See **Volume 1, Chapter 4** for a full summary of the position regarding the status of the draft HPC SPD.

25.3.46 In relation to PRoW, Box 16 in the draft HPC SPD states that strategic enhancements and maintenance of the PRoW network, which provides links between attractions and points of interest, should be undertaken to mitigate and compensate for cumulative obstruction and disturbance impacts (page 31).

25.4 Methodology

25.4.1 The assessment and all supporting surveys have been undertaken in accordance with the relevant EIA Directive, regulations, and various guidance documents as identified in **Volume 1**, **Chapter 7**, in particular the Guidelines for Environmental Impact Assessment (Ref. 25.19). The methodology and criteria adopted for the assessment is described in detail in **Volume 1**, **Chapter 7**.

a) Study Area

25.4.2 For the purpose of this assessment, the geographical extent of the study area under consideration includes the site itself and a 1km buffer area around the site, to ensure that the implications of the proposed development on the wider amenity and recreation resource are identified (see **Figure 25.1**). However, the study area for disturbance (indirect effects) such as noise and vibration, air quality, and landscape and visual is identified in the relevant topic chapters (**Chapters 11**, **12** and **22** of this volume).

25.4.3 The study area includes a 500m wide corridor on either side of the C182 (Wick Moor Drove), running from Hinkley Point to the A39 at Cannington; this area is shown on **Figure 25.2**.

25.4.4 A 500m study area was also selected around the proposed off-site highway improvements (as shown in **Figure 25.3**). These works would occur at the following sites:

- A38 Bristol Road/The Drove junction (see **Figure 25.6**);
- A39 Broadway/A38 Taunton Road junction (see **Figure 25.6**);
- A38 Bristol Road/Wylds Road junction (see **Figure 25.6**);
- Wylds Road/The Drove junction (see **Figure 25.6**);
- A39 New Road/B3339 Sandford Hill Roundabout (see **Figure 25.7**);
- M5 junction 23 Roundabout (see **Figure 25.8**);
- Washford Cross Roundabout (see **Figure 25.9**);
- Claylands Corner junction (see **Figure 25.10**);

- C182 Farringdon Hill Lane, Horse Crossing (see **Figure 25.11**);
- Cannington Traffic Calming Measures (see **Figure 25.12**); and
- Huntworth Roundabout (see **Figure 25.13**).

b) Baseline Assessment

25.4.5 Baseline environmental characteristics of the site and surrounding areas with specific reference to amenity and recreation were identified through:

- A Recreational Access Survey, carried out in July and August 2009 (see **Appendix 25A**). The survey entailed counts of users of PRoW, both within and outside of the school holiday period, covering the PRoW linking Shurton, Burton, Wick and the western end of Stolford to the coastline around Hinkley Point, including the West Somerset Coast Path. A questionnaire survey was undertaken as part of this exercise to gain an understanding of the patterns of use of the PRoW.
- A review of existing information, including Ordnance Survey (OS) maps and relevant websites (see Refs. 25.20, 25.21, 25.22, 25.23, 25.24, 25.25, 25.26, 25.27, 25.28, 25.29, 25.30, 25.31, and 25.32), carried out in March 2010.
- Site walkover surveys, carried out on 14 November 2007, 4 April 2008, 8 January 2010 and 11 May 2011.
- Consultation with appropriate statutory consultees and non-statutory consultees, including SCC's Rights of Way Team and local sports and recreation clubs that may be affected by, or have an interest in, the proposed development.

c) Consultation

25.4.6 A number of meetings were held with SCC's Rights of Way Officers between November 2009 and September 2011, in which discussions centred on recreational use of PRoW, the likely effects of PRoW diversions/closures, and potential mitigation measures for any impacts. Site meetings were held with a SCC Rights of Way Area Officer and a Stogursey Parish Council representative in January 2010, July 2010, November 2010, and August 2011.

25.4.7 Consultation has also been undertaken with:

- Natural England (Taunton office);
- local equestrians;
- the Ramblers Association;
- local residents;
- users of the PRoW network (members of the public) through the Recreational Access Survey carried out in July and August 2009;
- a number of local and regional sailing clubs, including the Combwich Motor Boat and Sailing Club, Burnham on Sea Motor Boat and Yacht Club, the Bristol Channel Yachting Association, and the Royal Yachting Association (RYA);
- a number of local angling organisations, including the Bridgwater Angling Association and the Burnham Boat Owners Sea Angling Association; and

- wildfowling clubs, namely the Bridgwater Bay Wildfowlers Association and the Highbridge and Huntspill Wildfowling Association.

25.4.8 Further information on the consultation undertaken is provided within the **Consultation Report**.

d) Assessment Methodology

25.4.9 **Volume 1**, **Chapter 7** of this ES describes the assessment methodology for this EIA. In addition the following specific methodology was applied for the determination of receptor value and sensitivity (see **Table 25.1**) and impact magnitude (see **Table 25.2**).

e) Value and Sensitivity

25.4.10 All of the amenity and recreation receptors that may be impacted by the proposed development have been assigned a level of importance in accordance with Institute of Environmental Management and Assessment (IEMA) guidelines (Ref. 25.19). The value or potential value of a receptor is a function of a variety of factors (e.g. community value or designation) and can be determined within a defined geographical context. For example, the following hierarchy is recommended by IEMA:

- international;
- UK;
- national (i.e. England/Northern Ireland/Scotland/Wales);
- regional;
- county (or metropolitan, e.g. in London);
- district (or unitary authority, city, or borough);
- local or parish; and
- within zone of influence only (which might be the project site or a larger area).

25.4.11 The sensitivity of an amenity or recreation receptor is defined by its ability to continue to function and or maintain its intrinsic value subject to any change caused by a development and its related activities. Sensitivity is therefore a function of the nature of the amenity or recreation receptor and its current environmental setting. It is also the case that each amenity or recreation receptor will have different sensitivities to differing types of effects. Hence the nature of direct and indirect impacts is also an important factor in the assessment.

25.4.12 Determination of the sensitivity of an amenity or recreation receptor is based on two analyses:

- Could the activity or any aspect of the development fundamentally affect the use and function of a receptor (e.g. obstructing a public right of way, or obstructing areas used for formal recreational activities such as angling and wildfowling)?
- Could the activity or any aspect of the development significantly reduce the enjoyment of the users of the receptor (e.g. through visual intrusion in what was

an area of open countryside, or though increased noise levels in previously quiet and peaceful areas)?

25.4.13 In order to help define the importance of relevant receptors, the guidance provided in **Table 25.1** has been adopted for the purposes of the evaluation of amenity and recreation assets.

Table 25.1: Criteria Used to Determine Importance

Importance/ Sensitivity	Description
High	Feature/receptor possesses key characteristics which contribute significantly to the distinctiveness and character of the site e.g. PRoW of national significance such as the West Somerset Coast Path, and receptor is identified as having very low capacity to accommodate proposed form of change (i.e. is very highly sensitive). Feature/receptor possesses very significant social/community value. Feature/receptor is extremely rare.
Medium	Feature/receptor possesses key characteristics which contribute to the distinctiveness and character of the site e.g. PRoW of regional significance, and receptor is identified as having low capacity to accommodate proposed form of change (i.e. is moderately sensitive). Feature/receptor possesses significant social/community value. Feature/receptor is rare.
Low	Feature/receptor only possesses characteristics which are locally significant e.g. local PRoW network. Feature/receptor not designated or only designated at a local level. Feature/receptor identified as having some tolerance of the proposed change subject to design and mitigation (i.e. is of low sensitivity). Feature/receptor possesses moderate social/community value. Feature/receptor is relatively common.
Very low	Feature/receptor characteristics do not make a significant contribution to the character or distinctiveness of the site and surroundings at a local scale. Feature/receptor not designated. Feature/receptor identified as being generally tolerant of the proposed change (i.e. of very low sensitivity). Feature/receptor possesses low social/community value. Feature/receptor is common.

i. Magnitude

25.4.14 Determination of the magnitude of an impact is based on the effect that the proposed development would have upon the amenity and recreation resource in the study area, and has been considered in terms of high, medium, low and very low (see **Table 25.2**). Magnitude refers to the ‘size’ or ‘amount’ of an impact and it is a function of other aspects, such as the impact’s extent, duration, likelihood and reversibility. In order to help define the level of magnitude of an impact on an amenity or recreational resource, the following guidance (see **Table 25.2**) has been adopted.

25.4.15 Where an impact could reasonably be placed within more than one magnitude rating, conservative professional judgement has been used to determine which rating would be applicable.

25.4.16 Definitions of timescales (short/medium/long-term) are presented in **Volume 1**, **Chapter 7**.

Table 25.2: Guidelines for the Assessment of Impact Magnitude

Magnitude	Guidelines
High	Significant, permanent loss or obstruction/irreversible changes to key characteristics, features or the function of amenity and recreation assets. Impact may occur over the whole asset. Impact certain or likely to occur.
Medium	Obstruction or change to key characteristics, features or the function of amenity and recreation assets in the medium term. Impact may occur over the majority of the asset. Impact likely to occur.
Low	Noticeable but not significant obstruction or change (temporary/potentially reversible), over a part of the asset, to key characteristics, features or the function of amenity and recreation assets in the short-term. Impact possibly would occur.
Very low	Barely discernible obstruction or changes over a small area, to key characteristics, features or the functions of amenity and recreation assets, which are infrequent or temporary. Impact unlikely to occur.

ii. Significance of Impacts

25.4.17 The significance of the impact is judged on the relationship of the magnitude of impact to the assessed sensitivity and/or importance of the resource. The predicted significance of the impacts, without mitigation, is outlined in **Volume 1**, **Chapter 7.**

iii. Cumulative Impacts

25.4.18 The influence of noise, air and visual related disturbance effects on the amenity and recreational resource cannot be assessed cumulatively for the reasons explained in **Volume 11** of this ES. That is, there is no established EIA methodology for assessing the interactive or combined impact of ‘change’ or ‘disturbance’ (e.g. the combined effect of increased noise and dust) on human receptors and quality of life. Human receptors tend to respond to disturbance in different ways and to varying degrees, which typically reflect personal perception and valuation of the relevant amenity and recreation asset(s). Therefore combined ‘responses’ cannot be assessed. However, such effects on human receptors are considered in the Health Impact Assessment and the direct cumulative impacts on amenity and recreation assets are assessed in **Volume 11** of this ES.

f) Limitations, Constraints and Assumptions

25.4.19 The assessment does not consider the effects of the construction workforce on the amenity and recreation provision within the study area. Impacts of the construction workforce are addressed in **Chapter 9** of this volume.

25.4.20 For the purposes of the assessment of impacts on the PRoW network, the construction phase includes the period during which the construction site is restored (as part of the landscape restoration strategy) up until the PRoW are reopened (a period of approximately 11 years).

25.4.21 The assessment of disturbance to users of amenity and recreation assets which could arise from noise, dust and visual intrusion is examined in the relevant chapters (**Chapters 11**, **12**, and **22** of this volume). The sensitivity of receptors and the criteria used in the disturbance assessments is also presented in these chapters. This chapter only provides a summary of the disturbance effects.

25.4.22 Navigational risk in relation to recreational sailing and boating is examined in **Chapter 26** of this volume.

25.5 Baseline Environmental Characteristics

a) Introduction

25.5.1 This section of the ES presents the baseline environmental characteristics for the study area, including the site.

b) Study Area Description

25.5.2 The study area for the HPC development site lies in Stogursey Parish in Somerset.

25.5.3 As shown in **Figures 25.1** and **25.2**, the northern boundary of the HPC development site is delineated by the Severn Estuary. The HPC development site extends southwards for approximately 1.5km, terminating at the village of Shurton. The western boundary runs alongside Benhole Lane, in a northerly direction to the coast, while the eastern boundary is formed by the C182 (Wick Moor Drove), which lies immediately south of the existing Hinkley Point Power Station Complex.

25.5.4 The study area includes the foreshore of the Severn Estuary and the PRoW network that services Hinkley Point and the surrounding settlements. This includes the West Somerset Coast Path, which follows the foreshore on the northern boundary of the HPC development site, and the footpaths that extend to the east, south and west across the HPC development site to Stogursey, Burton, Shurton, and Stolford.

25.5.5 The study area also extends to the south, as a 500m corridor along the C182 (Wick Moor Drove), where it joins the A39 at the south-east corner of Cannington. The C182 runs south-east from Hinkley Point, passing to the west of Combwich, before entering the northern end of Cannington and passing through the village in a north-south direction.

25.5.6 In addition, the study area encompasses a 500m area around the proposed highway improvements as identified in Section 2.4 of this chapter.

i. PRoW

HPC Development Site PRoW Network

25.5.7 **Figure 25.1** shows the PRoW network around Hinkley Point. There are a total of *c.*8.1km of PRoW within the HPC development site, including 230m of restricted byway. A total of *c.*34.5km of PRoW are located within the study area, and a total of c.73.5km are located within the Parish of Stogursey.

25.5.8 The HPC development site and study area contain a section of the West Somerset Coast Path (see **Plate 25.1** and **Plate 25.2**). A resource of national importance, the West Somerset Coast Path is a 35km linear walk that links the River Parrett Trail at Steart in Bridgwater Bay with the West Somerset Coast Path National Trail at Minehead.

Plate 25.1: View of the Foreshore from the West Somerset Coast Path (Looking East towards the Existing Hinkley Point Power Station Complex)

Plate 25.2: View of the Foreshore from the West Somerset Coast Path (Looking West)

25.5.9 The PRoW within the study area are listed in **Table 25.3**. The average length of the PRoW sectors (i.e. between the start and any connecting link with another footpath) within the study area is around 390m. To the west of the C182, a network of north-south PRoW link the settlements of Shurton, Burton, and Knighton with the West Somerset Coast Path. All of PRoW WL23/57 and part of PRoW WL23/70 are restricted byways (represented on **Figure 25.1** by the brown hashed line).

Table 25.3: PRoW within 1km of the HPC Development Site

PRoW Reference Number (Somerset County Council)		
WL23/15	WL23/45	WL23/59
WL23/16	WL23/46	WL23/60
WL23/20	WL23/47	WL23/61
WL23/21	**WL23/48**	WL23/62
WL23/22	**WL23/50**	**WL23/68**
WL23/24	WL23/52	**WL23/69**
WL23/25	WL23/53	**WL23/70 restricted byway**
WL23/28	WL23/54	WL23/71
WL23/29	WL23/55	**WL23/95**
WL23/41	**WL23/56**	**WL23/105**
WL23/43	WL23/57 restricted byway	**WL23/110**
WL23/44	WL23/58	

Note: PRoW in bold are either within or partially within the HPC development site.
Source: SCC [http://webapp1.somerset.gov.uk/SCCPROW/Index.asp?showalerts=1]

25.5.10 The PRoW network across the study area provides access to a mix of coastal and inland environments (see **Plate 25.3**), with long distance views to the west and along the West Somerset Coast Path. To the east of Hinkley Point, views are constrained with occasional distant glimpses of Exmoor and the Quantock Hills Area of Outstanding Natural Beauty (AONB) to the west and south-west, or the Brean Down/Bleadon Hills, and Mendip Hills AONB to the east. Views are experienced from Green Lane, which follows the east-west ridge running through the HPC development site (see **Plate 25.4**).

Plate 25.3: View from Junction of PRoW WL23/56 and WL23/105 (within the HPC Development Site Looking North to the Severn Estuary)

Plate 25.4: View from the East-west Ridge Path (Green Lane, WL23/110) Looking East towards the Existing Hinkley Point Power Station Complex

Usage of HPC development site PRoW Network

25.5.11 Data regarding use of the West Somerset Coast Path is presented in **Figure 25.4** and **Table 25.4**, and was obtained through consultation with SCC's Rights of Way Team. The data provides approximate visitor numbers each month along the West Somerset Coast Path between 2006 and 2009, with counts taken from the junction of PRoW WL23/56 and WL23/95. The data indicates that use of the West Somerset Coast Path generally peaks during the summer months, and also during holiday periods, including Easter.

Table 25.4: West Somerset Coast Path – Visitor Count Data 2006 to 2009

Month	Number* of Counts				
	2006	2007	2008	2009	Average
January	–	80	100	140	105
February	–	90	120	95	100
March	–	125	150	125	135
April	30	265	170	200	165
May	125	155	160	–	145
June	180	125	170	–	160
July	175	75	200	–	150
August	190	150	410	–	250
September	225	195	260	–	225
October	155	100	180	–	145
November	70	95	125	–	95
December	70	90	130	–	95

** Counts have been rounded up to nearest 5 from the original data.*
Source: Somerset County Council Environmental Directorate (2009).

25.5.12 Based on a rolling 12 months total, this shows an increasing number of users from April 2006 to April 2009, up by about 30%. However, this may be due to a depression in the number of users in 2006 and 2007 as a consequence of the foot and mouth outbreak, with numbers now rebounding. The total number of yearly users reaches a maximum of around 2,200 (for the 12 months between February 2008 and January 2009), reaching equilibrium around that number in later counts.

25.5.13 The Marine and Coastal Access Act provides for the expansion of recreational access to the coast; including the development of the England Coast Path (a coastal corridor with public access along the whole length of England's shore). This would encompass the route of the West Somerset Coast Path and Natural England and SCC (as one of the pilot authorities) are working on ensuring that there is access along the entire Somerset coast ahead of publicising the route. Following this, it is likely that numbers using the Coast Path will increase, though it is expected to take up to five years to arrange and process the Coast Path in relation to the Marine and Coastal Access Act requirements.

25.5.14 The Recreational Access Survey, carried out in 2009 (see **Appendix 25A**), identified that 70% of those surveyed using the PRoW were local residents who lived within

3km of the HPC development site, and 90% of those surveyed resided in Somerset. Of those surveyed that were not Somerset residents (10%), their purpose for visiting Somerset was to visit relatives or to go fishing.

25.5.15 The PRoW network is predominantly favoured for dog walking (85% of those surveyed) although, for some lengths, use is specific to the interest along it (such as fishing along the coastal path). Approximately 65% of those surveyed indicated that they intended to follow a circular route whilst the remainder intended to return the way they had come.

25.5.16 The counts presented and reported in **Appendix 25A** did not reveal significant differences in visitor/user numbers between weekdays and weekends, which reflects the fact that it is mostly local residents using the PRoW network, and mainly for the regular walking of their dogs. Use of the PRoW network, therefore, can be seen to be dominated by a relatively small number of repeat users (mainly residents), who use the PRoW network frequently (i.e. once or twice every day). **Table 25.5** presents the combined user counts generated from the four day survey for the various PRoW. Although there are methodologies available for generating annual user counts for PRoW these can provide widely differing numbers depending on the assumptions and factors applied. **Table 25.5** provides an indicative estimate of user numbers daily and annually based on averaging the user counts over the survey period, and multiplying this up using a 12 hour day and 365 day each year factor.

Table 25.5: Combined User Counts from Four Day Survey

Footpath	Combined Survey Count (number of users)	Indicative Daily Numbers (Factored)	Indicative Annual Numbers (Factored)
WL23/43 (north of WL23/110)	2	6	2,190
WL23/45 (south of WL23/110)	7	21	7,665
WL23/46	2	6	2,190
WL23/48 (southern end)	1	3	1,095
WL23/48 (south of WL23/110)	2	6	2,190
WL23/56 (north of Shurton Road)	1	3	1,095
WL23/56 (south of WL23/110)	4	12	4,380
WL23/56 (north of WL23/110)	2	6	2,190
WL23/95 (east of Hinkley Point)	4	12	4,380
WL23/95 (shoreline in front of site)	3	9	3,285
WL23/95 (coast path west of site)	1	3	1,095
WL23/107	3	9	3,285
WL23/110 (east of WL23/48)	2	6	2,190
WL23/110 (west of WL23/48)	1	3	1,095
WL23/110 (west of WL23/46)	5	15	5,475

25.5.17 Those surveyed identified the most desirable characteristics of a footpath as ‘good views’ (80%) and ‘peace and quiet’ (65%), followed by ‘a mix of countryside and coast’ (50%), ‘good condition of the footpaths’ (40%), ‘connections to other footpaths’ (30%), ‘well marked footpaths’ (25%), and ‘far from the road’ (20%).

25.5.18 The PRoW network within the HPC development site provides a variety of routes to the West Somerset Coast Path from the settlements of Shurton, Knighton, Burton, and Wick, and vice versa. **Appendix 25B** presents the PRoW routes through the HPC development site and the destinations. The routes through the HPC development site connect to Knighton (with eight routes), Shurton (with ten routes), and to a lesser extent Wick (with three routes).

25.5.19 The PRoW network is also used for circular walks. Within the study area around Hinkley Point, there are just under 50 discrete circular routes, of which 18 are completely off-road. Eight of these are located wholly or partially within the HPC development site boundary. Given that the discrete routes may be combined, the number of circular routes currently available is therefore considerably greater. A list of the circular routes is provided in **Appendix 25C** and shown on **Figure 25.5**.

Importance and Sensitivity of HPC development site PRoW Network

25.5.20 With the exception of the West Somerset Coast Path, the PRoW within the study area comprise a locally important (low importance) network of footpaths. The West Somerset Coast Path is considered to be a nationally important (high importance) resource because it will ultimately form part of the England Coast Path. PRoW are sensitive to obstruction which would prevent their use. Sensitivity to indirect (disturbance) impact is identified in the relevant topic chapter (**Chapters 11**, **12** and **22** of this volume) where the indirect (disturbance) impact has been assessed.

PRoW along the C182

25.5.21 There are a large number of footpaths that run adjacent to, or connect with the C182 between Hinkley Point and Cannington, and a smaller number that specifically cross the C182 within the study area. PRoW within the C182 route study area are presented in **Table 25.6** and shown in **Figure 25.2**.

Table 25.6: PRoW within 500m of the C182 between Hinkley Point and Cannington

PRoW Reference Number (Somerset County Council)		
WL23/15	WL23/110	**BW25/12**
WL23/16	**BW5/1**	BW25/14
WL23/20	**BW5/2**	BW25/16
WL23/21	**BW5/3**	**BW25/17**
WL23/22	**BW5/4**	**BW25/18**
WL23/55	BW5/5	**BW25/19**
WL23/56	**BW5/5A**	**BW25/20**
WL23/57	BW5/8	**BW25/21**
WL23/58	**BW5/16**	**BW25/22**
WL23/59	BW5/22	BW25/23
WL23/60	BW5/24	BW25/25
WL23/61	**BW5/25**	BW25/30
WL23/62	BW5/26	**BW25/34**
WL23/67	BW5/27	BW25/35

PRoW Reference Number (Somerset County Council)		
WL23/70	BW5/32	**BW32/4**
WL23/71	BW5/33	**BW32/5**
WL23/88	BW5/34	**BW32/7**

*Note: PRoW in **bold** are those that cross the C182 or link PRoW on either side of the C182.*
Source: SCC [http://webapp1.somerset.gov.uk/SCCPROW/Index.asp?showalerts=1]

25.5.22 The PRoW within or adjacent to the C182 comprise a locally important (low importance) network of footpaths. PRoW are sensitive to obstruction which would prevent their use. Sensitivity to indirect (disturbance) impact is identified in the relevant topic chapter (**Chapters 11**, **12** and **22** of this volume) where the indirect (disturbance) has been assessed.

Off-Site Highway Improvements Sites

25.5.23 There are a number of PRoW within 500m of the proposed off-site highway improvements. The off-site highway improvements and PRoW are presented in **Figures 25.6** to **25.12**. A list of the specific PRoW within or adjacent to each off-site highway improvements site is presented in **Appendix 25D**. A summary of the PRoW network for each is as follows:

- A38 Bristol Road/The Drove junction – the nearest PRoW (BW38/1) is located 100m away, and another 2 PRoW are located within 500m (see **Figure 25.6**).
- A39 Broadway/A38 Taunton Road junction – one PRoW (BW38/26) connects to the highway pavement in the works area, whilst another 6 PRoW are located between 190m and 500m away (see **Figure 25.6**).
- A38 Bristol Road/Wylds Road junction – the nearest PRoW (BW38/2) is located 30m away, and another 3 PRoW are located between 100m and 500m away (see **Figure 25.6**).
- Wylds Road/The Drove junction – one PRoW (BW38/2) is located immediately adjacent to the works area, whilst another 8 PRoW are located between 70m and 500m away (see **Figure 25.6**).
- A39 Quantock Hill Road/Sandford Hill (B3339)/Charlynch Lane junction – one PRoW (BW34/23) is located immediately adjacent to the works area, whilst another 3 PRoW are located between 330m and 500m away (see **Figure 25.7**).
- M5 junction 23 – one PRoW (BW28/3) connects to the highway pavement in the works area, another PRoW (BW28/6) runs underneath the roundabout structure, whilst eight other PRoW (including two lengths of bridleway) are located between 50m and 500m away (see **Figure 25.8**).
- A39/B3190 (Washford Cross) junction – the nearest PRoW (WL28/14) is located 120m away, whilst another PRoW (WL28/13) is located 450m away (see **Figure 25.9**).
- C182 Clayland Corner – one PRoW (BW32/4) connects to the highway pavement in the works area, whilst another 2 PRoW are located between 310m and 500m away (see **Figure 25.10**).

- C182/Farringdon Hill Lane horse crossing – one PRoW (WL23/15) connects to the site boundary, whilst another 6 PRoW (including one restricted byway) are located between 500m and 700m away (see **Figure 25.11**).
- Cannington traffic calming measures– five PRoW (BW5/1, BW5/3, BW5/4, BW5/5A, and BW5/16) connect to the highway pavement in the works area, whilst another 11 PRoW are located between 20m and 500m away (see **Figure 25.12**).
- Huntworth roundabout – two PRoW are located 470m (BW23/69) and 490m (BW23/4) away from the site (see **Figure 25.13**).

25.5.24 All of these PRoW form part of the local network and are of low (local) importance.

ii. Equestrians

25.5.25 The total length of restricted byways within the study area and Stogursey Parish is 2,276m, but only 230m of this is located within the HPC development site. Of the total length, 1,500m is along public highways (the C182 and Wick Lane).

25.5.26 Many local residents own and ride horses for recreational purposes. In addition, there are two professional horse trainers in Stogursey, an equestrian centre located at Stockland Lovell Manor, and horse stables and training facilities located at Farringdon Hill Lane. Data on numbers of registered horse-riders in the wider study area was obtained from SCC, and this is presented in **Table 25.7**. Further information on equestrian numbers in the local area was provided by members of the equestrian community in 2010 and is presented in **Table 25.8**.

25.5.27 Through consultation, it was established that the limited number of restricted byways within and around the HPC development site are used by equestrians. However, due to the limited availability of restricted byways (or any other PRoW available for use by equestrians), most equestrian activity takes place on private land (with the permission of local farmers) or on the existing road network. The equestrian community frequently cross at the Farringdon Hill Lane/Wick Moor Drove junction, and also the Doggetts Lane and Wick Moor Drove junction. During consultation, equestrians raised concerns regarding crossing the C182 due to high speeds travelled by traffic along this road.

25.5.28 While there are a number of professional trainers and stables, as well as private owners, within the Parish of Stogursey (see **Table 25.8**), given the limited bridleway provision and access, equestrian facilities are considered to be of local importance.

Table 25.7: Registered Horse-riders within Local Parishes

Parish	Horses	Adult Riders	Child Riders	Carriage Drivers
Cannington	10	4	2	0
Fiddington	25	13	0	1
Kilve	41	32	16	0
Nether Stowey	22	10	4	0
Otterhampton	No Data			
Stockland Bristol	34	15	4	0
Stogursey	70	39	4	0

Parish	Horses	Adult Riders	Child Riders	Carriage Drivers
Stringston	2	2	0	0

Source: Somerset County Council (obtained in 2009), based on 2005 data collection.

Table 25.8: Registered Horses within the Parish of Stogursey

Settlement Location	Number of Horses
Farringdon Hill	14
Stogursey	26
Monkton	4
Burton	5
Shurton	12
Stolford	10
Wick	3
Idson	9
Doggetts	3

Source: Equestrian community based on information provided in 2010.

25.5.29 There is no equestrian access (bridleway or restricted byway) within or adjacent to any of the proposed off-site highway improvements, with the exception of the study area around the M5 junction 23 and the C182 / Farringdon Hill Lane which are proposed equestrian crossing sites.

iii. Cyclists

25.5.30 As described above, there is limited byway or bridleway (both of which cyclists may use) provision within the study area. There are no cycle paths. Cycling takes place locally on the rural roads, but there are no indications of popular cycle routes within the study area and limited cycling has been observed during the site visits and surveys undertaken within the study area.

25.5.31 There is no cycle provision (other than on highways) within or adjacent to any of the proposed off-site highway improvements, with the exception of the study area around the M5 junction 23 and the C182 / Farringdon Hill Lane sites.

iv. Water-based Recreation

25.5.32 There are a large number of sailing, cruising, boating and yacht clubs that sail or cruise within the Severn Estuary and Bristol Channel.

25.5.33 Burnham Yacht Club, whose facilities are located at the mouth of the River Brue in Highbridge (approximately 9km east of the HPC development site), use the Bridgwater Bay and Severn Estuary for sailing and motor boating.

25.5.34 Combwich Motorboat and Sailing Club have mooring facilities and slipways at Combwich Wharf, which lies on the River Parrett, approximately 5km south-east of the HPC development site, but within 600m of the C182. With regard to use of open water, consultation indicates that the majority of members use the River Parrett and Bridgwater Bay for sailing and motor boating, but would not use the foreshore in the vicinity of Hinkley Point due to insufficient depth of water.

25.5.35 With regard to sea based recreational fishing, there is only one known organisation in the area, the Burnham Boat Owners Sea Angling Association. Consultation indicated that they fish (for bass, cod, ling, thornback and spurdog) in a 15km radius from Burnham every weekend over the winter; the location varies (dependent on the fish) but association members are often in Bridgwater Bay / the Hinkley Point area, which covers 17,330ha offshore and 3,093ha inshore (within 1km of low tide).

25.5.36 Given that no formal water-based recreation (organised by clubs and other organisations) takes place along the foreshore or immediately offshore of the HPC development site, a low (local) importance has been assigned to this recreational resource. In addition, during the Recreational Access Survey, as well as the many other walkover studies carried out during the assessment, no recreational boating activity was observed. Given the limited usage and the extremely large area of available estuary in the surrounding area, this resource is not considered to be sensitive to obstruction.

v. The Foreshore

25.5.37 In terms of proximity to the HPC development site, the foreshore is the largest available area of informal/undesignated open space, albeit limited in extent by tides.

25.5.38 The access points onto the foreshore within the study area are presented on **Figure 25.1**; the nearest are located 300m west of the site; at the north-west corner of the HPC development site; to the immediate north-west of the junction between PRoW WL23/56 and WL23/95; at the western end of the sea defences fronting Hinkley Point (at the north-east corner of the HPC development site); and from the sea defences north-east of the existing Hinkley Point Power Station Complex.

25.5.39 The foreshore is also used for a number of other activities including walking, angling and wildfowling, although by relatively low numbers of people.

25.5.40 In terms of walkers, The Marine and Coastal Access Act specifies that all land seaward of the route of the proposed England Coast Path should normally be accessible to the public. In this context, once the West Somerset Coast Path becomes part of the England Coast Path, the foreshore would be regarded as of national importance to users of PRoW.

25.5.41 Two wildfowling clubs, the Highbridge and Huntspill Wildfowling Association and the Bridgwater Bay Wildfowlers Association operate within the Bridgwater Bay National Nature Reserve (NNR), which extends along the foreshore from Lilstock in the west, to the Steart Peninsula and beyond, and includes the foreshore in the immediate vicinity of Hinkley Point. The clubs also have rights to shoot in the Parrett Estuary and on the Huntspill Foreshore, some 6km east of the HPC development site.

25.5.42 **Figures 25.1** and **25.2** show the Excepted Area for wildfowlers on the foreshore at Hinkley Point. This stretches from Stolford in the east, past Hinkley Point, to the boundary of the Bridgwater Bay NNR in the west. The Excepted Area can be used for shooting by any member of the British Society for Shooting and Conservation (BASC). Consultation with Natural England has indicated that usage of the Excepted Area is low, although due to the often solitary nature of the sport, Natural England and BBWA have indicated that it is not possible to quantify usage, 25.5.43 In terms of shore-angling, the majority of fishing activity occurs to the east of the existing Hinkley Point Power Station Complex due to the ease of access for vehicles. In this context the HPC development site is located over 1.2km from the nearest vehicular access point known to be used by anglers (which makes it less popular due to this distance and the need to carry the equipment over rough terrain). The Recreational Access Survey (see **Appendix 25A**) did not identify anglers on the shore fronting the HPC development site, though anglers were observed to the east of Hinkley Point B (1km away).

25.5.44 Angling also takes place at many other locations along the Somerset coastline (excluding the River Parrett Estuary), though locations characterised by higher use levels are influenced by accessibility. Locations identified from the Bristol Channel Sea Angling Club (Ref. 25.33) include Porlock Weir, Bossington, Minehead (Town Beach and Gasworks Beach), Dunster, Blue Anchor, Watchet, Doniford, St Audries, Kilve, Lilstock, and also Hinkley Point.

25.5.45 Fishing lakes are located 730m to the south-west of the HPC development site (see **Figure 25.1**) and approximately 200m to the east of the C182 at Combwich (see **Figure 25.2**).

25.5.46 Amateur geologists are known to visit the foreshore and the cliff exposure along the Blue Angel to Lilstock Coast SSSI. However, the best geological sections are further to the west of the HPC development site (see **Chapter 14** of this volume).

25.5.47 Given the limited recreational use of the foreshore directly in front of the HPC development site and the availability of similar recreational resource in the surrounding area, local importance is ascribed to the use of the foreshore in terms of recreational activities (other than walking on the Coast Path). These activities would be sensitive to obstruction of the foreshore. Sensitivity to indirect (disturbance) impacts, where relevant, is identified in the relevant topic chapter (**Chapters 11**, **12** and **22** of this volume) where the indirect (disturbance) has been assessed.

vi. Sports and Recreation Facilities

25.5.48 A search of the Sport England Active Places database (Ref. 25.21) indicates only one existing sports and recreation facility (including playing fields and sports clubs) within the study area for the HPC development site which is:

- Stogursey and District Victory Hall – local facilities for the residents of Stogursey, including a village hall, playing field and outdoor basketball court, located approximately 1km south of the HPC development site.

25.5.49 The following sports and recreation facilities (including playing fields and sports clubs) were identified (Ref. 25.21) within the study area (within 500m) for the C182 from Hinkley Point to Cannington (A39):

- Combwich Fishing Lakes (Site 22 on **Figure 25.2**) – located approximately 190m east of the C182.
- A sports pitch and clubhouse (Site 21 on **Figure 25.2**) – located near Shark's Lane 30m east of the C182, immediately north of Cannington.
- A playing field (Site 20 on **Figure 25.2**) owned and operated by Bridgwater College approximately 50m to the west of the C182 within Cannington.

- Recreation facilities operated by Bridgwater College (Site 82 on **Figure 25.2**), including golf course and a horse riding school – located approximately 160m to the east and north-east of the C182 at Cannington.
- Cannington Church of England Primary School (Site 18 on **Figure 25.2**) – located towards the centre of the village, approximately 30m east of the C182 at Cannington.
- Cannington Cemetery (Site 15 on **Figure 25.2**) – located approximately 410m west of the C182 at Cannington.
- Cannington Grange (Site 17 on **Figure 25.2**) – a private estate located approximately 250m south-east of the C182. The estate has been divided into a series of cottages and apartments for letting purposes and provides a range of recreational facilities, including tennis, badminton and fishing.

25.5.50 The following sports and recreation facilities (including playing fields and sports clubs) were identified (Ref. 25.21) within the study area (within 500m) for the proposed off-site highway improvements:

- The Exchange (Site 1 on **Figure 25.6**) – a health and fitness centre located at Express Park, approximately 480m north of the A38 Bristol Road / Wylds Road junction off-site highway improvements site.
- Drove House (Site 3 on **Figure 25.6**) – a health and fitness centre located approximately 460m south-west of the A38 Bristol Road/Wylds Road junction off-site highway improvements site, 130m west of the A38 Bristol Road / The Drove off-site highway improvements site, and 130m east of The Drove / Wylds Road junction (NDR) off-site highway improvements site.
- Trim Wise (Site 4 on **Figure 25.6**) – a health and fitness centre located 350m north-east of the A38 Taunton Road / A39 Broadway junction off-site highway improvements site.
- Eastover Park Tennis Centre and Eastover Park Bowling Club at Eastover Park (Site 5 on **Figure 25.6**) – located 300m east of the A38 Taunton Road / A39 Broadway junction off-site highway improvements site.
- Bridgwater Town Football Club (Site 10 on **Figure 25.6**) – facilities include three outdoor football pitches located 420m south-east of the A38 Bristol Road / The Drove off-site highway improvements site.
- Bridgwater and Albion Rugby Football Club (Site 11 on **Figure 25.6**) – facilities include two rugby football pitches and ancillary buildings located 360m south-east of the A38 Bristol Road / The Drove off-site highway improvements site.
- Bridgwater Sports and Social Club (Site 12 on **Figure 25.6**) – facilities include a bowling green, a cricket net, two outdoor football pitches, and a club house with additional facilities, located 300m south-east of the A38 Bristol Road / Wylds Road junction off-site highway improvements site, and 330m to the east of the A38 Bristol Road / The Drove off-site highway improvements site.
- Cannington Cemetery (Site 15 on **Figure 25.12**) – located approximately 10m north-west of the Cannington Traffic Calming Measures.

- Cannington Church of England Primary School (Site 18 on **Figure 25.12**) – located towards the centre of the village, approximately 220m south-east of the Cannington Traffic Calming Measures.
- A playing field (Site 20 on **Figure 25.12**) − owned and operated by Bridgwater College approximately 50m to the west of the Cannington Traffic Calming Measures.
- A sports pitch and clubhouse (Site 21 on **Figure 25.12**) – located near Shark's Lane, 300m north of the Cannington Traffic Calming Measures.
- Puriton playing fields providing indoor bowls (Site 25 on **Figure 25.8**) − an outdoor grass football pitch, and an outdoor cricket pitch, located 430m to the north-east of the M5 Junction 23 off-site highway improvements site.
- Bridgwater Lawn Tennis Club (Site 28 on **Figure 25.13**) − the club facilities include 5 courts, of which 3 are all-weather 'Astroturf' that are floodlit and two American fast clay courts, and a clubhouse with shower and changing facilities. Membership is open to the public, and there are 8 teams that play in the North Somerset League. The Club is open all day and evening, 7 days a week, being weather dependent. The Club is located 440m to the east of the Huntworth Roundabout off-site highway improvements site.
- The Tropiquaria Zoo (Site 59 on **Figure 25.9**) − located 800m to the south of the site, and is accessed from the B3190 and the A39. Tropiquaria is a tourism and leisure facility that comprises a tropical hall, aquarium, a radio museum, and outdoor play areas. It is accessible to the public from February to November, seven days a week from 10:30 to 17:00 (and 10:00 to 18:00 in summer), for an admission fee.
- Recreation facilities operated by Bridgwater College (Site 82 on **Figure 25.12**) − including golf course and a horse riding school, located approximately 160m to the east of the Cannington Traffic Calming Measures.

25.5.51 All of these sports and recreational facilities are considered to be of local importance. The facilities would be sensitive to obstruction which would prevent access or interfere with the use of the facilities. Sensitivity to indirect (disturbance) impact is identified in the relevant topic chapter (**Chapters 11**, **12** and **22** of this volume) where the indirect (disturbance) impact has been assessed.

vii.Open Access Land and Public Open Space

Open Access Land

25.5.52 There are no areas of open access land within the HPC development site itself. A search of Natural England's Common Rights of Way (CRoW) database (Ref. 25.22) indicated that the nearest areas of open access land include a series of commons immediately east of the HPC development site, to the south of the existing Hinkley Point Power Station Complex, extending east along the foreshore to the Steart Peninsula. These comprise Wick Moor Common, North Moor Common and Great Hooks and Little Hooks Common (see **Figure 25.1**).

25.5.53 The nearest to the HPC Development Site are North Moor Common and Wick Moor Common (separated from each other by Wick Moor Drain). These are located directly east of the HPC development site and south of the existing Hinkley Point Power Station Complex. No significant use of North Moor or Wick Moor Commons was indicated during consultation, which is supported by the results of the Recreational Access Survey and observations made during field surveys in the course of this EIA. Hence use of North Moor and Wick Moor Commons is assessed as being infrequent and low for the purposes of this assessment.

25.5.54 Given the limited recreational use of the North Moor and Wick Moor Common and the availability of similar recreational resource in the surrounding area, local importance is ascribed. The Commons would be sensitive to obstruction which would prevent access or use. Sensitivity to indirect (disturbance) impacts is identified in the relevant topic chapter (**Chapters 11**, **12** and **22** of this volume), where relevant, where the indirect (disturbance) has been assessed.

25.5.55 There are no areas of open access land within the study area for the proposed off-site highway improvements, with the exception of the equestrian crossing proposed on the C182/Farringdon Hill junction, where common land (part of Wick Moor Common) is located 390m to the north of the works area.

Public Open Space

25.5.56 There are no areas of public open space, such as formal parks and gardens within the HPC development site. The nearest formal areas of public open space adjacent to the C182 or the off-site highway improvements include:

- Cranleigh Gardens and Eastover Park (Site 56 on **Figure 25.6**) – comprising a 3ha park that contains mainly open grass areas which are surrounded by mature and semi-mature trees, with a fenced play area for toddlers and juniors in the north of the park (inspected on a weekly basis by Sedgemoor Council). The Park also includes a football pitch which is available for hire from SDC's Clean Surroundings. It is located 350m east of the A38 Taunton Road / A39 Broadway junction off-site highway improvements site.
- Cannington Walled Garden in Cannington (Site 84 on **Figure 25.2**) – located approximately 4m south of the C182 and the Cannington Traffic Calming Measures.

25.5.57 A number of areas of public open space, such as formal parks and gardens, are located adjacent to or within 500m of the C182 between Hinkley Point and Cannington, as follows:

- an area of amenity grassland adjacent to Folly Close (Site 67 on **Figure 25.2**) – located 50m east of the C182 at Cannington;
- an area of amenity grassland on Church Street (Site 68 on **Figure 25.2**) – located 80m south of the C182 at Cannington;
- St Mary the Virgin Churchyard (Site 69 on **Figure 25.2**) – located 50m west (or 110m south) of the C182 at Cannington;
- Cannington Play Area (Site 70 on **Figure 25.2**) – located 5m east of the C182 at Cannington;
- an area of amenity grassland on Duke Avenue (Site 71 on **Figure 25.2**) – located 175m east of the C182 at Cannington;
- an area of amenity grassland situated between Brooks Street and Main Road (Site 72 on **Figure 25.2**) – located 5m west of the C182 at Cannington;

- an area of amenity grassland adjacent to Denmans Lane (Site 73 on **Figure 25.2**) – located 30m west of the C182 at Cannington;
- an area of amenity grassland on Teals Acre (Site 74 on **Figure 25.2**) – located 90m west of the C182 at Cannington;
- an area of amenity grassland on Rydon Crescent (Site 75 on **Figure 25.2**) – located 70m east of the C182 at Cannington;
- an area of amenity grassland on Southbrook Crescent (Site 76 on **Figure 25.2**) – located 50m east of the C182 at Cannington;
- two areas of amenity grassland on Oak Tree Way (Site 77 and 78 on **Figure 25.2**) – located 40m to 80m west of the C182 at Cannington;
- an area of amenity grassland on Southbrook Close (Site 79 on **Figure 25.2**) – located 285m east of the C182 at Cannington;
- two areas of amenity grassland on Lonsdale Road (Site 80 and 81 on **Figure 25.2**) – located 145m to 210m east of the C182 at Cannington; and
- allotments north of East Street (Site 82 on **Figure 25.2**) – located 130m east of the C182 at Cannington.

25.5.58 A number of areas of public open space, such as formal parks and gardens, are located near to but not within the areas of proposed off-site highway improvements, as follows:

- Crowpill Lane area of grassland and play area (Site 38 on **Figure 25.6**) – located 380m west of The Drove / Wylds Road junction (NDR) off-site highway improvements site.
- Chilton Street Children's Play Area (Site 44 on **Figure 25.6**) – located 250m west of The Drove / Wylds Road junction (NDR) off-site highway improvements site.
- Union Street Children's Play Area (Site 48 on **Figure 25.6**) – located 190m to the south-east of the A38 Bristol Road / The Drove off-site highway improvements site, and 420m south-east of the Drove / Wylds Road junction (NDR) off-site highway improvements.
- King Square (Site 50 on **Figure 25.6**) – an area of public open space located 360m north-west of the A38 Taunton Road / A39 Broadway junction off-site highway improvements site.
- Blake Gardens (Site 53 on **Figure 25.6**) –municipal garden located 30m north of the east end of the A38 Taunton Road / A39 Broadway junction off-site highway improvements site.
- An area of amenity grassland adjacent to Folly Close (Site 67 on **Figure 25.12**) – located 50m east of the Cannington Traffic Calming Measures.
- An area of amenity grassland on Church Street (Site 68 on **Figure 25.12**) – located 70m south of the Cannington Traffic Calming Measures.
- St Mary the Virgin Churchyard (Site 69 on **Figure 25.12**) – located 120m south-east (or 110m south) of the Cannington Traffic Calming Measures.
- Cannington Play Area (Site 70 on **Figure 25.12**) – located 300m south-east of the Cannington Traffic Calming Measures.

- An area of amenity grassland on Duke Avenue (Site 71 on **Figure 25.12**) – located 370m south-east of the Cannington Traffic Calming Measures.
- An area of amenity grassland situated between Brooks Street and Main Road (Site 72 on **Figure 25.12**) – located 240m south-east of the Cannington Traffic Calming Measures.
- An area of amenity grassland adjacent to Denmans Lane (Site 73 on **Figure 25.12**) – located 250m south of the Cannington Traffic Calming Measures.
- An area of amenity grassland on Teals Acre (Site 74 on **Figure 25.12**) – located 350m south of the Cannington Traffic Calming Measures.
- An area of amenity grassland on Rydon Crescent (Site 75 on **Figure 25.12**) – located 495m south-east of the Cannington Traffic Calming Measures.
- Two areas of amenity grassland on Oak Tree Way (Site 77 and 78 on **Figure 25.12**) – located 445m to 450m south of the Cannington Traffic Calming Measures.
- Allotments north of East Street (Site 82 on **Figure 25.12**) – located 290m east of the Cannington Traffic Calming Measures.

25.6 Assessment of Impacts

a) Introduction

25.6.1 This section identifies and assesses the potential impacts associated with the proposed development throughout the construction and operational phases. A description of construction and operational activities is presented in **Chapters 2** and **3** of this volume. The assessment includes the examination of the construction phase impacts associated with the proposed off-site highway improvements.

b) Construction Phase Impacts

i. Obstruction to PRoW

HPC Development Site

25.6.2 On commencement of construction works a timber post and rail fence would be erected around the perimeter of the HPC development site, and a chain link inner security fence would be installed around the construction area. There would be a space between the two fences, varying from 4m to 30m wide. All PRoW within the inner security fence would be obstructed and public access would be prohibited for health and safety reasons for the duration of the construction works (up to 11 years). The fencing would also include the coastal edge as construction works for the seawall would prevent access to this area from commencement for a period of up to three years.

25.6.3 **Figure 25.14** shows the site and the PRoW that would be affected by the construction works, including the construction of the jetty and sea wall. The total length of PRoW obstructed would be 7,875m, which constitutes 23% of the 34.5km resource within the study area, and 11% of the 73.5km resource within Stogursey Parish. **Table 25.9** provides a summary of the footpaths that would be obstructed and the nature of the impact on each PRoW.

Table 25.9: Significance of Impacts for Each PRoW Affected during Construction

Footpath ID	Length	Description of Impact	Importance	Impact Magnitude	Significance
WL 23/48	740m	Obstruction for up to 11 years	Low	High	Moderate adverse
WL 23/50	300m	Obstruction for up to 11 years	Low	High	Moderate adverse
WL 23/56	1,530m	Obstruction for up to 11 years	Low	High	Moderate adverse
WL 23/68	627m	Obstruction for up to 11 years	Low	High	Moderate adverse
WL 23/69	694m	Obstruction for up to 11 years	Low	High	Moderate adverse
WL 23/70	1,147m	Obstruction for up to 11 years	Low	High	Moderate adverse
WL 23/95 (Part of the West Somerset Coast Path)	1,250m	Obstruction for up to three years and for a short period during jetty dismantling	High	High	Major adverse
WL 23/105	557m	Obstruction for up to 11 years	Low	High	Moderate adverse
WL 23/110	1,030m	Obstruction for up to 11 years	Low	High	Moderate adverse

25.6.4 Following completion of the jetty and seawall, the West Somerset Coast Path (WL23/95) would be re-opened, and would run along the top of the new sea wall. **Figure 25.15** shows the site and the PRoW that would be affected by obstruction after completion of the jetty and seawall.

25.6.5 Once the Coast Path (WL23/95) is reopened, the total length of PRoW obstructed during the construction phase would represent a maximum of 6,625m, which constitutes 19% of the resource within the study area, and 8% within Stogursey Parish.

25.6.6 During dismantling of the temporary jetty at the end of the construction phase, a further short duration closure would be required for the West Somerset Coast Path for health and safety reasons.

25.6.7 In terms of the wider PRoW network, the presence and retention of PRoW to the east, south, and west of the HPC development site would maintain an indirect access route to Stolford from the settlements of Burton, Shurton and Knighton. Consequently, although direct routes would be affected, particularly during the closure of the West Somerset Coast Path, indirect routes would be available which have minimal lengths along or crossing roads and lanes.

25.6.8 The permanent obstruction of the affected PRoW (excluding the West Somerset Coast Path (WL23/95)) for up to eleven years would be, on a conservative premise, a change of a high magnitude for each individual PRoW because the right of passage would be prevented for this duration. The affected PRoW network is a resource of low (local) importance and, consequently, an impact of **moderate adverse** significance is predicted.

25.6.9 The temporary obstruction of the nationally important West Somerset Coast Path would be a change of a high magnitude due to the loss of right of access along the coast, albeit for a lesser period of time than for the other PRoW on site. Given the high importance of this asset, a medium-term impact of **major adverse** significance is predicted.

25.6.10 The closure of the restricted byway within the HPC development site would result in a loss of 230m or 10% of the restricted byways (2,279m) available to equestrians and cyclists in the study area. However, as the affected byway results in a dead end currently, it is of limited use. Taking this into account, along with the low (local) importance of the restricted byway, a medium-term **negligible** impact is predicted.

PRoW along the C182 and Off-Site Highway Improvements

25.6.11 The PRoW that cross, connect or run parallel to the road are all of low (local) importance and users of these PRoW would experience a change of very low magnitude due to increased traffic and associated longer waiting times to cross the C182. Therefore, a **negligible** impact is predicted.

25.6.12 During consultation, equestrians raised concerns about the safety of horses and riders crossing the road at the junction of Farringdon Hill and the C182 in particular. This impact is related to road safety rather than specific effects on users (including equestrians) of PRoW and is therefore considered in **Chapter 10** (Transport) rather than within this assessment.

25.6.13 The following off-site highway improvements are located adjacent to PRoW or contain PRoW within their site boundaries (see **Appendix 25D**):

- M5 Junction 23 – BW28/3;
- The Drove/Wylds Road junction – BW38/2;
- A38 Taunton Road / A39 Broadway junction – BW38/26;
- Sandford Hill junction – BW34/23;
- C182 Clayland Corner – BW32/4; and
- C182/Farringdon Hill Lane – WL23/15.

25.6.14 However, the off-site highway improvement construction activities would not result in the obstruction of or physical disturbance to any PRoW. Consequently, **no impact** is predicted.

ii. Disturbance to Users of PRoW

25.6.15 The construction works could result in noise, air quality and visual disturbance, which could cause an adverse impact on the amenity value of the PRoW in the study area for up to 11 years. These impacts are examined in **Chapters 11**, **12**, and **22** of this volume, and are summarised below.

HPC Development Site

25.6.16 **Chapter 11** (Noise and Vibration) considers PRoW in the category of outdoor public amenity receptor locations and as of 'low' sensitivity due to the transient presence of human receptors in these locations, and the options that such receptors would have available allowing them to select other locations at any given time.

25.6.17 Disturbance impacts to the section of the West Somerset Coast Path running along the north of the HPC development site (WL23/95) and at two points along WL23/48 adjacent to and within the western boundary of the HPC development site (one on Benhole Lane and the other at the junction of WL23/48 and WL23/50) are assessed. Impacts are also assessed at Wick Barrow (Pixies Mound) Scheduled Monument. PRoW WL23/71 runs directly south of the field in which the monument is located so this may be considered indicative of impacts on the section of WL23/71 directly to the east of the site (see **Figure 11.1**, **Chapter 11** for specific monitoring and assessment locations).

25.6.18 Noise impacts will vary over the construction phase depending on activities underway and their location in relation to the PRoW.

25.6.19 At worst case, short-term high magnitude construction noise levels are predicted to occur at Pixies Mound (WL23/71) during the nearby upgrade of roads (2-3 months) and this is assessed as being of **moderate adverse** significance. Similarly, at the assessed West Somerset Coast Path (WL23/95) location during construction of the temporary jetty, high magnitude noise levels are predicted. As a worst-case assessment, the significance of this noise magnitude is also assessed as **moderate adverse**.

25.6.20 During final landscaping activities close to the site boundary, short-term noise impacts of **moderate adverse** significance are also predicted at all three assessed public footpath receptors. However, it should be noted that noise impacts for the majority of this phase of works, when plant is operating further away from the site boundary, will be less significant.

25.6.21 At each of the assessed outdoor public amenity receptor locations, during all other phases of works, the noise magnitude will vary between very low and medium. Therefore the impact significance is predicted to be **minor adverse** to **negligible**.

25.6.22 The magnitude assigned to public amenity receptors is given as if the receptors at these locations would be stationary. However, human receptors at these amenity locations will be transient and are therefore very unlikely to be subject to the same exposure duration as defined for fixed property receptor locations. Therefore, whilst the predicted noise levels might result in short-term disturbance, the impact on a person's enjoyment of these amenities is likely to be less significant than has been assessed.

25.6.23 **Chapter 12** (Air Quality) of this volume considers that the sensitivity of users of PRoW to air quality impacts is low because adverse health impacts are not expected due to the transient short-term exposure to potentially elevated air pollutant concentrations. For this reason air quality impacts upon users of PRoW are scoped out of the Air Quality assessment and consequently from the remainder of this assessment.

25.6.24 **Chapter 22** (Landscape and Visual) considers impacts on PRoW in terms of change in landscape character and in terms of change in composition of view for specific viewpoints, as follows (see **Chapter 22** for detailed viewpoint descriptions):

- Principal Viewpoint 1 – PRoW WL23/110 west of Benhole Lane;
- Principal Viewpoint 2 − PRoW WL23/95, West Somerset Coast Path,;
- Principal Viewpoint 3 − PRoW WL 24/10, West Somerset Coast Path, Lilstock;
- Principal Viewpoint 4 − PRoW WL24/8;
- Principal Viewpoint 5 − PRoW 24/3, Higher Hill;
- Principal Viewpoint 6 − PRoW WL 24/11 near the edge of the Great Plantation;
- Principal Viewpoint 8 − PRoW WL23/46, Knighton Farm;
- Principal Viewpoint 10 − local Farm near PRoW WL23/48, Shurton West;
- Principal Viewpoint 11 − PRoW WL23/56, Shurton east;
- Principal Viewpoint 13 − PRoW WL23/57, west of Wick;
- Principal Viewpoint 15 − PRoW WL23/61;
- Principal Viewpoint 16 − PRoW WL23/61, Wick;
- Principal Viewpoint 19 − PRoW WL23/95, West Somerset Coast Path, Stolford;
- Principal Viewpoint 20 − PRoW No. BW32/3, Stockland Bristol;
- Principal Viewpoint 21 − PRoW WL24/1, Quantock Hills AONB;
- Principal Viewpoint 22 − PRoW WL8/30, East Quantoxhead;
- Principal Viewpoint 28 − PRoW WL10/9, Quantock Hills AONB;
- Principal Viewpoint 30 − PRoW WL10/28, Quantock Hills AONB;
- Principal Viewpoint 35 − Cannington Park, public footpath; and
- Principal Viewpoint 36 – PRoW BW 28/3, Puriton Hill.

25.6.25 For the construction phase, impacts on PRoW in terms of change in landscape character are predicted to be **major adverse** while impacts on the viewpoints set out above are predicted to be **major adverse** on Viewpoints 1, 2, 3, 8, 10, 11, 16, 19, 20 and 28; **moderate adverse** on Viewpoints 4, 5, 6, 13, 15, 21, 22, 29 and **minor adverse** on Viewpoints 35 and 36.

25.6.26 However, as for the noise and vibration assessment above, people using the PRoW would usually be transient and are, therefore, unlikely to be subject to the same exposure duration as defined for fixed receptor locations on which the assessment is based.

PRoW along the C182 and Off-Site Highway Improvements

25.6.27 **Chapter 11** (Noise and Vibration) does not specifically assess disturbance impacts to PRoW along the C182. However, it does assess general impacts to low sensitivity receptors along the route and concludes that the magnitude of change in terms of day time traffic noise would be either low or very low and therefore a **minor adverse** impact is predicted.

25.6.28 In terms of the highway improvements, **Chapter 11** (Noise and Vibration), considers that of the 11 off-site highway improvements, the only works of sufficient scale to cause significant adverse noise effects are associated with construction of the new roundabouts at Washford Cross and Sandford Hill. PRoW are not identified as sensitive receptors in terms of noise disturbance in these locations however.

25.6.29 **Chapter 12** (Air Quality) has scoped out disturbance impacts to PRoW.

25.6.30 **Chapter 22** (Landscape and Visual) scopes out disturbance impacts to users of PRoW on the C182 as this comprises an existing road. The highway improvements are also scoped out as the proposed works are of small scale and have no potential to exert significant landscape and visual impacts.

iii. Obstruction to Sports and Recreation Facilities

25.6.31 No formal sports or recreational facilities are located within the HPC development site, alongside the C182 or within or immediately adjacent to any of the off-site highway improvements. Therefore **no impact** is predicted.

iv. Disturbance to Users of Sports and Recreation Facilities

HPC Development Site

25.6.32 The nearest sports and recreational facility is the fishing lakes to the south-west of the site. However these are located in excess of 730m from any major works and are therefore scoped out of the Noise and Vibration (**Chapter 11**), Air Quality (**Chapter 12**) and Landscape and Visual (**Chapter 22**) assessments and therefore from the remainder of this assessment.

Along the C182 and Off-Site Highway Improvements

25.6.33 **Chapter 11** (Noise and Vibration) does not specifically assess disturbance impacts to sports and recreation receptors along the C182. However, it does assess general impacts along the designated transport routes for construction traffic and the impacts on sports and recreation facilities may be derived from these.

25.6.34 For 2013, a high magnitude impact is assessed for receptors along Cannington High Street and Rodway and this would result in a **major adverse** impact on Cannington Cemetery (medium sensitivity, Site 15 on **Figure 25.2**) and **moderate adverse** on the sports pitch on Shark's Lane (low sensitivity, Site 21 in **Figure 25.2**), for example.

25.6.35 For 2016, when the Cannington bypass is predicted to be in place, receptors on C182 (Rodway) south of the northern roundabout of the bypass and on Main Road / Fore Street through Cannington would experience a decrease in daily traffic noise. For the sports pitch on Shark's Lane this would result in a **minor beneficial** impact. For Cannington Cemetery, an adverse impact would remain but this would reduce to **moderate adverse**.

25.6.36 In terms of the highway improvements, as described in the PRoW section above, **Chapter 11** (Noise and Vibration) considers that the only works of sufficient scale to cause significant adverse noise effects are associated with construction at the new roundabouts at Washford Cross and Sandford Hill.

25.6.37 There are no sports and recreation facilities within the vicinity of the Sandford Hill highway improvement works. The closest sensitive noise receptor to Washford Cross is Tropiquaria Zoo (25m to the north west). Construction of the Washford Cross roundabout is expected to last a maximum of six months and a **moderate adverse** impact is predicted on the closest outdoor area of Tropiquaria during this time.

25.6.38 As for PRoW, **Chapter 12** (Air Quality) considers that the sensitivity of users of sports and recreation facilities to air quality impacts is low because adverse health impacts are not expected due to the transient short-term exposure to potentially elevated air pollutant concentrations. For this reason air quality impacts upon users of sports and recreation facilities are scoped out of the Air Quality assessment and consequently from the remainder of this assessment.

25.6.39 **Chapter 22** (Landscape and Visual) scopes out disturbance impacts to users of sports and recreation facilities along the C182 as this comprises an existing road. The highway improvements are also scoped out as the proposed works are of small scale and have no potential to exert significant landscape and visual impacts.

v. Obstruction to Open Access Land and Public Open Space (including Foreshore)

HPC Development Site

25.6.40 There are no areas of open access land or public open space within the landward footprint of the construction area for the HPC development site, nor would the common land which is located along part of the eastern boundary of the works area be obstructed. Therefore, **no impact** is predicted.

25.6.41 On commencement of construction, two foreshore access locations would be obstructed for up to three years during the construction of the jetty and the seawall. The two points obstructed would be the access near the northwest corner of the HPC development site, and the access to the northwest of the junction between WL23/56 and WL23/95 (see **Figure 25.16**). The access point 300m west of HPC development site and off the sea defences fronting the existing Hinkley Point Power Station Complex) would remain unobstructed. The obstruction of two access points for up to three years is considered to represent a very low magnitude impact, due to the availability of the two other access points in close proximity.

25.6.42 In addition, for the construction of the jetty and the seawall, an area from the base of the cliff extending along the northern boundary of the development site and then 30m outwards towards the sea would be obstructed. The construction drainage outfall would also extend across the foreshore but appropriate measures would be provided to allow access over these works and along the foreshore.

25.6.43 The foreshore to the north of the HPC development site is accessible to the public and is used for a variety of recreational activities, including walking, angling, and wildfowling. Impacts on these activities are assessed as follows:

25.6.44 In terms of users of the West Somerset Coast Path, the foreshore is considered of national importance as the Marine and Coastal Access Act specifies that all land seaward of the proposed England Coast Path route should normally be accessible to the public. However, as the West Somerset Coast path will be closed during the construction of the sea wall and jetty, no additional impact is assessed.

25.6.45 In terms of shore-angling, the foreshore at the HPC development site is located approximately 1.2km from the nearest vehicular access point known to be used by anglers (to the east of Hinkley Point B), which makes the site less suitable for angling (due to this distance and the need to carry equipment over rough terrain). Given the current limited accessibility to the area of foreshore that would be obstructed and the limited time period of the obstruction, as well as the availability of more suitable and accessible locations to the east and west of the site, a change of very low magnitude would be expected. The foreshore is considered of local (low) importance for shore-angling and therefore a short-term **minor adverse** impact is predicted.

25.6.46 The foreshore is an Excepted Area for wildfowling and is assessed as a locally (low) importance resource for this activity as use of the site is made by a relatively small number of people and there are two other Excepted Areas within Bridgwater Bay National Nature Reserve alone. Only a small amount of the area available for wildfowling (less than five percent) would be obstructed during the construction of the jetty and sea wall. Consequently, a change of low magnitude is assessed for up to three years and a direct medium-term **minor adverse** impact is predicted.

25.6.47 The estuary to the north of the HPC development site is also used for a variety of recreational activities, including sea-angling and boating. Exclusion requirements due to the construction, operation and dismantling of the jetty and the construction of the offshore structures is detailed in **Chapter 26** (Navigation) of this volume.

25.6.48 Based on the limited scale of the extent of obstruction, there would be a change of a low magnitude. The recreational resource is ascribed low (local) importance and therefore a medium-term **minor adverse** impact is predicted with respect to sea angling and boating.

Along the C182 and Off-Site Highway Improvements

25.6.49 No areas of open access land or public open space alongside the C182 or within any of the proposed off-site highway improvements would be obstructed and therefore **no impact** is predicted.

vi. Disturbance to Users of Open Access Land and Public Open Space (including Foreshore)

HPC Development Site

25.6.50 The construction works could result in noise, air quality and visual disturbance impacts on the amenity value of the open access land and public open space in the study area for up 11 years.

25.6.51 **Chapter 11** (Noise and Vibration) does not specifically identify open access land and public open space receptors. However, noise impacts on visitors to Wick Barrow (Pixies Mound) Scheduled Monument, which is directly north of North Moor and Wick Moor Commons, are assessed as are impacts to the West Somerset Coast Path, which is considered to be representative of the foreshore and intertidal zone.

25.6.52 As detailed in the disturbance impacts to PRoW above, impacts on Pixies Mound (North Moor and Wick Moor Commons) are assessed as being of **moderate adverse** significance during road upgrading works reducing to **minor adverse** during all other construction works.

25.6.53 Impacts on the West Somerset Coast Path are assessed as **moderate adverse** during construction of the jetty and during landscape restoration and **negligible** to **minor adverse** for the remainder of the construction phase.

25.6.54 As for PRoW, this is a worse-case scenario because users of these amenity locations are likely to be transient and are unlikely to be subject to the same exposure duration as defined for fixed property receptor locations (on which the assessment is based). Furthermore, following completion of the seawall and jetty construction, noise levels along the foreshore would decrease significantly.

25.6.55 **Chapter 12** (Air Quality) scopes out users of the foreshore and Wick Common, where they are adjacent to the construction site boundary, because of the transitory nature of these receptors, their short-term exposure, and the intermittent nature of such emissions.

25.6.56 **Chapter 21** (Landscape and Visual) assesses "Wick Moor and Coast" (which would include Wick Moor Common and North Moor Common) in terms of impacts on landscape character and predicts a **major adverse** impact during the construction phase.

25.6.57 Impacts on the West Somerset Coast Path may be considered representative of impacts on the foreshore and these are assessed by Viewpoints 2, 3 and 19. For the construction phase, impacts are predicted to be **major adverse** on these viewpoints.

Along the C182 and Off-Site Highway Improvements

25.6.58 **Chapter 11** (Noise and Vibration) does not specifically assess disturbance impacts to users of open access land and public open space along the C182. However, it does assess general impacts along the designated transport routes for construction traffic and the impacts on open access land and public open space recreation facilities may be derived from these.

25.6.59 For 2013, a high magnitude impact is assessed for receptors along Cannington High Street and Rodway. There is no open access land or public open space directly adjacent to these roads, with the exception of Cannington Walled Garden (Site 84 on **Figure 25.2**), the north western edge of which is located on the corner of High Street and Rodway. As this is of local importance, a **moderate adverse** impact is predicted.

25.6.60 For 2016, when the Cannington bypass is predicted to be in place, receptors on C182 (Rodway) south of the northern roundabout of the bypass and on Main Road / Fore Street through Cannington would experience a decrease in daily traffic noise. This would result in a **minor beneficial** impact on St Mary the Virgin Churchyard (Site 69 on **Figure 25.2**), as well as a number of areas of amenity grassland.

25.6.61 In terms of the highway improvements, as described in the PRoW section above, **Chapter 11** (Noise and Vibration) considers that the only works of sufficient scale to cause significant adverse noise effects are associated with construction at the new roundabouts at Washford Cross and Sandford Hill. There are no areas of open access land or public open space in proximity to these sites and therefore impacts are scoped out of the noise and vibration assessment.

25.6.62 As for PRoW, **Chapter 12** (Air Quality) considers that the sensitivity of users of open access land and public open space to air quality impacts is low because adverse health impacts are not expected due to the transient short-term exposure to potentially elevated air pollutant concentrations. For this reason air quality impacts upon users of sports and recreation facilities are scoped out of the Air Quality assessment and consequently from the remainder of this assessment.

25.6.63 **Chapter 22** (Landscape and Visual) scopes out disturbance impacts to users of sports and recreation facilities along the C182 as this comprises an existing road. The highway improvements are also scoped out as the proposed works are of small scale and have no potential to exert significant landscape and visual impacts.

c) Operational Phase Impacts

25.6.64 Operational phase impacts are only considered in terms of the HPC development site and the C182 as all highway improvements works would be completed during the construction phase.

25.6.65 **Chapter 11** (Noise and Vibration) does consider traffic-related noise impacts to some sports and recreation, open access land and public open space receptors within Cannington, which fall within the C182 study area for this assessment. However, these are summarised in the Cannington Bypass Amenity and Recreation chapter (**Volume 5**, **Chapter 17**) and are therefore not repeated here.

i. Obstruction to PRoW

25.6.66 On commencement of the operational phase, only the HPC permanent development site boundary would result in the obstruction of any PRoW. However, as the PRoW within the HPC permanent development site boundary would already have been closed for the duration of the construction phase, the operational footprint of HPC would not result in additional closure or loss of PRoW.

25.6.67 **Figure 25.17** shows the HPC permanent development site boundary and the PRoW that would be affected on commencement of the operational phase (on the basis that the construction phase assessment covers the period up to reinstatement of the PRoW on the construction site land outside the operational footprint).

25.6.68 The total length of PRoW obstructed by the operational boundary would be 4,549m, which constitutes 13% (of the 34.5km resource) within the study area, and 6% (of the 73.5km) within Stogursey Parish. **Table 25.10** provides a summary of the footpaths that would be obstructed and the nature of the impact on each PRoW.

Table 25.10: Significance of Impacts for Each PRoW Affected by the Operational Site Footprint

Footpath ID	Length	Description of Impact	Importance	Impact Magnitude	Significance
WL23/48	738m	Permanent obstruction	Low	High	Moderate adverse
WL23/50	299m	Permanent obstruction	Low	High	Moderate adverse
WL23/56	840m	Permanent obstruction	Low	High	Moderate adverse
WL23/68	627m	Permanent obstruction	Low	High	Moderate adverse
WL23/70	1,148m	Permanent obstruction	Low	High	Moderate adverse
WL23/105	557m	Permanent obstruction	Low	High	Moderate adverse
WL23/110	340m	Permanent obstruction	Low	High	Moderate adverse

25.6.69 The density of PRoW per km^2 within the study area would decrease from 3,272m of PRoW per km^2 to 2,986m of PRoW per km^2, a permanent reduction of 9%. In terms of circular routes within the study area, five of the current 49 routes forming the PRoW network would be affected.

25.6.70 The permanent obstruction of the affected PRoW is, on a conservative premise, considered to represent a high magnitude change for each individual PRoW because the right of passage would be permanently prevented. The affected PRoW network is considered to represent a resource of low (local) importance and, consequently, a permanent **moderate adverse** impact is predicted.

25.6.71 The permanent closure of a restricted byway within the HPC development site would result in a loss of 230m or 10% of the restricted byways (2,279m) available to equestrians and cyclists in the study area (and Stogursey Parish). However, the legal route currently results in a dead end and therefore a low magnitude change on this resource of local (low) importance is assessed and a permanent **minor adverse** impact is predicted.

ii. Disturbance to Users of PRoW

25.6.72 The operation of HPC could result in noise, air quality and visual disturbance which could impact the amenity value of PRoW in the study area.

25.6.73 **Chapter 11** (Noise and Vibration) does not identify PRoW as sensitive receptors for the operational phase while **Chapter 12** (Air Quality) has scoped out impacts to PRoW (see construction phase section above).

25.6.74 **Chapter 22** (Landscape and Visual) considers impacts on PRoW in terms of change in landscape character and in terms of change in composition of view for specific viewpoints, as follows:

- Principal Viewpoint 1 – PRoW WL23/110 west of Benhole Lane;
- Principal Viewpoint 2 − PRoW WL23/95, West Somerset Coast Path;
- Principal Viewpoint 3 − PRoW WL 24/10, West Somerset Coast Path, Lilstock;
- Principal Viewpoint 4 − PRoW WL24/8;
- Principal Viewpoint 5 − PRoW 24/3, Higher Hill;
- Principal Viewpoint 6 − PRoW WL 24/11 near the edge of the Great Plantation;
- Principal Viewpoint 8 − PRoW WL23/46, Knighton Farm;
- Principal Viewpoint 10 − local Farm near PRoW WL23/48, Shurton West;
- Principal Viewpoint 11 − PRoW WL23/56, Shurton east;
- Principal Viewpoint 13 − PRoW WL23/57, west of Wick;
- Principal Viewpoint 15 − PRoW WL23/61;
- Principal Viewpoint 16 − PRoW WL23/61, Wick;
- Principal Viewpoint 19 − PRoW WL23/95, West Somerset Coast Path, Stolford;
- Principal Viewpoint 20 − PRoW No. BW32/3, Stockland Bristol;
- Principal Viewpoint 21 − PRoW WL24/1, Quantock Hills AONB;
- Principal Viewpoint 22 − PRoW WL8/30, East Quantoxhead;
- Principal Viewpoint 28 − PRoW WL10/9, Quantock Hills AONB;
- Principal Viewpoint 30 − PRoW WL10/28, Quantock Hills AONB;
- Principal Viewpoint 35 − Cannington Park, public footpath; and
- Principal Viewpoint 36 – PRoW BW 28/3, Puriton Hill.

25.6.75 For the operational phase, **Chapter 22** considers impacts at Year 1 (first year of the operational phase) and then again at Year 15 when the screen planting which has been built into the design of the scheme would have become more established. The Year 15 assessment provides a good indication of the longer-term impacts of the proposed development.

25.6.76 At Year 1, impacts on PRoW in terms of change in landscape character are predicted to be **minor adverse** while impacts on the viewpoints set out above are predicted to be **major adverse** on Viewpoints 1 and 2, **moderate adverse** on Viewpoints 3, 6, 8, 10, 11, 13, 16, 19, 20 and 28 and **minor adverse** on Viewpoints 4, 5, 15, 21, 22, 30, 35 and 36.

25.6.77 At Year 15, impacts on Viewpoints 1 and 2 are predicted to have reduced to **moderate adverse** and on Viewpoint 8 to **minor adverse.** Impacts on all other Viewpoints are predicted to remain as assessed at Year 1.

25.6.78 However, as for the construction phase, people using the PRoW would usually be transient and are, therefore, unlikely to be subject to the same exposure duration as defined for fixed receptor locations on which the assessment is based. Hence, whilst the predicted visual impacts might result in short-term disturbance as walkers pass through the zone of influence, the impact on a person's enjoyment of the amenity is likely to be less significant than has been assessed.

iii. Obstruction to Sports and Recreation Facilities

25.6.79 There are no formal sports or recreational facilities within the HPC permanent development site boundary. Therefore no physical disturbance or obstruction would occur and **no impact** is predicted.

iv. Disturbance to Users of Sports and Recreation Facilities

25.6.80 The nearest sports and recreation facility to HPC is the fishing lakes to the southwest of the site (Site 22 on **Figure 25.2**). Given that these are in excess of 1.5km from the HPC permanent development site boundary, they are scoped out of the Noise and Vibration (**Chapter 11**), Air Quality (**Chapter 12**) and Landscape and Visual (**Chapter 22**) assessments.

v. Obstruction to Open Access Land and Public Open Space

25.6.81 There are no areas of open access land or public open space (including common land) within the landward footprint of the HPC permanent development site boundary. Consequently **no impact** is predicted.

25.6.82 No operational structures or activities would cause obstruction to the foreshore. The permanent footprint of the seawall could obstruct two existing access points. However, the seawall design comprises an access ramp to the foreshore at the western end, and two stepped access points equidistant between the eastern and western ends of the seawall so, overall, access to the foreshore would be slightly improved.

25.6.83 The foreshore is used for a variety of recreational activities, including shore-angling and wildfowling, and may be designated as part of the England Coast Path in the future. As no obstruction of the foreshore would take place during the operational phase and as access would be retained, **no impact** is predicted.

25.6.84 Navigational risk in relation to recreational sailing and boating is examined in **Chapter 26** of this volume. Following dismantling of the jetty, no off-shore obstructions would remain, with the exception of navigational marker buoys to show the location of the intake and outfall head structures and the fish return system. Based on the limited scale of the extent of obstruction, but considering its duration, a very low magnitude change would be expected. Therefore, a permanent **negligible** impact is predicted.

vi. Disturbance to Users of Open Access Land and Public Open Space

25.6.85 The operation of HPC could result in noise, air and visual disturbance impacts to open access land and public open space within the study area.

25.6.86 **Chapter 11** (Noise and Vibration) does not identify open access land and public open space as sensitive receptors during the operational phase.

25.6.87 **Chapter 12** (Air Quality) scopes out disturbance to users of the foreshore and Wick Common.

25.6.88 **Chapter 22** considers impacts at Year 1 (first year of the operational phase) and then again at Year 15 when the screen planting which has been built into the design of the scheme would have become more established. The Year 15 assessment provides a good indication of the longer-term impacts of the proposed development.

25.6.89 **Chapter 21** (Landscape and Visual) assesses "Wick Moor and Coast" (which would include Wick Moor Common and North Moor Common) in terms of impacts on landscape character and predicts a **minor adverse** impact at Year 1 and at Year 15.

25.6.90 Impacts on the West Somerset Coast Path may be considered representative of impacts on the foreshore and these are assessed by Viewpoints 2, 3 and 19.

25.6.91 At Year 1, the impact on Viewpoint 2 is predicted to be of **major adverse** significance while impacts on Viewpoints 3 and 19 are predicted to be of **moderate adverse** significance. At Year 15, the impact on Viewpoint 2 is predicted to have reduced to **moderate adverse** while impacts on Viewpoints 3 and 19 are predicted to remain as assessed at Year 1.

25.6.92 However, it should be noted that users of the foreshore would often be facing away from the source of the visual disturbance (that is, the HPC permanent development site). In addition, users of the PRoW would usually be transient and are, therefore, unlikely to be subject to the same exposure duration as defined for fixed receptor locations on which the assessment is based. Hence, whilst the predicted visual impacts might result in short-term disturbance the impact on a person's enjoyment of the amenity is likely to be less significant than has been assessed.

25.7 Mitigation of Impacts

a) Introduction

25.7.1 This section identifies mitigation measures proposed for certain receptors to avoid, minimise or offset the potential impacts on amenity and recreation associated with the construction and operational phases of HPC.

b) Construction Phase

i. Obstruction to PRoW

25.7.2 Following consultation with local residents, Stogursey Parish Council, and SCC's Rights of Way officers, it has been agreed that a temporary alternative route would be provided around the boundary of the HPC development site. This route would also be used by those following the West Somerset Coast Path for the duration of jetty and seawall construction. On completion of jetty and seawall construction, the West Somerset Coast Path would be reinstated as soon as possible, incorporated into the sea wall design.

25.7.3 The following objectives informed the design of the alternative route:

- it should provide a connection to existing PRoW;
- it should not result in a dead end;
- it should be clear and accessible throughout the year;
- it should be sufficiently wide to provide ease of access, and to avoid a 'tunnel' effect;

- it should be appropriately signposted;
- it should allow for disabled access as far as practicable; and
- where separation through a boundary is necessary, self-closing pedestrian gates should be used, otherwise gaps should be left (and stiles avoided).

25.7.4 The alternative route would be prepared prior to the closure of existing PRoW within the HPC development site. In addition, signposting would be in place on access routes and at the access point where closures would occur. The alternative route would be available at all times for the duration of the construction phase.

25.7.5 The alternative route entails, for the most part, the relocation of PRoW to a route around the perimeter of the HPC development site (set between the inner security fence and the outer boundary fence). **Figure 25.18** presents the proposed diversion route and PRoW closures for the first three years of the construction phase.

25.7.6 Due to the requirement to maintain foreshore access as close to the site as possible, the West Somerset Coast Path (WL23/95) would remain unobstructed from the northeast corner of the HPC development site. However, the alternative route to maintain coastal access around the site would be directed from the junction of WL23/95 and WL23/61 to the immediate east of Hinkley Point B (see **Figure 25.18**). The diversion route for the West Somerset Coast Path would run from this point along WL23/61, and then continue along WL23/71 until it reaches the C182 on the eastern boundary of the HPC development site. From here the diversion would follow the alternative route that passes around the HPC development site boundary until it reconnects to the West Somerset Coast Path (WL23/95) at the northwest corner of the HPC development site.

25.7.7 The alternative route around the HPC development site boundary would run southwards along the site boundary, around the area of common land and around the planned new southern roundabout. The route would cross the access road into the site once the new southern roundabout is constructed.

25.7.8 Once the route reaches the south eastern corner of the site, it would move east-west to the north of Doggetts to WL23/56. The section of WL23/56 to the south of the diverted route would be retained and a self-closing pedestrian gate provided in the land boundary fence (replacing the current stile) to enable continued access to the WL23/56 to the south and into Shurton.

25.7.9 The route would continue running east-west until it joins Benhole Lane (WL23/48) to the north of the stretch of Benhole Lane that is frequently flooded (in the extreme south-west corner of the HPC development site).

25.7.10 The alternative route would then continue south to north up Benhole Lane (WL23/48) (outside the HPC development site, using the existing PRoW) until it reaches the junction with Green Lane (WL23/110). At this point a new route would be provided along the western boundary of the site up to the coast and connecting with the West Somerset Coast Path (WL23/95). There are no existing boundary gates along this western side of the HPC development site and consequently no gates would be installed, as gaps would be appropriate.

25.7.11 In addition, a new access route from Shurton would be provided which would run northwards and connect to the alternative route. This would ease local concerns about increased use of the PRoW route along Benhole Lane (WL23/48) which passes through a resident's field.

25.7.12 By providing alternative routes the magnitude of impacts may be significantly reduced, as the right of passage would be retained to the existing destinations of the PRoW, such as from the Coast Path to Shurton, Knighton, Burton and Wick (as listed in **Appendix 25B**).

25.7.13 **Table 25.11** presents the approximate distance of diversion routes expected for the PRoWs affected. It is predicted that the alternatives would reduce the distance of some routes, whilst others would be extended by up to 4.2km (specifically the West Somerset Coast Path).

Table 25.11: PRoW Diversions and Likely Magnitude Reduction

Footpath ID	Diversion Length	Original Length of PRoW	Additional Distance	Magnitude of Reduction
WL 23/48	400m	740m	-340m	Medium to Very Low
WL 23/50	Closed for the duration of the construction phase (11 years)			
WL 23/56	2,060m	1,530m	530m	Medium to Very Low
WL 23/68	Closed for the duration of the construction phase (11 years)			
WL 23/69	Closed for the duration of the construction phase (11 years)			
WL 23/70	450m	1,147m	-697m	Medium to Very Low
WL 23/95 (Part of the West Somerset Coast Path)	5,420m	1,250m	4,170m	Medium to Very Low
WL 23/105	Closed for the duration of the construction phase (11 years)			
WL 23/110	2,550m	1,030m	1,522m	Medium to Very Low
New access route at the west end of Shurton	294m	0m	294m	None

25.7.14 Early restoration works are planned to take place within the southern part of the HPC development site to ensure early screening for local residents. As part of these, the PRoW diversion alignment would alter slightly and a permissive stretch of bridleway would be created. Proposals for early restoration works, including the footpath diversion and permissive bridleway are shown in **Chapter 22**, **Figure 22.58**).

25.7.15 In order to provide mitigation and enhancement to the wider PRoW network (outside the site boundary), a number of actions have been identified as part of EDF Energy's Site Preparation Works (Planning Application Reference 3/32/10/037) Section 106 agreement. These would be implemented, subject to landowner consent where required, by SCC with the support of EDF Energy. These measures are listed in **Appendix 25E** and the locations presented on **Figures 25.19A**, **25.19B**, **25.20**). These measures would be implemented in the early years of construction.

25.7.16 Actions would include resurfacing, clearance of vegetation and provision of self-closing gates, new bridges and waymarks, all of which would improve access to the wider PRoW network. In addition, additional bridleway provision is proposed, by creating a new bridleway along Woolstone Lane and by upgrading of PRoW Wl23/106.

25.7.17 Successful implementation of all of these actions would result in improved accessibility to over 13,307m of PRoW within Stogursey Parish (5,979m within the study area). As well as benefitting walkers, bridleways within the Parish would increase by 1,149m and this would significantly improve accessibility by different user groups (e.g. cyclists and equestrians).

25.7.18 At the end of the construction phase, a number of PRoW would be reinstated in the construction area, although following consultation with SCC Rights of Way Team and the implementation of the landscape restoration proposals, the routes would be slightly altered from their baseline locations. The routes and the lengths to be reinstated are listed in **Table 25.12** and shown on **Figures 25.19A** and **25.19B**. The benefit arising from this reinstatement is examined with respect to the operational phase of HPC.

Table 25.12: Reinstatement of PRoW (including Permanent Diversions) to be Carried Out at the End of Construction of HPC (see Figures 25.19A and 25.19B)

Reference	Reinstatement Action	Length
3-1	Permanent diversion of altered route of PRoW WL23/48 from WL23/110 north to WL23/95 along western bund.	831m
3-2	Reinstate diverted route of PRoW WL23/110.	1,070m
3-3	Upgrade part of PRoW WL23/110 (diversion) to bridleway.	380m
3-4	Reinstate route of PRoW WL23/56 from WL23/110 to reconnect with WL23/56 to the south of the construction area; route would follow a line proposed by Somerset County Council, and will incorporate pedestrian gates and waymarks where required.	836m
3-5	Create new PRoW bridleway from WL23/56 and connect to WL23/110.	450m
3-6	Upgrade PRoW WL23/56 from 3-5 to 3-8, to bridleway status.	637m
3-7	Reinstate diverted route of PRoW reference WL23/69; route would follow a line proposed by Somerset County Council, and will incorporate pedestrian gates and waymarks where required.	991m
3-8	Create permanent PRoW (bridleway) from Shurton Lane (entrance to the Emergency Access Road) to C182.	1,063m
3-9	Create permanent PRoW from WL23/48 to PRoW created for Action Reference 3-8.	250m

25.7.19 Monitoring of access along the PRoW diversion route within and adjacent to the HPC development site would be undertaken throughout the construction phase to ensure that access is not obstructed (for example, by growth of vegetation, waterlogged ground conditions) and maintenance would be undertaken, where appropriate. An automated counter would be installed along the diversion route where it connects onto Benhole Lane (WL23/48), in order to identify the number of users of the diversion route. Furthermore, an appropriate mechanism for reporting, logging and investigating complaints would be employed and monitored during the construction phase, accompanied by an action plan to ensure that any issues are tackled rapidly.

ii. Obstruction to Open Access Land and Public Open Space

25.7.20 During the construction phase, permissive access would be permitted to the southern area between the inner security fence and the HPC development site boundary fence in response to requests from local residents for the provision of space for short circular walks. This would provide a maximum of 13ha of 'permissive' access land, for amenity and recreation for the residents of Shurton in particular. However, it should be noted that access to certain parts of this area would be restricted at certain times such as during archaeological excavations and construction of the emergency access road.

iii. Disturbance to Users of PRoW, Sports and Recreation Facilities, Open Access Land and Public Open Space

25.7.21 The majority of measures designed to limit disturbance impacts are either inherent in the design or are built into the construction methodology or procedures.

25.7.22 Some specific mitigation is proposed for visual impacts however. This includes provision of a bund on the north-west boundary of the HPC development site which would help to mitigate impacts on Viewpoints 1 and 2. The PRoW diversion route would run directly west of the bund and so this would effectively screen views of the construction site for walkers in this location. Offsite planting is also proposed to mitigate visual impacts on Viewpoints 4 and 8.

c) Operational Phase

i. Obstruction to PRoW

25.7.23 In order to mitigate the closure of PRoW located within the footprint of the proposed HPC permanent development site, a number of measures have been identified. Consultation with SCC's Rights of Way Team identified the rationalisation and enhancement of the existing PRoW to be a key mitigation measure. This has been incorporated into the scheme design, where EDF Energy has the relevant ownership rights.

25.7.24 **Table 25.12** lists the measures to be undertaken at the end of the construction phase (see **Figures 25.19A** and **25.19B**). These measures would reinstate (and in some cases create) 5,491m of designated PRoW (footpaths) and would increase the length of designated bridleway by 2,530m, thereby providing a significant increase in accessibility for a wider range of recreational activities (horse riding, cycling) in the study area.

25.7.25 In addition, a number of permissive paths and bridleways would be provided throughout the former southern construction phase area, as well as interpretation boards with information on the natural and historic environment (tying in with the displays within the Public Information Centre) at a number of locations. In total, 2,340m of permissive rights of way would be created, of which 893m would be permissive bridleway.

25.7.26 In addition, although not specifically related to PRoW obstruction impacts, a horse crossing would be provided at the junction of the C182 and Farringdon Lane as part of the highway improvements. This is designed to increase the safety of horses and riders.

ii. Obstruction to Open Access Land and Public Open Space

25.7.27 Although no mitigation is required in this respect, general access would be permitted to the land north of Shurton up to Green Lane, as an enhancement measure. This area is shown on the Landscape Restoration/Habitats Plan in **Chapter 22, Figure 22.59**. This also shows the location of the designated and permissive PRoW (footpaths) and bridleways.

iii. Disturbance to Users of PRoW, Sports and Recreation Facilities, Open Access Land and Public Open Space

25.7.28 As for the construction phase, the majority of measures designed to limit disturbance impacts are inherent in the design. In terms of visual impacts, following construction, the bund on the north-west boundary would be removed to be replaced by permanent landscaping within the HPC operational site boundary. The offsite planting would be more established during the operational phase and would continue to mitigate visual impacts on Viewpoints 4 and 8.

25.8 Residual Impacts

a) Introduction

25.8.1 This section identifies the residual impacts associated with the proposed HPC development throughout the construction and operational phases, following the implementation of the mitigation measures described in Section 25.7.

b) Construction Phase Residual Impacts

25.8.2 The implementation of the mitigation measures identified above would reduce the magnitude of the obstruction impacts on PRoW on the HPC development site to very low and, consequently, a long-term **minor adverse residual** impact is predicted.

25.8.3 The provision of a diversion route for the West Somerset Coast Path during the first three years of construction would retain the connection to the coast either side of the HPC development site and thereby reduce the magnitude of the effect to very low. Consequently, a medium-term **minor adverse residual** impact would remain. The impact would cease on the reopening of the West Somerset Coast Path.

25.8.4 The mitigation measures proposed for visual disturbance on Viewpoints 1, 2, 4 and 8 (**Chapter 22**, Landscape and Visual) are not predicted to reduce the assessed impact significance. For Viewpoints 1 and 2, this is because of the scale of the bund in comparison to the scale of construction activities. For Viewpoints 4 and 8, this is because the planting would not be sufficiently mature to provide an effective screen. Therefore impacts on these Viewpoints would remain as initially assessed.

25.8.5 No other mitigation measures have been proposed for the construction phase, other than those inherent in the scheme design, and therefore all other impacts remain as initially assessed. In the case of disturbance impacts, however, the transient nature of users of amenity and recreation assets means that impacts are likely to be less significant than assessed.

25.8.6 In addition, the actions identified as part of EDF Energy's Site Preparation Works planning application (Planning Application Reference 3/32/10/037) Section 106 agreement are designed to provide users of PRoW with improved access to the wider PRoW network should they wish to avoid the PRoW diversion around the site because of the predicted disturbance impacts.

c) Operational Phase Residual Impacts

25.8.7 The implementation of the mitigation measures described above would, on commencement of the operational phase, reduce the predicted magnitude of the impacts on PRoW on the HPC permanent development site to a neutral level as connections to routes and right of passage around the site would be available. Furthermore, the provision of additional permissive footpaths to the south of HPC would result in an overall net increase in the available footpath network. Consequently, a **negligible residual** impact is predicted from commencement of the operational phase.

25.8.8 In terms of bridleways, the mitigation measures would result in an increase in the length of bridleways within the study area and Stogursey Parish and would also improve the accessibility of the area to cyclists and equestrians. Overall, the length of bridleway within Stogursey Parish would increase by 6,721m, from a baseline of 3,198m. Consequently, a permanent **minor beneficial residual** impact is predicted on accessibility for equestrians and cyclists.

25.8.9 The mitigation measures proposed for Viewpoints 4 and 8 (**Chapter 22**, Landscape and Visual) are predicted to reduce the assessed impact significance at Year 15 to of **minor adverse residual** significance.

25.8.10 No other specific mitigation measures have been proposed for the operational phase, other than those inherent in the scheme design and therefore all other impacts remain as initially assessed. In the case of disturbance impacts, however, the transient nature of users of amenity and recreation assets means that impacts are likely to be less significant than assessed.

25.9 Summary of Impacts

25.9.1 **Table 25.13** presents a summary of the potential impacts associated with the proposed development.

Table 25.13: Summary of Construction and Operational Phase Impacts on the Amenity and Recreation Resource

Receptor	Potential Impact	Magnitude	Description	Importance	Significance	Proposed Mitigation	Residual Impact
Construction Phase							
PRoW (HPC Development Site)	Obstruction to PRoW	High	Direct Medium-term Adverse Reversible	Low	Moderate adverse	PRoW diversions, and wider network enhancement	Minor adverse
	Obstruction to Coast Path	High	Direct Medium-term Adverse Reversible	High	Major adverse	PRoW diversion and alternative route, and reinstatement on completion of seawall	Minor adverse for three years reducing to no impact
	Obstruction to bridleways and byways accessible to equestrians and cyclists	Very low	Direct Medium-term Adverse Reversible	Low	Negligible	PRoW diversions, and wider network enhancement	Negligible
	Noise disturbance	Very low to high	Localised Direct Adverse Temporary Long-term Reversible	Low	Negligible to moderate adverse	None other than that inherent in scheme design/operating practices	Negligible to moderate adverse
	Air quality disturbance	N/A	N/A	N/A	N/A	N/A	N/A
	Visual disturbance	Very low to high	Medium-term Adverse	Medium to high	Minor adverse to major adverse	North-west bund Off-site planting	Minor adverse to major adverse

Receptor	Potential Impact	Magnitude	Description	Importance	Significance	Proposed Mitigation	Residual Impact
Construction Phase							
PRoW (C182)	Obstruction to PRoW users crossing C182	Low	Direct Temporary Medium-term Adverse Reversible	Low	Negligible	None proposed	Negligible
	Noise, air quality, visual disturbance	N/A	N/A	N/A	N/A	N/A	N/A
PRoW (off-site highway improvements)	Obstruction	N/A	N/A	N/A	N/A	N/A	N/A
	Noise, air quality, visual disturbance	N/A	N/A	N/A	N/A	N/A	N/A
Sports and recreation facilities (HPC Development Site)	Obstruction	N/A	N/A	N/A	N/A	N/A	N/A
	Noise, air quality, visual disturbance	N/A	N/A	N/A	N/A	N/A	N/A
	Obstruction	N/A	N/A	N/A	N/A	N/A	N/A
	Noise disturbance 2013 – Cannington Cemetery / Sports pitch on Shark's Lane	High	Localised Adverse Temporary Long-term Reversible	Medium/low	Major adverse/ moderate adverse	None proposed other than that inherent in design	Major adverse/moderate adverse but reduces in 2016
	Noise disturbance 2016 - Cannington Cemetery / sports pitch on Shark's Lane	Medium to very low	Localised Adverse/beneficial Temporary Long-term Reversible	Medium/low	Moderate adverse/minor beneficial	None proposed other than that inherent in design	Moderate adverse/minor beneficial

Receptor	Potential Impact	Magnitude	Description	Importance	Significance	Proposed Mitigation	Residual Impact
Construction Phase							
Sports and recreation facilities (C182)	Air quality and visual disturbance	N/A	N/A	N/A	N/A	N/A	N/A
Sports and recreation facilities (off-site highway improvements)	Obstruction	N/A	N/A	N/A	N/A	N/A	N/A
	Noise disturbance – Tropiquaria	High	Localised Adverse	Low	Moderate adverse	None proposed	Moderate adverse
	Air quality and visual disturbance	N/A	N/A	N/A	N/A	N/A	N/A
Open Access Land and Public Open Space (HPC Development Site)	Obstruction to common land / public open space	N/A	N/A	N/A	N/A	N/A	N/A
	Obstruction to foreshore access for anglers	Very low	Direct Medium-term Adverse Reversible	Low	Minor adverse	None proposed	Minor adverse
	Obstruction to Excepted Area for wildfowling	Low	Direct Medium-term Adverse Reversible	Low	Minor adverse	None proposed	Minor adverse
	Obstruction to sea-angling / recreational boating	Low	Direct Medium-term Adverse Reversible	Low	Minor adverse	None proposed	Minor adverse

Receptor	Potential Impact	Magnitude	Description	Importance	Significance	Proposed Mitigation	Residual Impact
Construction Phase							
Open Access Land and Public Open Space (HPC Development Site)	Noise disturbance to Wick Moor Common and North Moor Common	Very low to high	Localised Adverse Temporary Long-term Reversible	Low	Minor adverse to moderate adverse	None proposed	Minor adverse to moderate adverse
	Noise disturbance to foreshore	Very low to high	Localised Direct Adverse Temporary Long-term Reversible	Low	Negligible to moderate adverse	None other than that inherent in scheme design/operating practices	Negligible to moderate adverse
	Air quality disturbance	N/A	N/A	N/A	N/A	N/A	N/A
	Visual disturbance (change in landscape character) to Wick Moor Common and North Moor Common	Medium	Adverse Medium-term	High	Major adverse	None proposed	Major adverse
	Visual disturbance (change in composition of view) to foreshore	Medium to high	Adverse Medium-term	High	Major adverse	None proposed	Major adverse
Open Access Land and Public Open Space (C182)	Obstruction	N/A	N/A	N/A	N/A	N/A	N/A
	Noise disturbance 2013 – Cannington Walled Garden	High	Localised Direct Adverse Temporary Long-term Reversible	Low	Moderate adverse	None proposed other than that inherent in design	Moderate adverse

Receptor	Potential Impact	Magnitude	Description	Importance	Significance	Proposed Mitigation	Residual Impact
Construction Phase							
Open Access Land and Public Open Space (C182)	Noise disturbance 2016 – Cannington Walled Garden, amenity grassland, St Mary the Virgin Churchyard	Very low	Localised Direct Beneficial Temporary Long-term Reversible	Low to medium	Minor beneficial	N/A	Minor beneficial
	Air quality and visual disturbance	N/A	N/A	N/A	N/A	N/A	N/A
Open Access Land and Public Open Space (off-site highway improvements)	Obstruction	N/A	N/A	N/A	N/A	N/A	N/A
	Noise, air quality, visual disturbance	N/A	N/A	N/A	N/A	N/A	N/A
Operational Phase							
PRoW	Obstruction to PRoW	High	Direct Permanent Adverse Reversible	Low	Moderate adverse	PRoW diversions, and wider network enhancement	Negligible impact
	Obstruction to West Somerset Coast Path	N/A	N/A	N/A	N/A	N/A	N/A
	Obstruction to bridleways and byways accessible to equestrians and cyclists	Low	Direct Permanent Reversible	Low	Minor adverse	PRoW diversions, and wider network enhancement	Minor beneficial
	Noise, air quality disturbance	N/A	N/A	N/A	N/A	N/A	N/A
	Visual disturbance - Year 1	Very low to high	Medium-term Adverse	Medium to high	Minor adverse to major adverse	Construction phase off-site planting	Minor adverse to major adverse
	Visual disturbance -Year 15	Very low to medium	Long-term Adverse	Medium to high	Minor adverse to moderate adverse	Construction phase off-site planting (maturing)	Minor adverse to moderate adverse

Receptor	Potential Impact	Magnitude	Description	Importance	Significance	Proposed Mitigation	Residual Impact
Operational Phase							
Sports and recreation facilities	Obstruction	N/A	N/A	N/A	N/A	N/A	N/A
	Noise, air quality disturbance	N/A	N/A	N/A	N/A	N/A	N/A
Open Access Land and Public Open Space	Obstruction to common land / public open space	N/A	N/A	N/A	N/A	N/A	N/A
	Obstruction to foreshore for walkers, anglers, wildfowlers	N/A	N/A	N/A	N/A	N/A	N/A
	Obstruction to sea-angling / recreational boating	Very low	Permanent Adverse	Low	Negligible	None proposed	Negligible
	Noise, air quality disturbance	N/A	N/A	N/A	N/A	N/A	N/A
	Visual disturbance (change in landscape character) to Wick Moor Common and North Moor Common – Year 1 and Year 15	Very low	Adverse Medium-term	High	Minor adverse	None proposed	Minor adverse
	Visual disturbance (change in composition of view) to foreshore – Year 1	Low to medium	Adverse Medium-term	High	Major adverse to moderate adverse	None proposed	Major adverse to moderate adverse
	Visual disturbance (change in composition of view) to foreshore – Year 1	Low	Adverse Long-term	High	Moderate adverse	None proposed	Moderate adverse

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CHAPTER 26: NAVIGATION

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TABLES

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26. NAVIGATION

26.1 Introduction

26.1.1 This chapter of the Environmental Statement (ES) provides an assessment of the potential risks to navigation at and around Hinkley Point (including the River Parrett, Bridgwater Bay and the wider Bristol Channel) associated with all of the marine aspects of the Hinkley Point C (HPC) Project, namely: the proposed Temporary Jetty development, the cooling water intake and outfall structures, and the refurbishment and extension of Combwich Wharf. Construction, operational and post-operational risks are all considered (see **Chapters 2**, **3**, **4** and **5** of **Volumes 2** and **7** of the ES for details). Where considered necessary, measures are proposed to mitigate and/or manage risks such that they are deemed to be as low as reasonably practicable (ALARP) or acceptable.

26.2 Scope of Assessment

a) EIA Scoping

26.2.1 The scope of this assessment has been determined through a formal Environmental Impact Assessment (EIA) scoping process undertaken with the Infrastructure Planning Commission (IPC). In their April 2010 Scoping Opinion (see **Annex 1**), the IPC identified that the implications on navigation of the power station buildings and the use of Combwich Wharf and the Temporary Jetty should be assessed.

26.2.2 In their consultation response to the IPC on the scope of the EIA, Trinity House advised that the EIA

> *"should include a Navigational Risk Assessment of the project to establish how the development may affect existing navigation in the area. This assessment should include establishing by means of a physical survey of all marine traffic in the area (which takes account of seasonal variations, if any, particularly of leisure craft) over a representative period (usually 28 days of data), existing vessel traffic routes and types. The traffic survey area should include movements in Bridgwater Bay within 5 nautical miles of Hinkley Point and the entrance to the River Parrett. The Navigational Risk Assessment should also include consideration of the potential impact of the proposed works during both construction and operation, which can be used to inform any consideration of the requirement for additional aids to navigation (because of the changed vessel traffic in the area) and/or navigational marking of the development as risk mitigation. The assessment should also consider whether any lighting exhibited from the works during construction and/or from the power station once constructed will adversely affect existing aids to navigation ("a false light"). This should include measures that need to be taken to reduce potential interference with the night vision of mariners."*

b) Scope and Objectives of the Assessment

26.2.3 Key legislation and planning policy relating to navigation is identified in Section 26.3. The assessment has been undertaken using the risk assessment methodology described in Section 26.4. The baseline conditions described in Section 26.5 are based on information derived from a range of databases and other data sources.

26.2.4 This assessment includes consideration of potential risks to navigation posed by the HPC Project, including relevant associated development. Section 26.6 provides an assessment of the potential risks associated with the Temporary Jetty, the intake and outfall structures, and the proposed refurbishment and extension of Combwich Wharf. Appropriate mitigation aimed at making any risks acceptable or ALARP is identified in Section 26.7. Any residual risks that would remain following the implementation of mitigation measures are set out in Section 26.8.

26.2.5 For the purpose of this assessment, the following objectives were applied:

- identify the existing navigation conditions in the study area that may be affected by the Hinkley Point C Project;
- assess the risks to navigation of the Hinkley Point C Project's construction, operation and post-operation (where applicable); and
- recommend mitigation measures, where necessary, to reduce the risks to navigation of the Hinkley Point C Project.

26.2.6 Potential cumulative impacts with other proposed or reasonably foreseeable projects are considered in **Volume 11** of this ES.

26.3 Legislative and Policy Context

a) International Conventions

26.3.1 The International Maritime Organisation (IMO) has introduced a number of conventions concerning navigation and shipping that are applied in the UK through international conventions and national legislation and policy. The conventions, legislation and policy that are relevant to this assessment are described below.

26.3.2 The Convention for the Safety of Life at Sea 1974 (SOLAS) specifies minimum standards for the construction, equipment and operation of ships compatible with their safety. Chapter V of SOLAS identifies certain navigation safety services to be provided by Government, including meteorological services, ship routing services, and search and rescue services. For example, the Government is required to arrange for the establishment of Vessel Traffic Services (VTS) where the volume of traffic or the degree of risk justifies such services.

26.3.3 The Convention on the International Regulations for Preventing Collisions at Sea 1972 (COLREGs) specifies requirements for navigation including steering, sailing, lighting and signalling, and provides guidance for determining safe speed, collision risk and the conduct of vessels operating in or near traffic separation schemes. This convention covers the conduct of vessels in all conditions of visibility, and sets out rules for safe speeds, taking action to avoid collisions in head-on situations.

b) National Legislation and Policy

26.3.4 The requirements for maintaining safety in ports and harbours are set out in marine-related legislation as well as the provisions of local Acts and Orders made under the Harbours Act 1964 (e.g. Harbour Empowerment Orders), and general legislation such as the Health and Safety at Work etc Act 1974 and the Docks Regulations 1988 made under that 1974 Act.

26.3.5 The Port Marine Safety Code (PMSC) (DfT 2009, Ref. 26.1) applies to all harbour authorities in the UK that have statutory powers and legal duties relating to the safety of people who use ports and harbours and their property, and to the wellbeing of the port environment and community. It supports the undertaking of powers and duties in relation to harbour authorities' local Acts and Orders and marine-related legislation such as the Harbours Act 1964, the Dangerous Vessels Act 1985, the Pilotage Act 1987 and the Merchant Shipping Act 1995 as amended by, for example, the Marine Safety Act 2003 and supported by, for example, the Merchant Shipping (Vessel Traffic Monitoring and Reporting Requirements) Regulations 2004. The PMSC establishes the principle of a national standard for every aspect of port marine safety and aims to enhance safety for those who use or work in ports, their ships, passengers and the environment. It applies to port marine operations, the well-established principles of risk assessment and Safety Management Systems (SMS). The supporting Guide to Good Practice on Port Marine Operations (GTGP) (DfT 2009; Ref. 26.2) complements the PMSC and provides harbour authorities with generic advice and examples about how they might meet the requirements under the Code.

26.3.6 Marine Notices publicise important safety, pollution prevention and other relevant information. There are three different types of notices:

- Merchant Shipping Notices (MSNs) often communicate UK law and are legally enforceable when referred to by a Statutory Instrument;
- Marine Guidance Notes (MGNs) give guidance and strong recommendations about best practice on interpretation of law and general safety advice; and
- Marine Information Notes (MINs) provide less important time limited information and changes of address after which they expire.

26.3.7 For example, MGN 401 (Navigation: VTS and Local Port Services (LPS) in the United Kingdom) (MCA, 2009; Ref. 26.3) defines the UK's interpretation of VTS, provides guidance for determining the need to establish a VTS, defines the responsibilities of those authorities concerned with providing VTS, and complements the PMSC and the GTGP on the management of safety in ports.

c) Local Policy and Guidance

26.3.8 The Port of Bridgwater has its own Marine Operations Plan (CF Spencer & Co Ltd/ Sedgemoor District Council, 2009; Ref. 26.4) in place to meet the requirements of the PMSC. This was last revised in July 2009. The plan includes a SMS and an Operations Plan, covering communications, collision, navigation control, speed limits, passage plan and pilotage. Combwich Wharf is within the Port of Bridgwater's harbour limits. The Temporary Jetty and the cooling water intake and outfall head structures would be situated outside of the Port of Bridgwater's harbour limits, but vessels using the Temporary Jetty might pass through or sufficiently near to the Port of Bridgwater's jurisdiction/control so that some of Marine Operations Plan's SMS and the Operations Plan come into effect and are therefore considered to be relevant to this assessment. The Port of Bridgwater also has in place an oil spill contingency plan and a port waste management plan.

26.4 Methodology

26.4.1 This assessment has been undertaken using an approach that differs from the general approach to EIA described in **Volume 1**, **Chapter 7** and instead undertakes an assessment of risk, rather than an assessment of impacts to navigation. The approach is described below. It considers the risks to all navigation expected and proposed to occur within the study area.

a) Consultation

26.4.2 Consultation has been undertaken throughout the EIA process and further information may be found in the **Consultation Report**. EDF Energy commenced consultation on navigation with key statutory consultees and other interested parties through the Stage 1 consultation process on Initial Proposals and Options (in November 2009) and then followed this with Stage 2 consultation on preferred proposals (in July 2010). This included consultation on the key development features potentially affecting navigation: that is, the Temporary Jetty, the cooling water intake and outfall head structures, and the refurbishment and extension of Combwich Wharf.

26.4.3 In addition, consultation with, amongst others, Sedgemoor District Council (SDC) and the Port of Bridgwater was undertaken over the course of 2009 and early 2010 at monthly meetings of the Marine Authorities Liaison Group (MALG). The MALG comprised a technical forum organised by EDF Energy and attended by representatives of regulatory and advisory agencies with an interest in the HPC Project from a marine and coastal perspective. The purpose of the MALG meetings was to provide a mechanism for continual consultation on technical aspects of the proposals for the HPC Project, relating to the water and marine environments in particular, as the project moved from conceptual through to detailed design, and also facilitated discussion on the assessment of potential environmental impacts.

26.4.4 Specific consultation concerned with navigation was undertaken in the form of a hazard identification (HAZID) workshop held on 5 May 2010. The workshop was hosted by EDF Energy and specialist navigation consultants Arcadis Vectra and Anatec, and attended by representatives of: the Port of Bridgwater, Bristol Port, Maritime and Coastguard Agency (MCA), Devon Sea Fisheries, the Royal Yachting Association (RYA) and Bristol Channel Yachting Association, Tarmac Marine Dredging (and the British Marine Aggregate Producers Association (BMAPA) and the Chamber of Shipping), and SDC as the harbour authority for the Port of Bridgwater. Trinity House was also invited to the workshop but could not attend.

26.4.5 The workshop was initiated to consider the ship collision risks associated with the proposed intake and outfall head structures associated with HPC. Ship collision risks associated with the Temporary Jetty development and Combwich Wharf were also raised at the workshop.

26.4.6 At the time of conducting the workshop, the positions of the intake and outfall head structures were indicated rather than fixed. The finalised positions of the head structures will not vary sufficiently from the indicated positions and, therefore, they will not alter the findings of the HAZID workshop. The workshop has, in part, informed the assessments made in this chapter.

26.4.7 In addition to the workshop, separate consultation was undertaken with SDC and/or the Port of Bridgwater on 21 February 2011, 9 March 2011 and 2 June 2011. Consultation included discussion on how the HPC Project could affect ongoing navigation to and operations within the Port of Bridgwater due to, in particular, the operation of the Temporary Jetty and the operation of the refurbished and extended Combwich Wharf. Key aspects of this discussion included the potential navigation issues and coordinated management requirements in relation to the shared approaches to the Temporary Jetty and the Port of Bridgwater (including discussion about moving the Gore Buoy) and the tidal restrictions that limit navigation within the River Parrett and Port of Bridgwater.

26.4.8 Separate consultation was also undertaken with the Ministry of Defence (MoD) in relation to the jetty's potential impact on the activities undertaken within the Bridgwater Bay Danger Area (D119) and the Lilstock Range Firing Area. Consultation included meetings held on 3 November 2010 and 20 September 2011 with representatives from the Defence Estates' Safeguarding team and Fleet Air Arm of the Royal Navy. At the first of these meetings, the MoD outlined their concerns about the Temporary Jetty where it could interfere with the MoD's activities within the Danger Area and Firing Area. Solutions were identified to allow the MoD's activities to continue with the facility in place.

26.4.9 Finally, a meeting was held with Combwich Motor Boat and Yacht Club on 21 February 2011. At this meeting, the club's representatives identified their concerns about the interaction of sailing activities with increased use of Combwich Wharf, with particular reference to the tidally constrained nature of navigation along the River Parrett.

26.4.10 The navigation issues identified during the Stage 1 and Stage 2 consultation, HAZID workshop and other consultations are addressed in Section 26.6 (assessment of risks).

b) Study Area

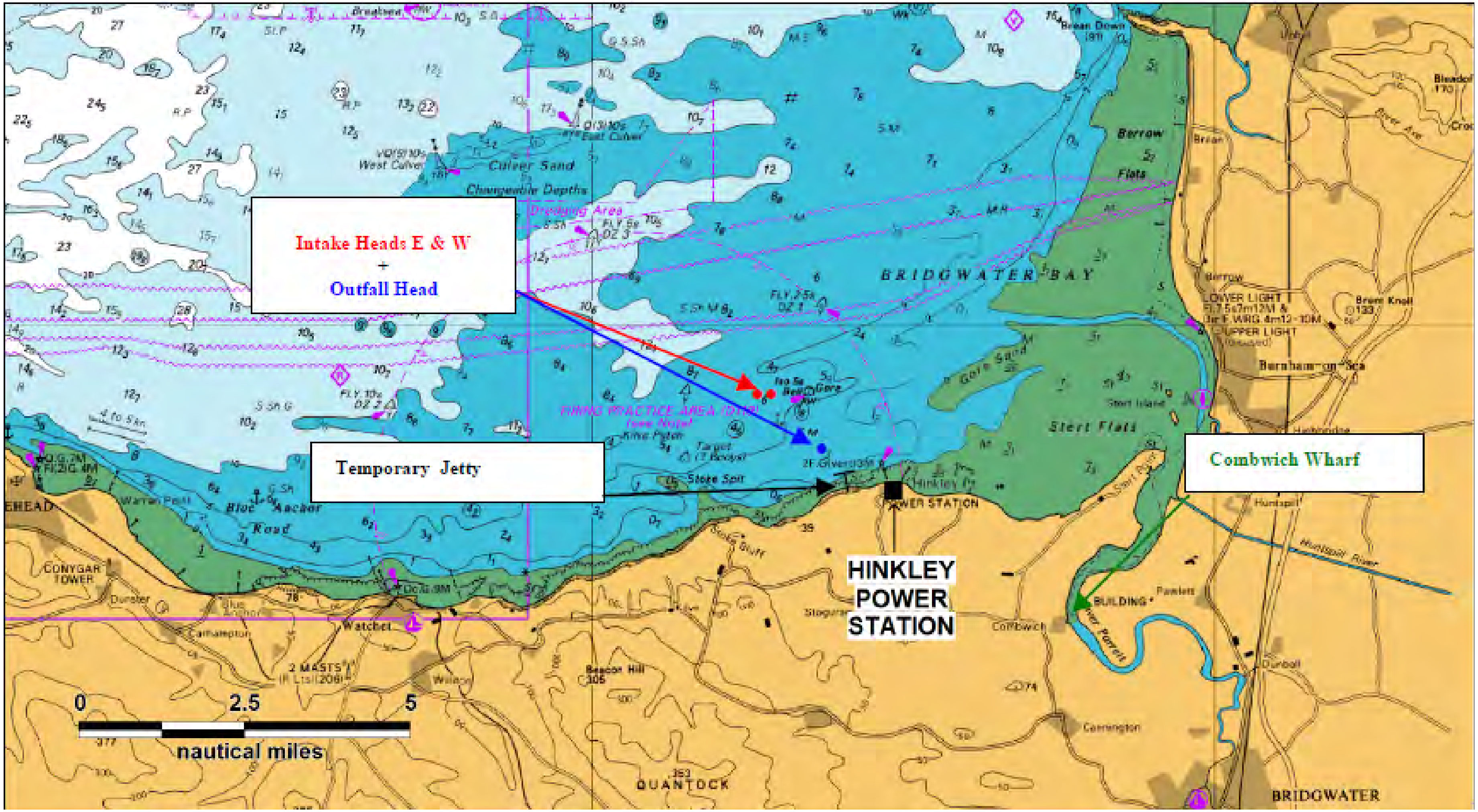
26.4.11 The study area covers the key maritime activities in relation to navigation, including commercial, military, fishing and recreational activities, and is therefore necessarily broad because it covers the waters at and around Hinkley Point, the River Parrett, Bridgwater Bay and the wider Bristol Channel. **Plate 26.1** provides an overview of Bridgwater Bay and the locations of the proposed intake and outfall head structures and the Temporary Jetty. Combwich Wharf is located on the River Parrett.

26.4.12 The various key maritime activities each have a different study area, as identified in **Plates 26.5** to **26.9** in Section 26.5. **Plate 26.5** indicates the broadest extent of the study area.

c) Baseline Environment Assessment

26.4.13 The existing navigation conditions were identified through reference to and use of publicly and commercially available databases, including ShipRoutes database, Automatic Identification System (AIS) data, and reference to and use of navigation data, including satellite and sightings data.

Plate 26.1: Location Chart of Bridgwater Bay and the River Parrett



d) Assessment Methodology

i. Hazard Identification

26.4.14 The HAZID method employed uses a team based approach which incorporates a structured brainstorming technique used to draw out information from participants at a HAZID workshop. The aim is to identify hazards capable to leading to undesirable consequences as well as the current and recommended control measures for each hazard.

26.4.15 The team is made up of appropriately qualified persons. The activity under review is broken down into tasks and steps. As each step is identified, they are in turn assessed for potential hazards. The hazards are further assessed in terms of the associated consequences and likelihood of occurrence.

26.4.16 A HAZID workshop was undertaken and its outcomes inform the assessment presented in this chapter. Consultation also informs the assessment presented in this chapter.

ii. Assessment of Inherent Risk

26.4.17 In order to assess the risks associated with the HPC Project's hazard components, frequency and consequence need to be determined. Frequency represents the likelihood of a risk's occurrence during navigation activities. Consequence represents the magnitude of the outcome of a risk's occurrence; for example, in terms of personal injury, equipment damage and environmental damage. In line with the standard approach used for navigation risk assessment, frequency and consequence can be expressed quantitatively using the categories and ranking numbers identified in **Table 26.1** and **Table 26.2**, respectively.

Table 26.1: Frequency Categories

Category	Likelihood Ranking Number (LRN)	Frequency Definition
High	5	Very likely to occur during activity
Medium	4	Likely to occur during activity
Low	3	May occur during activity
Very low	2	Unlikely to occur during activity
Remote	1	Not expected to occur during activity

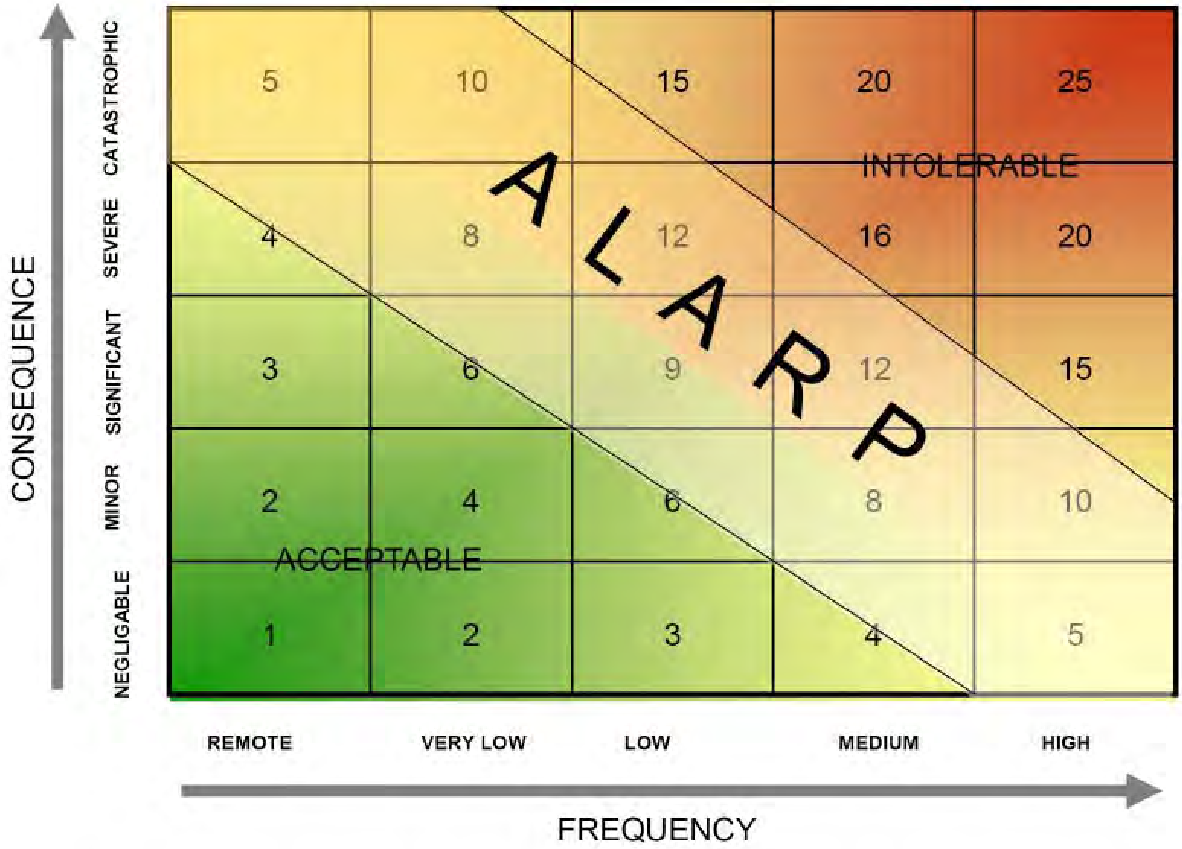
Table 26.2: Consequence Categories

Category	Consequence Ranking Number (CRN)	Consequence Definition
Catastrophic	5	Fatality, or severe personal injury, total plant loss, irreversible environmental damage.
Severe	4	Serious/moderate personal injury. Major/long term equipment damage. Long term environmental damage.

Category	Consequence Ranking Number (CRN)	Consequence Definition
Significant	3	Minor/serious injury. Medium term equipment and environmental damage.
Minor	2	Minor personal injury. Minor/short term equipment damage. Short term environmental damage.
Negligible	1	Negligible personal injury/plant or equipment failure/environmental damage.

26.4.18 A risk score for each hazard is predicted by multiplying the likelihood ranking number (LRN) by the consequence ranking number (CRN), and this score is then used to determine a risk's position within the risk matrix (see **Plate 26.2**).

Plate 26.2: Navigation Risk Assessment Matrix



26.4.19 Risks are assessed and put into one of the following significance categories:

- Low risk - acceptable/tolerable (risk score of 1 to 6) and no risk control measures are required;
- Moderate risk - tolerable (risk score of 7 to 15) and risk is as low as reasonably practicable (ALARP); and
- High risk - unacceptable/intolerable (risk score of 16 to 25) and further risk reduction measures are required.

e) Uncertainties, Limitations and Assumptions

26.4.20 No specific uncertainties relate to the risk assessment, which uses existing available information to establish the baseline conditions. This information includes detailed records of vessel movements throughout the study area. Given the extent of data available (see Section 26.5), a navigation traffic survey was not carried out to inform the EIA process; however this is not considered to be a limitation to the assessment on the basis that the data available from the relevant sources is considered to be more than sufficient for the purposes of this assessment.

26.4.21 The risk score and assessment described above, inherently assumes that awareness of navigation hazards can and will be raised, as appropriate, through the following measures that are typically put in place to manage navigation in accordance with relevant legislation and guidance:

- issue of Notices to Mariners;
- ensure marking on Admiralty Charts;
- circulate information to local sailing clubs, fishermen associations;
- deploy and use marker buoys and lights; and
- use of exclusion (i.e. safety) zones.

26.4.22 A key assumption for the risk assessment is that all the marine activities are undertaken in a competent manner (i.e. appropriate use of aids to navigation and in accordance with relevant laws and navigation advice provided by, for example, Notices to Mariners), and that all appropriate navigation information is updated (i.e. Admiralty Charts, Pilot Books, List of Lights, etc).

26.5 Baseline Environmental Characteristics

a) Ports and Harbours in the Severn Estuary

26.5.1 The Severn Estuary is an important shipping route, with commercial vessels navigating through the deep water approaches to several ports and harbours. Commercial ports in the Severn Estuary include the following:

- Royal Portbury and Avonmouth Docks (owned and operated by the Bristol Port Company);
- Cardiff, Newport and Barry Docks (owned and operated by Associated British Ports); and
- small ports and harbours including those located at Bridgwater, Watchet, Minehead, Knightstone (Weston-super-Mare), Sharpness and Chepstow.

26.5.2 Apart from the Port of Bridgwater, the other commercial ports are situated some distance away from Hinkley Point, either on the south coast of Wales or at and upstream of Bristol. As described below, they generate the majority of the commercial shipping activity passing through the study area.

26.5.3 Marinas and other recreational boating facilities in the study area include those located along the Somerset coast. That is, the Weston Bay Yacht Club at Uphill, Combwich Motor Boat and Sailing Club on the River Parrett, Burnham-on-Sea Yacht Club to the east of the River Parrett, and Watchet Marina seven nautical miles (nm) to the west of Hinkley Point.

b) Port of Bridgwater

i. Port Facilities

26.5.4 The Port of Bridgwater was established by the Bridgwater Navigation and Quays Act 1845. The port limits cover approximately 25nm^2 (see **Plate 26.3**), including the following areas:

- Bridgwater Bay from Brean Down to Hinkley Point;
- the River Parrett as far as Bridgwater;
- the River Brue as far as Highbridge; and
- a small part of the tidal River Axe.

26.5.5 The port limits include Combwich Wharf and Dunball Wharf on the River Parrett.

26.5.6 Bridgwater Harbour Authority (part of SDC) is responsible for navigation and mooring, safety, rights of access, pilotage, maintenance of channels and navigation aids, oil spill contingency and port waste management. Port operations, oil spill contingency and port waste management plans are in place.

26.5.7 Recreational moorings within the port limits are located mainly in the River Brue Estuary and Combwich Pill, although recreational activity tends to be focused around Burnham on Sea.

26.5.8 Commercial vessel movements at the Port of Bridgwater totalled 41 in 2007 and 37 in 2008 (Ref. 26.5). Most vessels were carrying aggregates from Area 472 (i.e. Culver Sands in the Bristol Channel, situated approximately 8nm north of Minehead) and general cargo to Dunball Wharf. A similar level of vessel movements at the Port of Bridgwater is assumed to occur in the future on the basis that the Port's key commercial use for aggregates will continue into the foreseeable future. The basis for this assumption is that a new licence to extract up to one million tonnes of marine sand and gravel per annum from Area 472 was granted by the Marine and Fisheries Agency (MFA; now the Marine Management Organisation (MMO)) to three aggregate extraction companies in May 2008; this licence lasts for 15 years (i.e. until 2023) subject to reviews after five and ten years.

Plate 26.3: Port of Bridgwater Harbour Limits

Source: www.sedgemoor.gov.uk (accessed 4 August 2011)

ii. Navigation

26.5.9 Vessels inbound for the River Parrett and the Port of Bridgwater pass to the west and south of the Gore Buoy. Due regard should be given to Cobblers Patch Shoal, which has a charted depth of 1.8m below Chart Datum (CD), and is located 2.5 cables (0.25nm) south-south-west of Gore Buoy. A special buoy is positioned 2 cables (0.2nm) east of the aforementioned shoal.

26.5.10 There is a designated anchorage, Gore, available some 5.8 cables (0.58nm) south-west of Gore Buoy for vessels awaiting tide to enter the River Parrett and the Port of Bridgwater. Whilst this anchorage offers good holding ground by the nature of the seabed (sand and mud), it is somewhat exposed and having a depth of approximately 6.0m above CD should be considered as a short stay/good weather anchorage.

26.5.11 The River Parrett is approached through a channel between Steart Flats and Gore Sand and is entered at the Bridgwater bar some 5nm west of Burnham-on-Sea. Pilotage is compulsory for all vessels over 30m length overall (LOA). Pilots board at the Brue Beacon, which is located inside the Port of Bridgwater's harbour limits in sheltered water.

26.5.12 **Plate 26.4** illustrates the typical route taken by a typical inbound commercial vessel for facilities on the River Parrett, including Combwich Wharf and Dunball Wharf, as identified in the Port of Bridgwater's Approaches Plan (Ref. 26.6). Recreational vessels bound for the Combwich Motor Boat and Sailing Club may take a more direct or alternative route than that used by commercial vessels.

c) Shipping Activity

26.5.13 The existing shipping activity in the vicinity of Hinkley Point covers the following vessel types:

- commercial vessels;
- military vessels;
- fishing vessels; and
- recreation vessels.

i. Commercial Shipping

26.5.14 The assessment of commercial shipping activity is based on two data sets: Anatec's ShipRoutes UK Database and in-house AIS database (see Ref. 26.5).

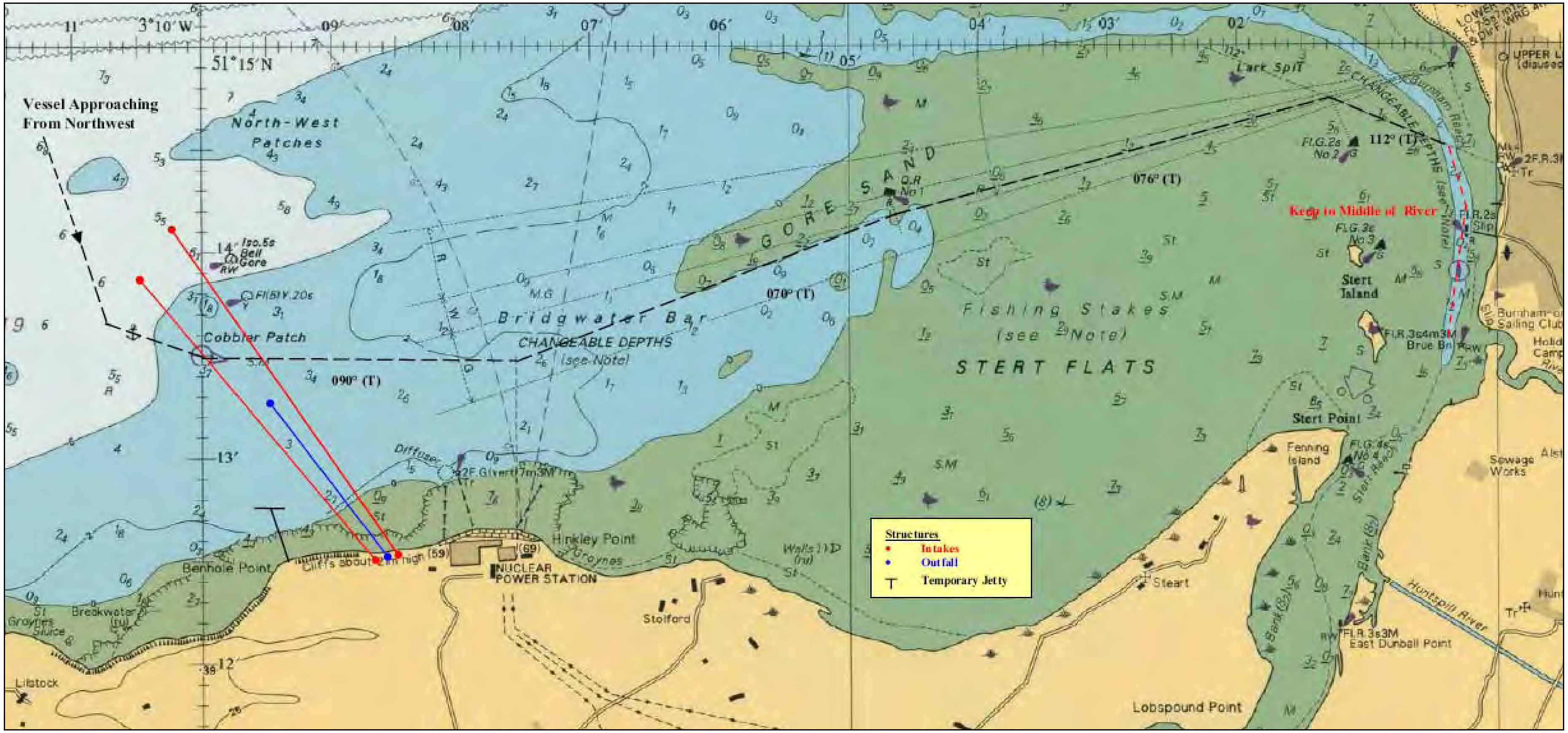
26.5.15 ShipRoutes is a shipping route database developed by Anatec to assist in identifying shipping passing in proximity to proposed offshore developments. The database was developed in two main phases: movements analysis and routeing analysis.

26.5.16 The number of movements per year on routes passing through UK waters was estimated by analysing a number of data sources, including port callings data and voyage information obtained directly from ship operators. It is noted that ShipRoutes excludes the movements of 'non-routine traffic' such as fishing vessels, naval vessels, tugs, dredgers, yachts and offshore service vessels to mobile rigs.

26.5.17 The routes taken by ships between ports were obtained from several data sources, including:

- offshore installation, standby vessel and shore-based survey data;
- passage plans obtained from ship operators;
- consultation with ports and pilots; and
- Admiralty Charts and publications.

Plate 26.4: Recommended Route for Inbound Commercial Vessels



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26.5.18 This information was combined to create the ShipRoutes database containing all the shipping routes passing through UK waters, with each route having a detailed distribution of shipping characteristics. The ShipRoutes database was analysed and it was identified that there were no routes in proximity to HPC, with the nearest shipping heading to and from Bristol, some 10 miles to the north of Hinkley Point.

26.5.19 The AIS database was based on two months of data from 2009. An overall plot of the information held is presented in **Plate 26.5** with a more local plot provided in **Plate 26.6**. It should be noted that **Plate 26.4** to **26.9** show the alignments of the intake (red) and outfall (blue) structures. In addition, it should be noted that the AIS database includes information on dredging vessels (including movements of dredgers between aggregate dredging Area 472 in the Bristol Channel (at Culver Sands) and the Port of Bridgwater), but ShipRoutes does not.

26.5.20 The outputs from both databases indicate that shipping in the study area is very low, with AIS providing a better basis due to its ability to track non-routine shipping. The more detailed plot (**Plate 26.6**) shows that there were four vessels passing to the south of the study area over the two month survey period, all of which were the Arco Dart dredger inbound from the Culver Sands aggregate extraction area to the Port of Bridgwater (Dunball Wharf). Only two other vessels were tracked within the area; there was Trinity House's multi-functional tender vessel Patricia, which was tracked to and from the Gore buoy, and Briggs Marine’s Cameron, which was tracked inspecting/servicing the buoys within the Lilstock Range Firing Area.

ii. Military Vessels

26.5.21 The proposed location for the head structures is within or adjacent to the Bridgwater Bay Danger Area (D119) and the Lilstock Range Firing Area, which are used mainly for military helicopter gunnery training.

26.5.22 No military vessels were identified in this area over the two month survey period. Overall the Temporary Jetty development is not considered to be in an area where military shipping levels are likely to be high.

iii. Fishing Vessels

26.5.23 According to the Port of Bridgwater’s Marine Operations Plan (2009; Ref. 26.4), no commercial fishing vessels are registered at the port or on the River Parrett, although there is one vessel that can be chartered for angling.

26.5.24 Two data sources were used to identify fishing vessels further afield: satellite data and sightings data (see below) (as described in Ref. 26.5).

26.5.25 The MMO operates a satellite vessel monitoring system from its Fisheries Monitoring Centre. This is used as part of the sea fisheries enforcement programme to track the positions of fishing vessels in UK waters. It is also used to track all UK registered fishing vessels globally.

26.5.26 Vessel position reports are received approximately every two hours, unless a vessel has a terminal on board which cannot be polled, in which case it must report once per hour. The data cover all European Union countries within British territorial waters and other countries (e.g. Norway and Faeroe Islands).

Plate 26.5: AIS Data for the Bristol Channel

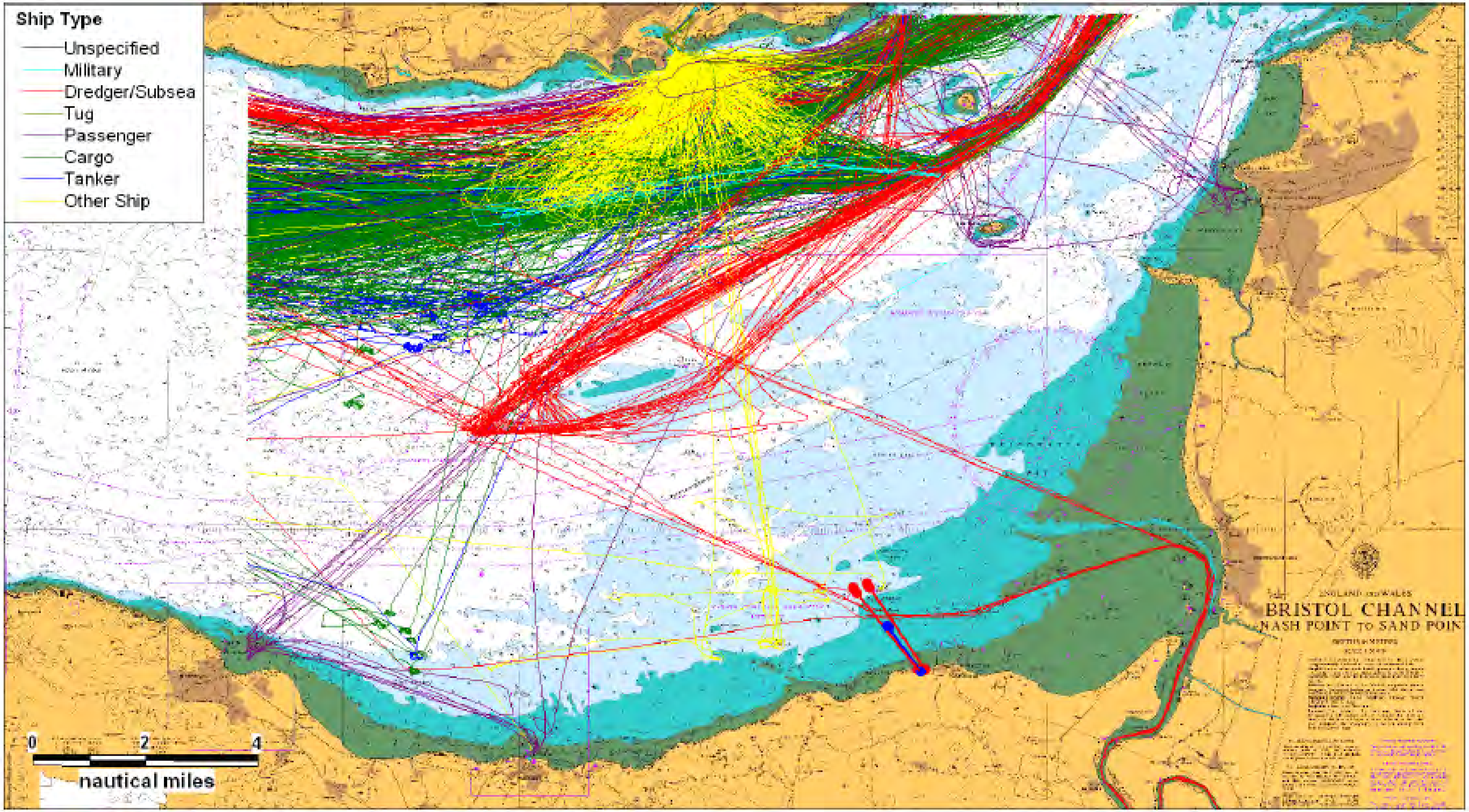


Plate 26.6: AIS Data for Hinkley Point

26.5.27 The MFA stopped releasing satellite data on non-UK vessels from 2006 and on UK vessels from 2008 (pending legal advice); data from these two latest years (i.e. 2006 and 2008 respectively) are presented in **Plate 26.7** (where fishing vessels are shown as block dots).

26.5.28 Data on fishing vessel sightings were obtained from the MMO and the Scottish Fisheries Protection Agency (SFPA). Each patrol logs the positions and details of fishing vessels within the rectangle being patrolled. All vessels are logged, irrespective of size, provided they can be identified by their Port Letter Number (PLN). Five years of data for the period from 2005 to 2009 were used to plot fishing vessels (see **Plate 26.8**).

iv. Recreational Craft

26.5.29 The water area surrounding Hinkley Point is a designated sailing area for recreational craft and the water area approximately 3.5nm to the west of Hinkley Point is used for racing (see **Plate 26.9**). The sailing area covers most of the Severn Estuary.

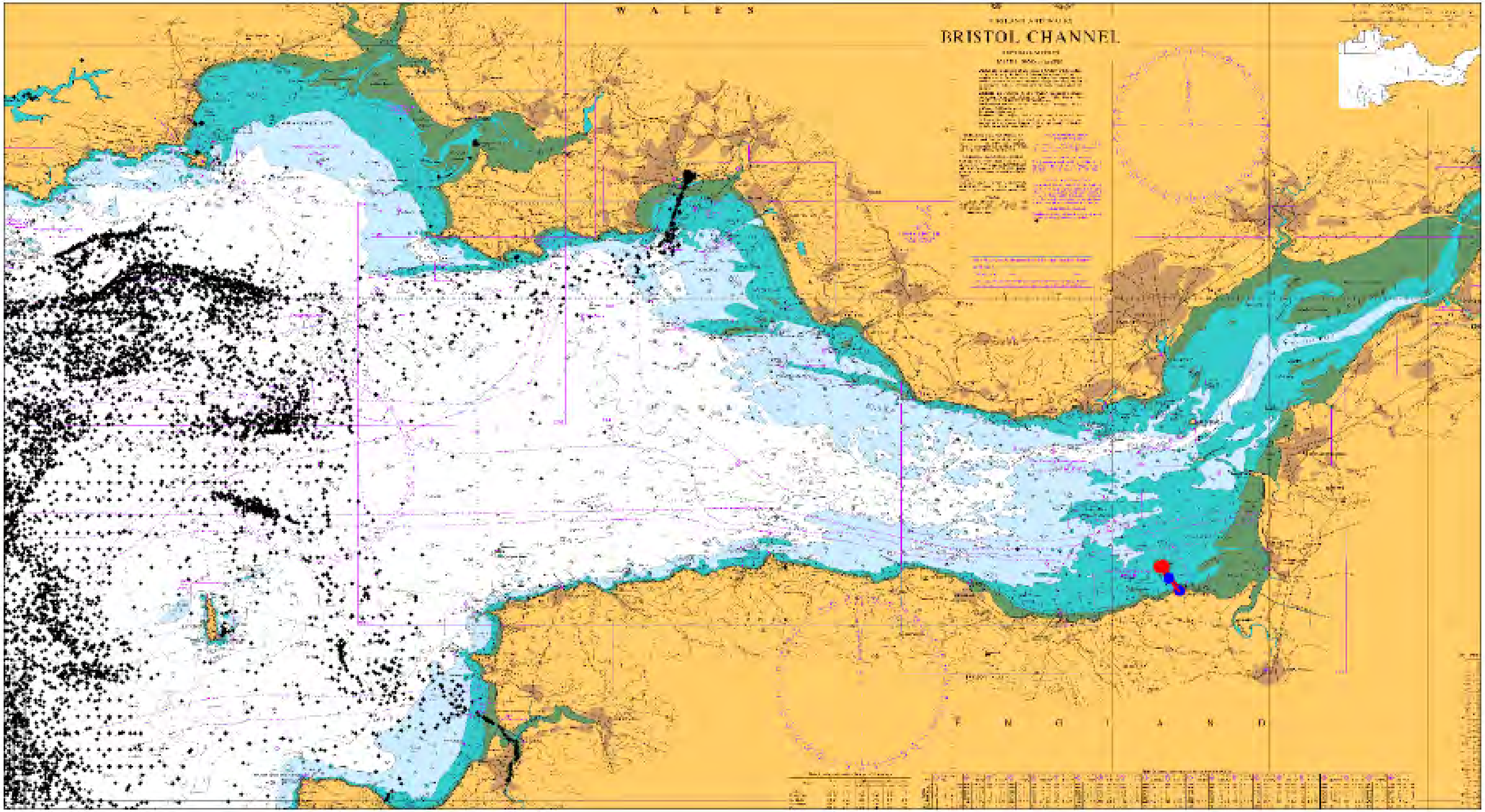
26.5.30 According to the Port of Bridgwater's Marine Operations Plan (2009; Ref. 24.4), there are three sailing clubs within the Port of Bridgwater. Combwich Motor Boat and Sailing Club is based at Combwich (adjacent to Combwich Wharf), and the Burnham-on-Sea Motor Boat and Sailing Club is based on the River Brue. Both clubs have afloat moorings. The Burnham Boat Owners' Sea Angling Association has a substantial membership but only small boats, which members launch from Burnham Slipway when required. Some visiting yachts call at these clubs.

26.5.31 There is a marina approximately 7nm to the west of Hinkley Point at Watchet and another approximately 9nm to the north-east at Uphill. A number of light, medium and heavy use cruising routes extend to and from the marinas and sailing clubs based at Watchet, Combwich, Burnham-on-Sea and Uphill (see **Plate 26.9**). Watchet's marina is the start/end point for several cruising routes including one busy route across the Severn Estuary to south Wales. Cruising routes to and from these marinas and clubs tend to avoid the area where the proposed intake and outfall head structures would be located. However, a medium use cruising route providing access to the River Parrett passes in between the proposed location for the intake and outfall head structures and Combwich Wharf (see **Plate 26.9**) in a similar manner to commercial shipping (see **Plate 26.4**).

d) Bridgwater Bay Danger Area and Lilstock Range Firing Area

26.5.32 The Bridgwater Bay Danger Area (D119) establishes the air space allocated for military activities. D119 covers a circular area over land in West Somerset and sea in Bridgwater Bay. Its extent over the sea is marked on Admiralty Charts (as "Firing Practice Area D119") and covers a partial circular area offshore that could be defined by an arc extending from Hinkley Point to beyond the 10m bathymetric contour towards Culver Sands and returning to land at Watchet. The Danger Area is a delineation of the air space above the water and does not place any restrictions on navigation and vessels have the right to transit it at any time.

Plate 26.7: Fishing Activity from Satellite Data



NOT PROTECTIVELY MARKED

Plate 26.8: Fishing Activity from Sightings 2005-2009

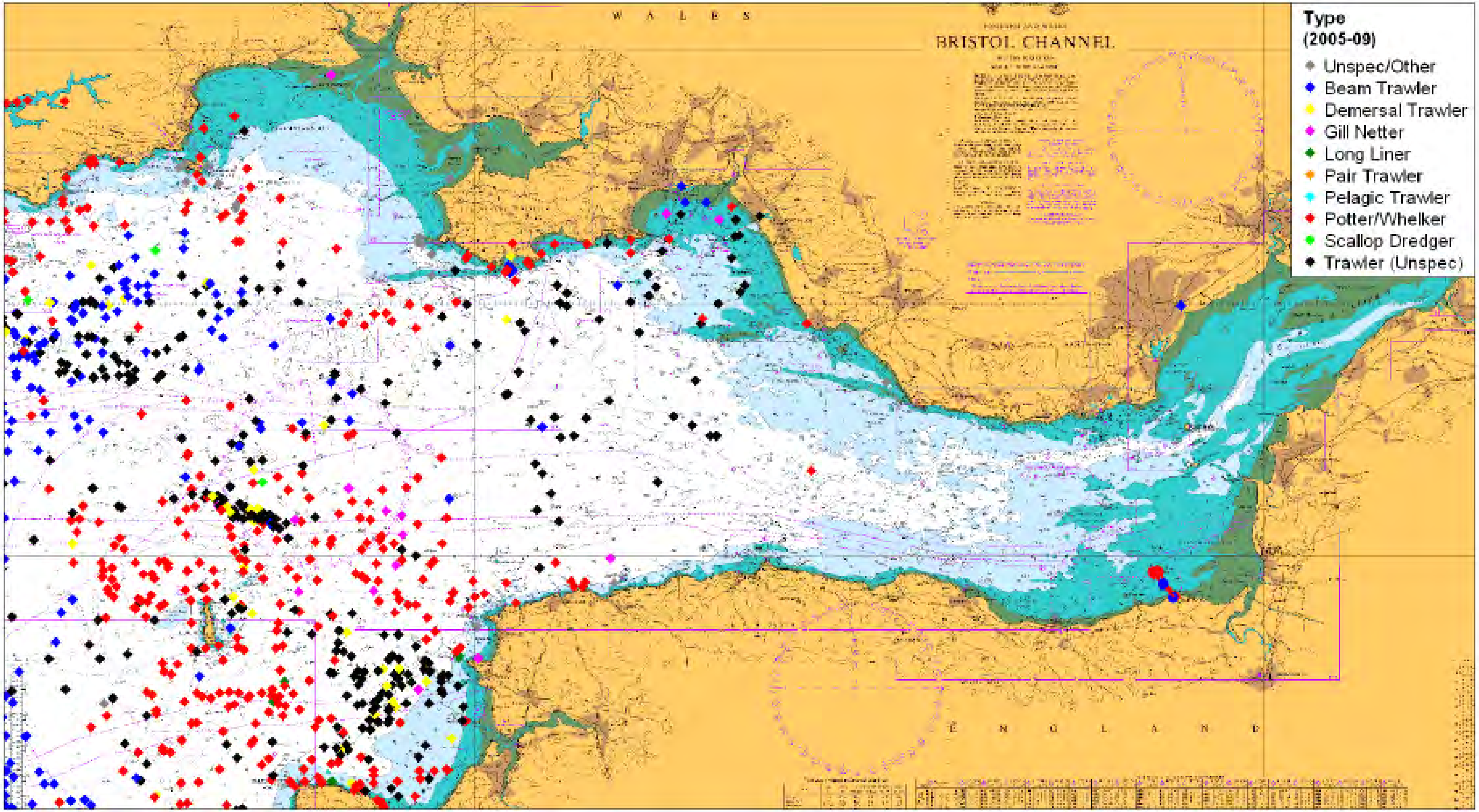
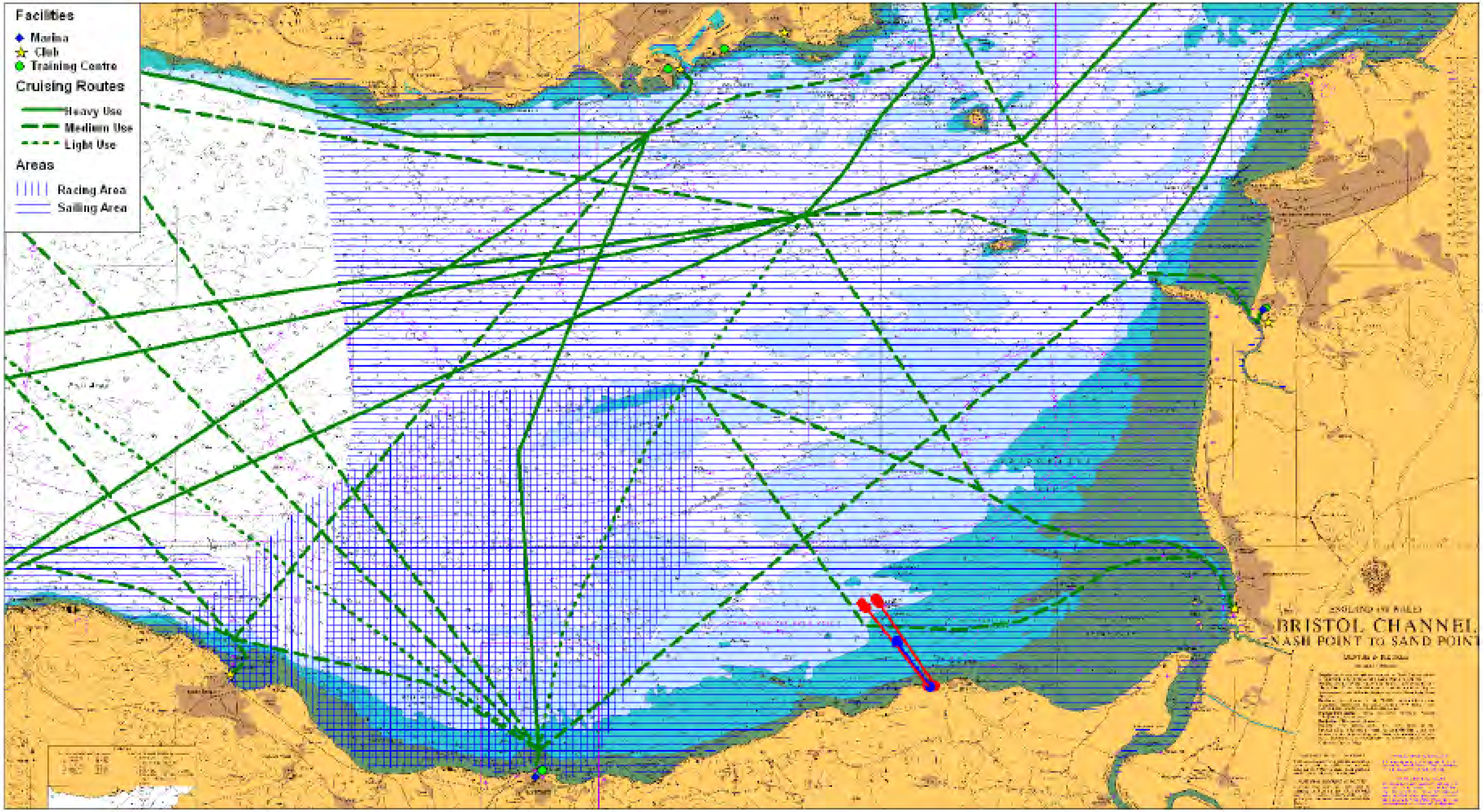


Plate 26.9: Recreational Activity



26.5.33 The Lilstock Range Firing Area is smaller and is situated within D119 but only extends over the sea in Bridgwater Bay. Similar to D119, the firing area covers a partial circular area offshore that could be defined by an arc extending from east of Hinkley Point and returning to land to the west of Watchet. The firing area delineates the water surface template for air to surface gunnery activities and is marked by buoys. The firing area's full extent is not marked on Admiralty Charts, although the water surface template is shown on Admiralty Charts and marked in the water by seven buoys. The firing area is used primarily for military helicopter gunnery training and is operated under a clear range procedure so that exercises and training only take place when the area is clear of vessels. It is typically used for activities undertaken by the Fleet Air Arm from Royal Navy Air Service, Yeovilton.

e) Other Features

26.5.34 There are a number of other physical features within the study area that influence navigation. These features include natural features (e.g. sands bars or 'patches', islands) and man-made features (e.g. HPB intake and outfall head structures, wave rider buoys). Where these features pose a risk to navigation (e.g. a risk of a vessel colliding with or grounding on a feature), then they are appropriately marked and identified on Admiralty Charts. For the purposes of this assessment, these features are considered to be part of the baseline conditions in which navigation already takes place and are sufficiently integrated into existing navigation systems that they do not contribute to the hazards posed by the HPC Project and assessed in this chapter.

26.6 Assessment of Risks

a) Introduction

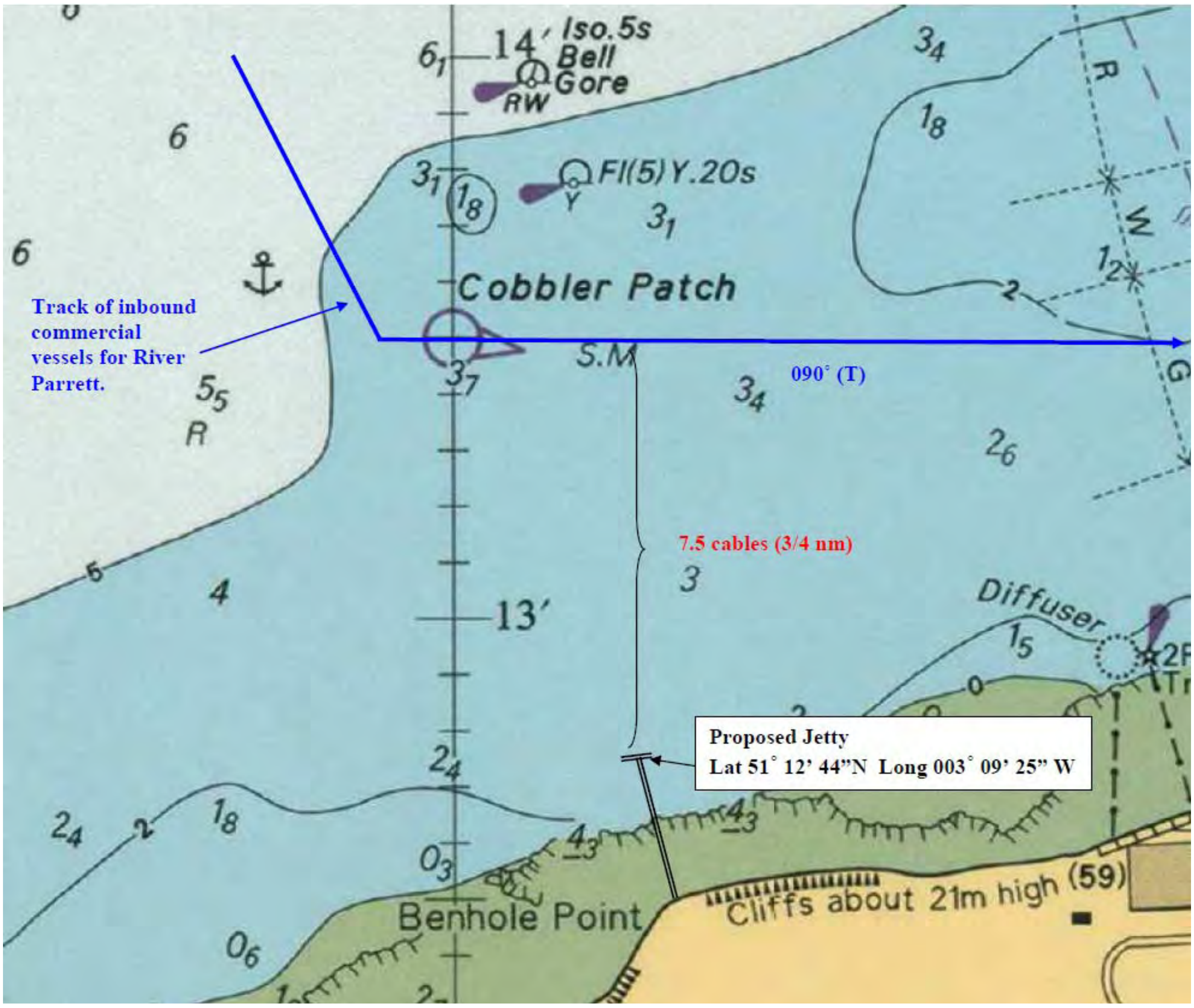
26.6.1 The following assessments focus on the risks to navigation posed by the HPC Project including the Temporary Jetty, cooling water intake and outfall head structures and the proposed refurbishment and extension of Combwich Wharf in the context of this assessment of the risks to navigation posed by those elements of the project.

26.6.2 The proposed site for the Temporary Jetty is located at Hinkley Point on the West Somerset coast, some 25km to the east of Minehead and 12km to the north-west of Bridgwater (see **Plate 26.1**). The onshore storage facility for the proposed Temporary Jetty and the associated access corridor would be situated on land to the west of HPA. The facility would extend approximately 550m offshore and the Temporary Jetty head would be approx 1.4km (0.75nm) south of the track that inbound vessels adopt in negotiating the approach channel to the River Parrett (see **Plate 26.9**).

26.6.3 The cooling water intake head structures would be located approximately 3.4 and 3.5km (1.8nm) offshore and the outfall head structures will be located approximately 1.8km (1.1nm) offshore. At these locations, the intake and outfall head structures would be positioned to the north and south respectively of the established inbound route for vessels accessing the River Parrett and Port of Bridgwater, including Combwich Wharf (as shown in **Plate 26.4**), and therefore has the potential to pose a risk to navigation. The undersea tunnels from HPC would be bored beneath the seabed before rising to meet head structures and, therefore, would not pose a risk to navigation.

26.6.4 Combwich Wharf lies on the western bank of the River Parrett and is currently used for the handling of Abnormal Indivisible Loads (AILs) for HPA and HPB. The wharf would be refurbished and extended to handle the arrival of approximately 180 AILs and other materials associated with the construction of HPC. It is anticipated that there would be on average eight or nine deliveries and a maximum of up to 15/16 deliveries per month to Combwich Wharf during the construction of HPC.

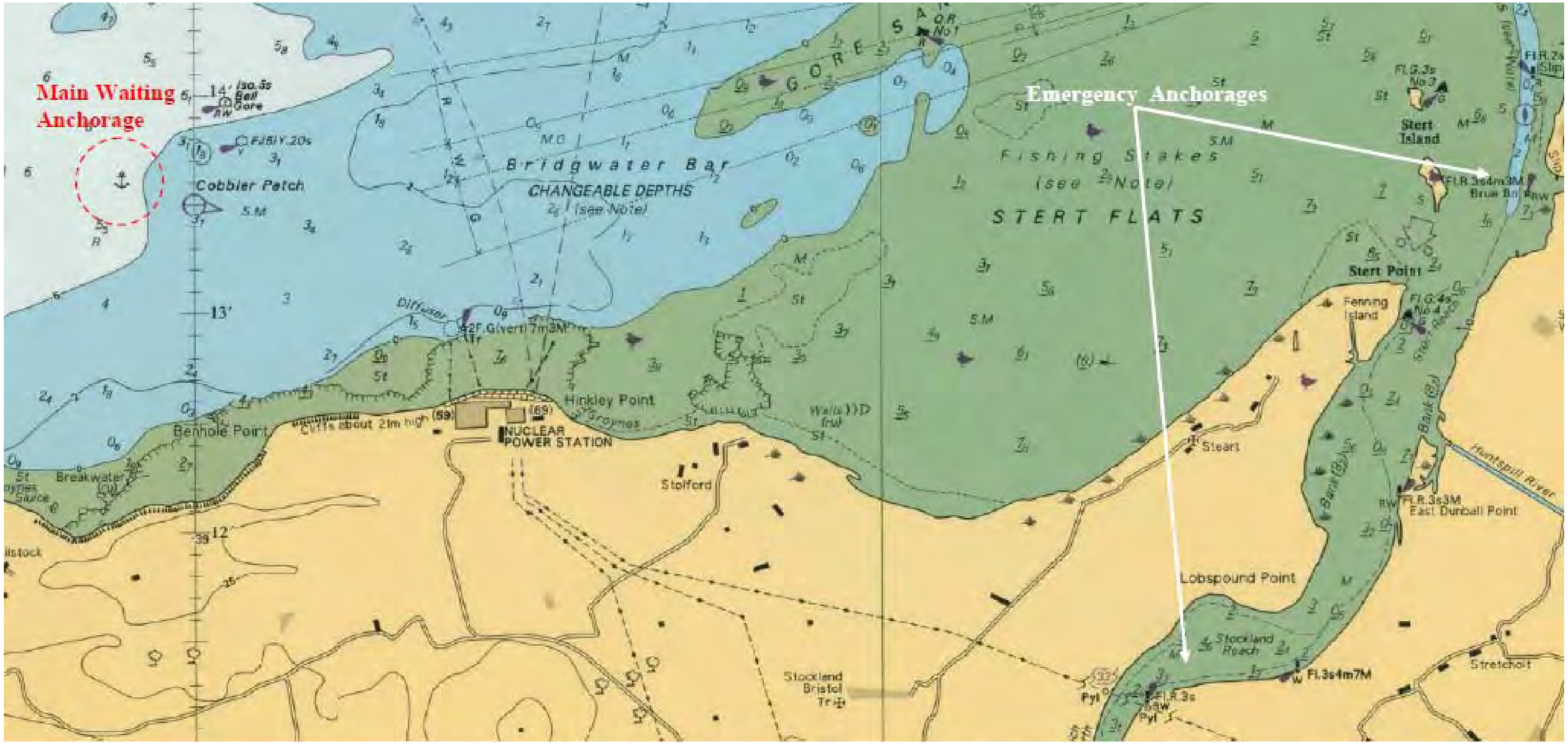
Plate 26.10: Jetty Passing Distances



26.6.5 Navigation to and on the River Parrett requires skill and local knowledge to deal with the tidal conditions. The tidal range restricts access to and berthing at Combwich Wharf and Dunball Wharf and in this respect all navigation to the Port of Bridgwater typically commences with the vessel passing the Gore Buoy at least two hours before High Water at Bridgwater (two and a half hours would be preferable). A passage plan is essential for berthing each AIL, with contingency plans built into the system for anchoring in an emergency. It is anticipated that these contingency plans will address circumstances when vessels carrying AILs and other commodities destined for Combwich Wharf are constrained by the tidal window or other cause which precludes the vessel completing the transit between the Gore Buoy and Combwich Wharf. For example, should an AIL vessel find itself in a position where it cannot arrive at the predetermined points given in the passage plan, as a contingency plan measure, use should be made of points where the vessel may abort the passage plan and seek safety in deeper water outside of the River Parrett or make use of one of the safe anchorages available off Brue Beacon and the West end of Stocklands Reach (see **Plate 26.11**).

26.6.6 The material that is to be removed from within the barge berth bed area during the refurbishment works at Combwich Wharf is to be removed using land-based plant operating in the dry and transported away by land. Clearance of the berth during the operational phase for maintenance purposes would be undertaken by excavator under low tide conditions and the sediment deposited back into the River Parrett channel (as it is now).

Plate 26.11: Main and Contingency Anchorage Locations



b) Navigation Receptors

26.6.7 The risk assessments in this chapter are made in relation to a number of navigation receptors that could be affected by the HPC Project. The navigation receptors are:

- commercial vessels;
- military vessels;
- fishing vessels;
- recreational vessels in Bridgwater Bay (i.e. the open water area covering Bridgwater Bay and the Severn Estuary);
- recreational vessels in the River Parrett (i.e. the enclosed water area covering the estuary of the River Parrett);
- the Port of Bridgwater and SDC's interests (where SDC is the harbour authority for the Port of Bridgwater); and
- the Lilstock Range Firing Area.

c) Risk Consequences and Likelihoods

i. Port and Shipping Receptors

26.6.8 The risk assessments in this chapter are based on the potential consequences and likelihoods of an incident occurring with respect to the hazards (i.e. the Temporary Jetty, the intake and outfall head structures and the refurbishment and extension of Combwich Wharf) in relation to the various navigation receptors. The following paragraphs set out the potential consequences and likelihoods of an incident for each hazard based on the definitions for each Consequence Ranking Number (CRN) and Likelihood Ranking Number (LRN) identified in Tables 26.1 and 26.2 respectively.

Temporary Jetty

26.6.9 For the purposes of the risk assessments for the Temporary Jetty's construction, operation and dismantling and restoration phases, the potential consequences of an incident are considered to be severe (CRN=4) for commercial vessels and the Port of Bridgwater's interests and minor (CRN=2) for military, fishing and recreational vessels passing through Bridgwater Bay. The higher CRN for commercial vessels reflects the inbound route taken by commercial vessels to the River Parrett and Port of Bridgwater. This route passes directly north of the proposed Temporary Jetty location (see **Plate 26.9**). Military, fishing and recreational vessels would not normally use the Port of Bridgwater (i.e. the port's berths) and/or do not need to take this route to the River Parrett, so they would not need to pass as close to the Temporary Jetty development as commercial vessels.

26.6.10 The potential likelihoods of a incident are considered to be medium (LRN=4) for commercial vessels and the Port of Bridgwater's interests and very low (LRN=2) for military, fishing and recreational vessels passing through Bridgwater Bay. The higher LRN for commercial vessels reflects the greater number of commercial vessels sailing on the inbound route to the River Parrett and the Port of Bridgwater.

Intake and Outfall Head Structures

26.6.11 For the purposes of the risk assessments regarding the construction and operation of the intake and outfall head structures, the potential consequences are considered to be severe (CRN=4) for commercial vessels and the Port of Bridgwater's interests and minor (CRN=2) for military, fishing and recreational vessels passing through Bridgwater Bay. The higher CRN for commercial vessels reflects the inbound route taken by commercial vessels to the River Parrett and Port of Bridgwater. This route should pass around to the two intake head structures (see **Plate 26.4**). Military, fishing and recreational vessels would not normally use the Port of Bridgwater (i.e. the port's berths) and/or do not need to take this route to the River Parrett, so they would not need to pass as close to the intake and outfall head structures as commercial vessels.

26.6.12 The potential likelihoods are considered to be medium (LRN=4) for commercial vessels and the Port of Bridgwater's interests and very low (LRN=2) for military, fishing and recreational vessels passing through Bridgwater Bay. The higher LRN reflects the greater number of commercial vessels sailing on the inbound route to the River Parrett and Port of Bridgwater.

Combwich Wharf

26.6.13 For the purposes of the risk assessments regarding the refurbishment and extension and operation of Combwich Wharf, the potential consequences of an incident are considered to be high (CRN=4) for commercial vessels and the Port of Bridgwater's interests and minor (CRN=2) for military and fishing vessels. The higher CRN for commercial vessels reflects the inbound route taken by commercial vessels to the River Parrett and Port of Bridgwater. Military and fishing vessels would not normally use the Port of Bridgwater (i.e. the port's berths) and/or do not need to take this route to the River Parrett. For recreational vessels the potential consequences have been split between recreational vessels in Bridgwater Bay and recreational vessels in the River Parrett. The CRN for recreational vessels in Bridgwater Bay is considered to be minor (CRN=2) but the CRN for recreational vessels in the River Parrett is significant (CRN=3).

26.6.14 The potential likelihoods are considered to be medium (LRN=4) for commercial vessels and the Port of Bridgwater's interests and very low (LRN=2) for military, fishing and recreational vessels in Bridgwater Bay. The higher LRN reflects the greater number of commercial vessels sailing on the inbound route to the River Parrett and Port of Bridgwater. For recreational vessels in the River Parrett the LRN is medium (LRN=4).

ii. Lilstock Range Firing Area Receptor

26.6.15 Potential consequences and likelihoods of an incident are also identified for the Lilstock Range Firing Area. The firing area is not a true navigation receptor because the military activities that take place within it (i.e. helicopter gunnery training) are affected by navigation rather than being navigation. Therefore, potential impacts on this receptor have been considered separately to impacts on the other receptors.

26.6.16 For the purposes of the risk assessments, the potential consequences are considered to be severe (CRN=4) and the potential likelihoods are considered to be medium (LRN=4). These are hypothetical assignments that provide context to the assessments because, in reality, military activities would not take place within the firing area if a vessel is present. Accordingly, it is relevant to acknowledge the fact that military activities and navigation would not take place in the firing area simultaneously. Nevertheless, there is potential conflict in this part of the sea between the MoD's desired use of it for military activities and EDF Energy's desired use of it for vessel movements as part of the HPC Project.

26.6.17 **Table 26.3** summarises the consequences (CRNs) and likelihoods (LRNs) assigned to the various receptors identified.

26.6.18 The risks identified below are all assessed on the basis that all the marine activities are undertaken in a competent manner (as described in Section 26.4) but without the implementation of the mitigation measures identified in Section 26.7.

Table 26.3: Assigned Risk Consequences and Likelihoods

Receptor	Consequence (CRN)	Likelihood (LRN)
Commercial vessels	Severe (4)	Medium (4)
Military vessels	Minor (2)	Very low (2)
Fishing vessels	Minor (2)	Very low (2)
Recreational vessels in Bridgwater Bay	Minor (2)	Very low (2)
Recreational vessels in the River Parrett	Significant (3)	Medium (4)
Port of Bridgwater's interests	Severe (4)	Medium (4)
Lilstock Range Firing Area	Severe (4)	Medium (4)

d) Construction Risks

i. Construction Plant in the Water during the Construction and Dismantling of the Temporary Jetty and Construction of the Cooling Water Intake and Outfall Head Structures

26.6.19 Construction plant (e.g. jack-up platforms) would be in the water during the construction and the dismantling of the Temporary Jetty and would, therefore, potentially pose a hazard to navigation. The Temporary Jetty head would lie in a position some 7.5 cables (i.e. 0.75nm or 1.4km) south of the track inbound vessels adopt in negotiating the approach channel for the River Parrett and Port of Bridgwater (see **Plate 26.9**). This track is typically used by commercial vessels rather than military, fishing and recreational vessels.

26.6.20 Construction plant (e.g. jack-up platforms) would also be in the water during the construction of the intake and outfall head structures and, similarly, would potentially pose a hazard to navigation. The intake and outfall head structures would lie east and south of the track that inbound vessels adopt in negotiating the approach channel for the River Parrett and Port of Bridgwater (see **Plate 26.4**); with the western intake head structure in very close proximity to the approach (approximately within two cables (0.2nm)). Further to this the inbound track also comes within approximately two cables (0.2nm) of the outfall head structure. This track is typically used by commercial vessels rather than military, fishing and recreational vessels.

26.6.21 Despite the distance and taking a precautionary approach, the risk to commercial traffic and the interests of the Port of Bridgwater is considered to be high (unacceptable) because of the volume of vessels and their inbound track to the Port of Bridgwater's harbour limits and berths in the River Parrett in relation to the Temporary Jetty and head structures' positions (i.e. there would be more potential for interference with navigation).

26.6.22 The risk to fishing activity is considered to be low (acceptable) because the activity vessels of 15m and more is confined mainly to the west of a north to south line between Bideford (north Devon) and Swansea (south Wales), while fishing activity to the east of this line is much reduced, particularly east of a north to south line through Lynmouth (north Devon).

26.6.23 The risk to military activity is considered to be low since naval vessels are not known to navigate in this area.

26.6.24 The risk to recreational activity in Bridgwater Bay is considered to be low. Some sailing does occur in this area of the Bristol Channel - there are a number of cruising routes and marinas along the Somerset coast (e.g. at Uphill, on the River Parrett, Burnham-on-Sea and Watchet) - and the jetty and head structures are located in a sailing area for recreational craft (although this sailing area covers a large part of the Severn Estuary (see **Plate 26.9**). Use is made by recreational vessels of the same inbound route through Bridgwater Bay to the River Parrett as commercial vessels, as shown in **Plate 26.4**.

26.6.25 In summary, the risks (without mitigation measures) associated with the construction plant for the temporary jetty are considered to be:

- **high/unacceptable** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in Bridgwater Bay; and
- **high/unacceptable** for the Port of Bridgwater and SDC's interests.

ii. Passage of Dredging Plant to/from the Offshore Disposal Site (Cardiff Grounds)

26.6.26 Dredging plant would be used to create the berthing pocket at the end of the Temporary Jetty head and would have to sail to and from an offshore disposal site to deposit the dredged material. Accordingly, the passage of dredging plant between the Temporary Jetty and the disposal ground could pose a hazard to navigation.

26.6.27 For the purposes of this risk assessment, it is assumed that the dredged material arising from the berthing pocket would be transported to the Cardiff Grounds offshore disposal site by either a small trailing suction hopper dredger or a self-propelled barge. The Cardiff Grounds offshore disposal site is situated on the Welsh side of the Bristol Channel, just off Cardiff, within the following latitude (north) and longitude (west) coordinates:

- 051°27'24.208, 003°05'53.942.
- 051°25'36.056, 003°06'24.233.
- 051°25'36.281, 003°06'42.184.
- 051°26'30.132, 003°07'06.192.

26.6.28 Sailing routes to and from the jetty's approaches would usually follow tracks between the Gore Buoy to the south and a position between Mackenzie Can Buoy and Holm Middle to the north. There are no significant hazards to be registered in this passage which could affect the navigation of the dredging plant.

26.6.29 Dredging plant navigating between the Cardiff Grounds and a position in the vicinity of Mackenzie Can Buoy and Holm Middle may navigate to the east or west of Flat Holm. The navigation hazards associated with this passage are:

- acceptable for passage to the east, where there is ample sea-room to be found and the route is well marked between Flat Holm, Monkstone Lighthouse and the Cardiff Grounds;
- ALARP for passage to the west - although shorter in distance, there are numerous shoal patches with the main ones marked by cardinal marks Wolves and South Cardiff; and
- ALARP in both cases where vessels would be crossing busy east-west shipping lanes, especially in the northern part of the Bristol Channel (see **Plate 26.5**).

26.6.30 Dredging plant would approach the jetty on return from the Cardiff Grounds. The hazards associated with this passage are:

- unacceptable for dredging plant navigating to and from the Temporary Jetty berthing pocket;
- unacceptable for dredging plant arriving from the Cardiff Grounds and hindering the path of inbound vessels in the approach channel bound for berths on the River Parrett; and
- unacceptable for dredging plant arriving from/departing for the Cardiff Grounds and passing close to the anchorage.

26.6.31 In summary, the risks (without mitigation measures) associated with the hazards posed by dredging plant to the navigation receptors are predicted to be highest in and around the Temporary Jetty (rather than on the sailing route to and from the disposal ground), particularly for interference with commercial vessels and the Port of Bridgwater's interests, as follows:

- **high/unacceptable** for commercial vessels;
- **low/acceptable** for military activity;
- **low/acceptable** for fishing activity;
- **low/acceptable** for recreation activity; and
- **high/unacceptable** for the Port of Bridgwater and SDC's interests.

iii. Construction Plant for the TemporaryJetty and Cooling Water Intake and Outfall Structures Interfering with Activities at the Lilstock Range Firing Area

26.6.32 The Temporary Jetty would be constructed and dismantled close to the Lilstock Range Firing Area and the marked water surface template (see 'Target' identified on **Plate 26.11**) - while the head structures would also be constructed close to the Lilstock Range Firing Area marked water surface template. Although there are no restrictions on navigation within these areas, the firing range is only used when it is clear of vessels. Therefore, depending on the presence and movement of construction plant in the firing area, the construction activities could preclude the use and/or the safe use of the firing area for military training and exercises.

26.6.33 Based on informal consultation with the MoD (described above), it is anticipated that the risk of interference to military activities would be **moderate/ALARP** since construction plant should not be present within or sufficiently close to the firing area during the construction and dismantling periods to the extent that the MoD could not use the firing area to undertake military training and exercises.

iv. Construction Plant in the Water at Combwich Wharf

26.6.34 The refurbishment and extension of Combwich Wharf will entail the following relevant demolition/construction aspects:

- demolition of the existing dolphin berthing structures;
- demolition of the existing finger pier;
- construction of the goods wharf including piling;
- construction of the abnormal loads out quay, including piling; and
- construction of the berth bed.

26.6.35 Construction plant may be in the water during the refurbishment and extension of Combwich Wharf and would, therefore, potentially pose a hazard to navigation. The following plant is anticipated, some of which will potentially need to be brought to the wharf via the inbound route to the Port of Bridgwater and the River Parrett:

- delivery ship;
- barges;
- piling rig;
- work support boat;
- crane barge; and
- mobile track crane.

26.6.36 The risk to commercial traffic and the interests of the Port of Bridgwater is considered to be high (unacceptable) because of the volume of vessels and their inbound track to the Port of Bridgwater's harbour limits and berths in the River Parrett. Work on the wharf may entail using plant that may protrude out into the main River Parrett Channel.

26.6.37 There will be no use of the existing wharf at Combwich by commercial vessels during the refurbishment.

26.6.38 The risk to fishing activity is considered to be low (acceptable).

26.6.39 The risk to military activity is also considered to be low since naval vessels are not known to navigate in this area.

26.6.40 Some sailing does occur in this area of the Bristol Channel and Combwich Wharf is located in the designated sailing area for recreational craft (although this sailing area covers a large part of the Severn Estuary). There are also a number of moorings for small recreational vessels within the area of Combwich Wharf (e.g. associated with Combwich Motor Boat and Sailing Club). The refurbishment and extension of the wharf may cause interference with the use of the moorings. The risk to recreational craft in Bridgwater Bay is therefore considered to be low (acceptable) but may be considered high (unacceptable) within the River Parrett.

26.6.41 In summary, the risks (without mitigation measures) associated with the refurbishment and extension of Combwich Wharf are considered to be:

- **high/unacceptable** for commercial vessels accessing berths in the River Parrett;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in Bridgwater Bay;
- **high/unacceptable** for recreation vessels in the River Parrett; and
- **high/unacceptable** for the Port of Bridgwater and SDC's interests.

e) Operational Risks

i. Presence of the Temporary Jetty

26.6.42 Once constructed, the Temporary Jetty would extend into the open water of Bridgwater Bay and would, therefore, potentially pose a risk to navigation.

26.6.43 The Temporary Jetty itself presents a low risk to navigation due to its presence in open water. It should not create any major hazards during its operation given that it would be marked and assuming that marine activities would be undertaken in a competent manner.

26.6.44 The potential navigational hazards associated with and posed by the Temporary Jetty itself include interference with:

- the general flow of traffic in the Bristol Channel;
- passing commercial coastal traffic;
- commercial vessels bound for River Parrett;
- commercial vessels departing River Parrett;
- vessels at Gore anchorage;

- ‘drifting vessels’ and vessels ‘not under command’ (i.e. vessels with restricted abilities to manoeuvre);
- fishing vessels;
- recreational vessels in Bridgwater Bay; and
- the Port of Bridgwater and SDC’s interests.

26.6.45 However, the Temporary Jetty itself, as a static structure, poses little hazard to navigation other than with respect to unforeseen ‘drifting vessels’ and vessels ‘not under command’, due to the situation that vessels could find themselves in. This risk has been conservatively ranked as high/unacceptable, but, notwithstanding the conservative risk assessment, it should be borne in mind that vessels have anchors and, therefore, it is likely that drifting vessels and vessels not under command could be brought under control through the use of anchors to avoid potential collision.

26.6.46 In summary, the risks (without mitigation measures) are predicted to be:

- **high/unacceptable** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in Bridgwater Bay; and
- **low/acceptable** for the Port of Bridgwater and SDC’s interests.

ii. Presence and Movement of Vessels Using and Maintaining the Temporary Jetty

26.6.47 Vessels would use the Temporary Jetty for the importation of aggregates, cement and, potentially, other construction materials, and their presence and movement would potentially pose a risk to navigation. In addition, there may be some need for maintenance dredging of the berthing pocket. Unlike capital dredging, it is anticipated that maintenance dredging would be undertaken by hydraulic methods (i.e. ploughing/bed levelling, agitation or water injection), which would require vessel movements to and from the Temporary Jetty to conduct the maintenance dredging but would not require any additional vessel movements to dispose of dredged material (e.g. to the Cardiff Grounds offshore disposal site). Since aggregate vessels will comprise the majority of vessels sailing to and from and using the Temporary Jetty, this risk assessment focuses on the risk associated with these vessels.

26.6.48 This risk assessment gives consideration to the following features:

- anchorages;
- approach route to the jetty;
- depths of water (i.e. tidal windows);
- existing aids to navigation; and
- berthing and mooring.

26.6.49 Anchorages are relevant for this assessment because vessels using the Temporary Jetty may be required to anchor to wait for berth availability, a suitable tidal range or due to adverse weather conditions. The closest anchorage is located some six (6) cables (0.6nm) south-west of the Gore Buoy, which itself is 1.1nm north-north-west of the structure. Whilst this anchorage offers good holding ground by the nature of the seabed (sand and mud), it is somewhat exposed and, having a depth of approximately 6.0m above CD, it should be considered as a short stay/good weather anchorage.

26.6.50 Anchorages affording greater protection are those which by definition lie in the lee of land, and this is then determined by the direction of the wind. Vessels requiring protection from southerly and westerly wind may find suitable anchorage at Blue Anchor Bay, 7.0m above CD some 9nm (c.1 hour steaming) from the Temporary Jetty. Safe anchorage may also be found close in to the east of Lundy Island, but being approximately 60nm away (c.6 hours steaming) may well conflict with other operations. Vessels requiring protection from a northerly wind will find suitable anchorages off Barry Roads and nearby Lavernock Point (small ship), both of which are some 10 to 12nm (in excess of 1 hours steaming) from the Temporary Jetty.

26.6.51 Clearly, the vessels' approach to the Temporary Jetty would depend on their origin. It is anticipated that aggregates could be imported from a land-based source, possibly in south Wales. Various ports in south Wales could be used to export the aggregates, including Swansea (at 37nm), Britton Ferry (37nm), Port Talbot (37nm), Barry (10nm), Cardiff (13nm) and Newport (19nm).

26.6.52 If approaching the Temporary Jetty, it is expected that vessels from all origins should at all times pass to the west of the Gore Buoy and Cobbler Patch, with due regard being given to the nearby 1_8m shoal patch (see **Plate 26.10**). Thereafter, the berthing will be determined by the master who would consider wind and tidal direction when deciding on which side to berth the vessel. The Temporary Jetty will have sufficient facilities to berth (e.g. fenders) and restrain (e.g. mooring hooks) vessels.

26.6.53 It is expected that vessels, when departing from the Temporary Jetty, should follow the same track as described for approaching vessels.

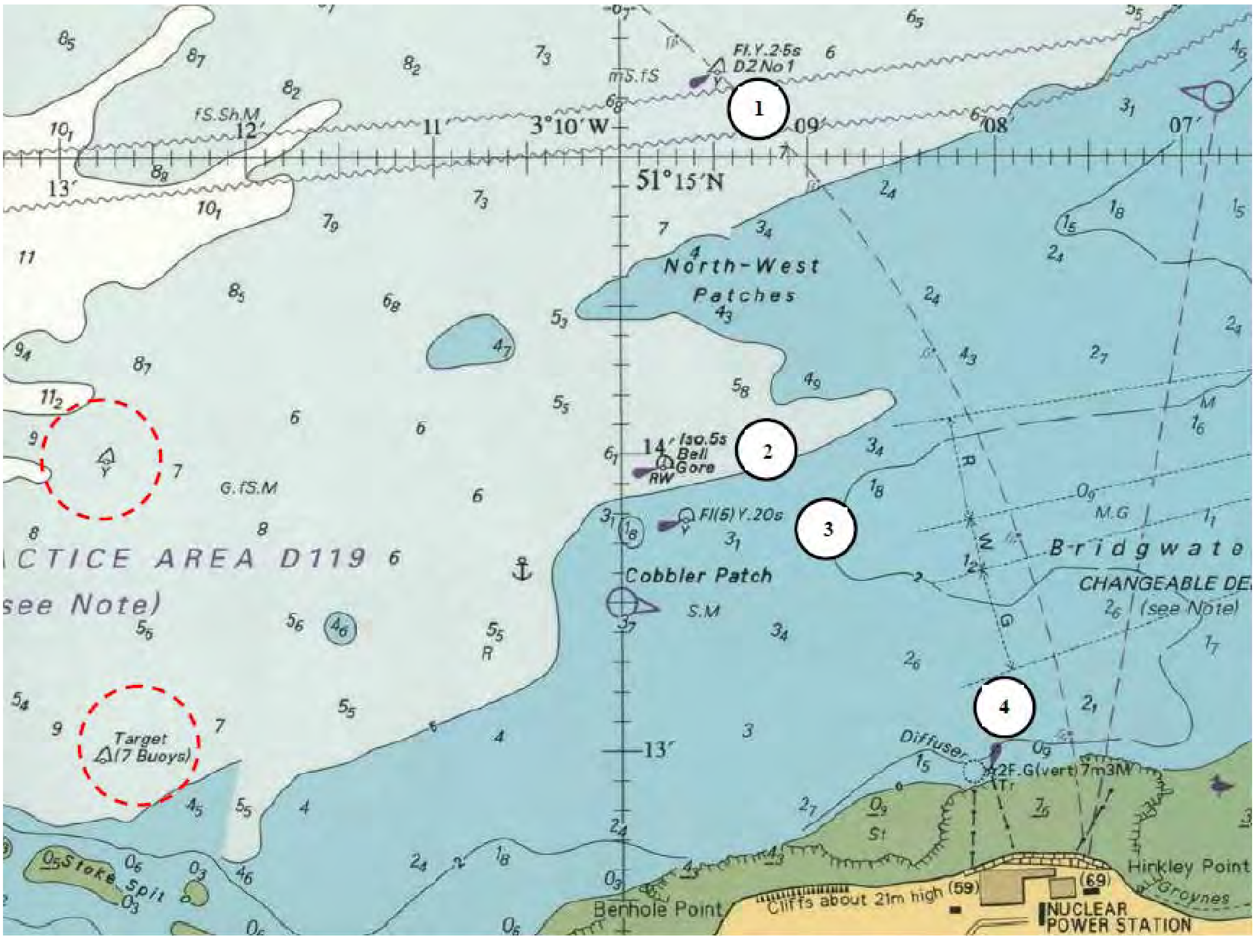
26.6.54 In terms of water depth, once vessels are inshore of the 5m bathymetric contour they would navigate within an operating envelope where the depth at Chart Datum is an average of 3.75m below CD, approaching 2.5m below CD nearer the berth.

26.6.55 There are few existing aids to navigation presently deployed in the locality of the Temporary Jetty. The aids include four lights and two unlit buoys (see **Plate 26.12**).

26.6.56 The following risk assessment factors are relevant in terms of the potential hazards associated with the aggregates vessels' potential for interference with navigation along their route between the Temporary Jetty and source of aggregates:

- vessels have several anchorage options and so the associated risk is considered to be ALARP;
- vessels cross the main shipping lanes on their approaches and departures from the aggregate loading ports in south Wales and so the associated risk is considered ALARP;

Plate 26.12: Existing Aids to Navigation



- vessel approaches and departures interface with commercial vessels in Gore anchorage and the approach channel to the River Parrett and so the associated risk is considered unacceptable;
- the range and flow of tides in the Bristol Channel are important variables for safe navigation and so the associated risk is considered unacceptable;
- there are some aids to navigation but improvements are required for some obstacles in the water, and so the associated risk is considered unacceptable; and
- there are some assumptions in place that masters should have sufficient experience and the Temporary Jetty should have the appropriate infrastructure to berth and restrain vessels, and so the associated risk is considered acceptable.

26.6.57 In summary, the risks (without mitigation measures) are predicted to be:

- **high/unacceptable** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels; and
- **high/unacceptable** for the Port of Bridgwater and SDC’s interests.

iii. Presence of the Intake and Outfall Head Structures

26.6.58 Once constructed, the intake and outfall head structures would extend into the open water of Bridgwater Bay and would, therefore, potentially pose a risk to navigation.

26.6.59 The potential navigational hazards associated with and posed by the head structures include interference with:

- the general flow of traffic in the Bristol Channel;
- passing commercial coastal traffic;
- commercial vessels bound for River Parrett;
- commercial vessels departing River Parrett;
- vessels at the Gore anchorage;
- 'drifting vessels' and vessels 'not under command';
- fishing vessels;
- recreational vessels in Bridgwater Bay; and
- the Port of Bridgwater and SDC's interests.

26.6.60 As already discussed, the current inbound course for vessels approaching the Port of Bridgwater and the River Parrett passes between the intake and outfall head structures. The risk to commercial traffic and the interests of the Port of Bridgwater is considered to be high (unacceptable) because of the volume of vessels and their current inbound track to the Port of Bridgwater's harbour limits and berths in the River Parrett in relation to the intake and outfall head structures' positions and the distance between them.

26.6.61 Specific assessments with regard to the collision risk found that for single or multiple structure collisions, the frequency of potential collisions is dominated by powered passing vessel collision scenarios (historically found to be mostly due to human error on the bridge of the vessel in question). Drifting vessel collisions would also be possible for single or multiple collisions although the frequency would be much lower for this type of collision.

26.6.62 In summary, the risks (without mitigation measures) associated with the presence of the intake/outfall structures are considered to be:

- **high/unacceptable** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in Bridgwater Bay; and
- **high/unacceptable** for the Port of Bridgwater/SDC's interests.

iv. Presence and Movements of Vessels maintaining the Intake and Outfall Head Structures

26.6.63 Once the head structures are in place there may be a need to undertake maintenance activities. The presence of a maintenance vessel would not be permanent since maintenance would be intermittent. The maintenance vessel would be positioned very close to the head structures and would not increase the navigational interference already existing due to the presence of the head structures themselves. The movement into place of the maintenance vessel would result in a relatively small increase in vessel movements in the area.

26.6.64 In summary, the risks (without mitigation measures) associated with the presence and movements of vessels maintaining the intake and outfall head structures are considered to be:

- **high/unacceptable** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in Bridgwater Bay; and
- **high/unacceptable** for the Port of Bridgwater and SDC's interests.

v. Temporary Jetty and Cooling Water Intake and Outfall Head Structures interfering with activities at the Lilstock Range Firing Area

26.6.65 The Temporary Jetty in particular and the intake and outfall head structures (including the presence and movement of operational and maintenance vessels) would be situated close to the Lilstock Range Firing Area and the marked surface water template (see 'Target' identified on **Plate 26.12**). Although there are no restrictions on navigation within these areas, the firing area is only used when it is clear of vessels. Therefore, depending on the presence of the Temporary Jetty, head structures and operational and/or maintenance vessels in relation to the firing area, operational activities could preclude the use or the safe use of the firing area for military training and exercises.

26.6.66 Based on informal consultation with the MoD (see Section 26.4), it is anticipated that the risk of interference to military activities would be **high/unacceptable** if the Temporary Jetty (in particular) and heads structures were sufficiently close to the firing area and/or if operational/maintenance vessels were to be frequently present within and/or transit the firing area, to the extent that the MoD could not use the firing area to sufficiently undertake military training and exercises.

vi. Presence of the Refurbished and Extended Combwich Wharf

26.6.67 The refurbished and extended wharf facility will not impinge on the River Parrett to any greater extent than at present. No increased navigational risk is anticipated due to the presence of the wharf.

26.6.68 In summary, the risks (without mitigation measures) associated with the physical presence of the refurbished and extended Combwich Wharf are considered to be:

- **low/acceptable** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in the River Parrett; and

- **low/acceptable** for the Port of Bridgwater and SDC's interests.

vii. Presence and Movements of Vessels using Combwich Wharf

26.6.69 Vessels would use Combwich Wharf for the importation of AILs and possibly other construction materials, and their presence and movement would potentially pose a risk to navigation. The newly refurbished and extended wharf will be able to accommodate larger vessels. The risk assessment focuses on the risk associated with these vessels.

26.6.70 This risk assessment considers the following navigation issues:

- anchorages;
- approaches to the wharf;
- depths of water (i.e. tidal windows);
- existing aids to navigation; and
- berthing and mooring.

26.6.71 Anchorages are relevant for this assessment because vessels using the wharf may be required to anchor to wait for berth availability, a suitable tidal range or adverse weather conditions. The closest anchorage to the wharf is located some six (6) cables south-west of the Gore Buoy, which itself is 1.1nm north-north-west of the Temporary Jetty and approximately four nautical miles west of the entrance to the River Parrett. Whilst this anchorage offers good holding ground by the nature of the seabed (sand and mud), it is somewhat exposed and, having a depth of approximately 6.0m above CD, it should be considered as a short stay/good weather anchorage.

26.6.72 Anchorages affording greater protection are those which by definition lie in the lee of the land; in a given situation the location of the lee of the land is determined by the direction of the wind. Vessels requiring protection from southerly and westerly winds may find suitable anchorage at Blue Anchor Bay, 7.0m above CD approximately 15nm from the entrance to the River Parrett. Safe anchorage may also be found close in to the east of Lundy Island, but being approximately 60nm away may well conflict with other operations. Vessels requiring protection from northerly wind will find suitable anchorages off Barry Roads and nearby Lavernock Point (small ship), both of which are approximately 15nm from the River Parrett entrance.

26.6.73 Anchoring in the River Parrett is not recommended unless the situation dictates that the action is necessary. Anchoring should therefore only be considered in an emergency. There are two areas set aside for this eventuality one being off the Brue Beacon (close to the pilot boarding/disembarking area) in about 2.0m of water at low spring tides and at the west end of Stockland Reach. The vessel will be dry at low water (i.e. Not Always Afloat But Safe Aground (NAABSA)).

26.6.74 The River Parrett is generally orientated in a north-south direction. It is equipped with lights, marks and buoys as aids to navigation. Through direct observation and informal consultation with the port of Bridgwater's Harbour Master, the navigable channel varies throughout its length but approximates to two thirds river width off Combwich. Average current flow is approximately three knots but can be as much as five knots. The overhead clearance of the power lines situated just north of

Combwich Reach North is 32m. The under-keel clearance (UKC) required is not less than 0.5m. No reductions on this figure are considered.

26.6.75 There are no restrictions for night time berthing.

26.6.76 Approaches to the wharf are split into two distinct phases. Guidance as far as the River Parrett and then pilotage on the River Parrett. These phases are described below.

26.6.77 Vessels bound for Combwich Wharf are monitored by Bridgwater Pilots on radar/AIS on passing the Gore Buoy. Pilots ‘talk’ vessels in on VHF, Channel 8. Guidance is given from passing the Gore Buoy onwards to the vessel passing Burnham on Sea No.2 Buoy where direction is given to head for the pilot boat. The pilot will board shortly thereafter.

26.6.78 Pilotage is compulsory on the River Parrett. After boarding and passing the Brue Beacon, RW, the vessel proceeds mid river in the direction of Black Rock Light. A distance of approximately 2nm. Passing close to Black Rock and staying close to the port-side bank along Stocklands Reach. On passing Combwich North Light the vessel crosses the river and remains close to the starboard-side of the river to Combwich Wharf.

26.6.79 On approach to Combwich Wharf, the start time for passing the Gore Buoy must not be less than 2.25 hours before high water at Bridgwater, and preferably 2.5 hours to allow for the unforeseen and/or personnel changes/additions which may be required en route.

26.6.80 The following risk assessment factors are relevant in terms of the potential hazards associated with a vessel’s potential for interference with navigation along the route to Combwich Wharf:

- vessels have several anchorage options and so the associated risk is considered to be ALARP;
- vessel approaches and departures interface with commercial vessels in the Gore anchorage and the approach channel to the River Parrett and so the associated risk is considered unacceptable;
- the range and flow of tides in the Bristol Channel are important variables for safe navigation and so the associated risk is considered unacceptable;
- there are several aids to navigation within the River Parrett and so the associated risk is considered ALARP; and
- there are some assumptions in place that masters should have sufficient experience and Combwich Wharf should have the appropriate infrastructure to berth and restrain vessels, and so the associated risk is considered acceptable.

26.6.81 In summary, the risks (without mitigation measures) are predicted to be:

- **high/unacceptable** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;

- **low/acceptable** for recreation vessels in Bridgwater Bay;
- **high/unacceptable** for recreation vessels in the River Parrett; and
- **high/unacceptable** for the Port of Bridgwater and SDC's interests.

viii. Maintenance of the Berth at Combwich Wharf

26.6.82 Should silt accrete on the berthing platform at Combwich Wharf, it is proposed that it would be cleared by an excavator, with a blade attachment, and returned to the River Parrett channel. It is anticipated that these works would take place subject to an inspection of silt accretion in the berth prior to the delivery of an AIL to the Wharf. If a sufficient amount of silt has accreted, then maintenance works would be required and would involve an excavator being positioned on the berthing platform from where it would plough / push the accreted silt from the berth into the adjacent channel. In effect, these works would be a continuation of the existing maintenance works that take place to clear the current berthing base at Combwich Wharf.

26.6.83 At present, maintenance of the existing berthing base occurs very infrequently (i.e. approximately once a year). It is anticipated that maintenance dredging of the proposed berthing platform would be undertaken more often but smaller quantities would be dredged, given that there would be more AIL deliveries during the construction of HPC and less time for silt accretion in between these deliveries.

26.6.84 The potential obstruction to navigation associated with these works would be limited to interference with the navigation and moorings of recreational craft in the River Parrett, in and immediately adjacent to Combwich Pill, and members of the Combwich Motor Boat and Sailing Club. Given the very localised nature and limited frequency of the works proposed, the potential hazard they pose to navigation is considered to be low.

26.6.85 Since future maintenance at Combwich Wharf would be a continuation of existing maintenance and limited to the berthing platform, navigational risk would be associated with the works in the berth and the immediately adjacent area of the River Parrett and would be (without mitigation measures):

- **low/acceptable** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **moderate/ALARP** for recreation vessels in the River Parrett; and
- **low/acceptable** for the Port of Bridgwater and SDC's interests.

26.7 Mitigation of Risks

26.7.1 This section sets out the mitigation measures that are proposed to reduce high/unacceptable risks to moderate/ALARP or low/acceptable risks. In general, these measures include standard approaches for managing navigation issues and should be straightforward to implement since they typically reflect good practice (e.g. use of anchorages, installation of navigation marks, issuing of Notices to Mariners, etc) and/or previously established methods (e.g. use of an exclusion zone).

26.7.2 The mitigation measures identified below assume that all the marine activities will be undertaken in a competent manner and that EDF Energy, as harbour authority for the Temporary Jetty, will appoint a harbour master and will prepare and implement a SMS Operations Manual for the Temporary Jetty in accordance with the PMSC. The harbour master and the SMS will provide key mechanisms through which EDF Energy will address and manage navigational risks, and particularly risks associated with the Temporary Jetty element of the HPC Project. In addition, on the basis of consultation with SDC and the Port of Bridgwater, it is expected that this SMS would dovetail into the Port of Bridgwater's SMS Operations Manual and should facilitate a coordinated approach to managing safe navigation in the water areas under the jurisdictions of both parties.

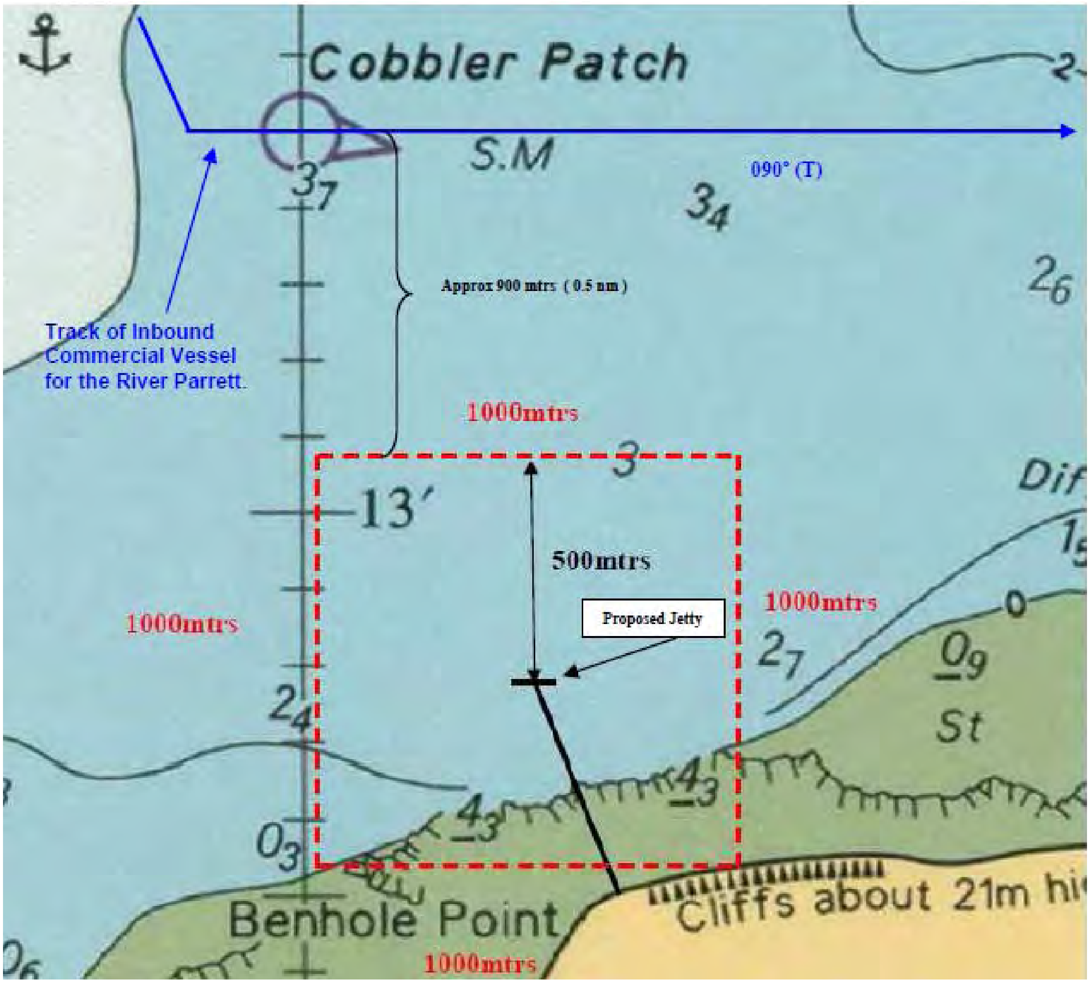
26.7.3 On the basis of consultation between EDF Energy and Sedgemoor District Council (as the harbour authority for the Port of Bridgwater), EDF Energy acknowledge that Combwich Wharf is situated within the Port of Bridgwater's harbour limits and, therefore, it will be necessary to consult with Sedgemoor District Council on the mitigation measures proposed below (e.g. traffic supervision, Notices to mariners, exclusion zones) in relation to the construction and operation of Combwich Wharf's refurbishment and extension.

a) Mitigation during Construction

i. Construction and Dismantling of the Temporary Jetty and Construction of the Cooling Water Intake and Outfall Head Structures

26.7.4 In relation to the Temporary Jetty, it is recommended that an exclusion zone of some 500m is provided temporarily around the construction plant during construction and dismantling (see **Plate 26.13**). The exclusion zone would mean that passing vessels would have to avoid entering this area of the water and, thereby, the exclusion zone would reduce the risk of passing vessels colliding with construction plant during its construction and dismantling works. This exclusion zone should be marked, at its corners, with marks and lights in line with the requirements to be advised by Trinity House. In addition, it may be prudent to implement a standby vessel (small patrol vessel) during working hours.

Plate 26.13: Proposed Exclusion Zone for the Jetty



26.7.5 These recommendations will be incorporated within the SMS for the jetty.

26.7.6 In relation to the head structures, a number of mitigation measures should be considered. It is recognised that the head structures will lie outside the harbour limits of both EDF Energy and the Port of Bridgwater and, therefore, it will be necessary for both harbour authorities to work together on mitigating and managing navigation issues.

26.7.7 It is recommended that exclusion zones are provided temporarily around the construction plant during the construction works for the head structures. It is anticipated that the exclusion zones would extend approximately 100m from the centre points of each of the head structures. In addition, it is recommended that the Gore Buoy be re-positioned and hence alter the recommended route for vessels navigating toward the River Parrett and the Port of Bridgwater to reduce the risk of collision with the construction plant and works for the head structures. Re-positioning of the Gore Buoy would be subject to discussion with the Port of Bridgwater and Government agencies, including the MCA, Trinity House and UKHO, and the approval of Trinity House.

26.7.8 In addition, it is recommended that one or more of the following measures be used, as appropriate:

- charting and marking the structures appropriately, although this could result in the intake and outfall heads being encased in fort like structures;
- notices to Mariners, as issued on a weekly basis by the UKHO;
- 'M' Notices issued by the MCA;
- Local Notices to Mariners, port directives and public notices, as issued by the Harbour Authority for the jetty;
- re-positioning of the anchorage area to increase distance from the head structures; and
- traffic supervision in Bridgwater Bay (e.g. via VHF communications) by the Harbour Authority for the Temporary Jetty, potentially in collaboration with the Harbour Authorities for the Port of Bridgwater and the Port of Bristol. This will be incorporated within the SMS for the structure.

26.7.9 In addition, Sedgemoor District Council and West Somerset Council have advised "Given the methodology adopted by the Port of Bridgwater to guide ships in over Gore Sands utilises a shore based radar at Burnham on Sea, it is possible that increased risk in the approaches warrants an upgrade to the existing system to allow for more accurate assessment of vessels' positions in the approaches". Although, EDF Energy believe that the recommended mitigation measures are sufficient to manage risks to at level that can be considered as ALARP, the quality of the Port of Bridgwater's guidance from the Gore Buoy is not dependant on an upgrade to this system, and the risks are greater in the vicinity of the No. 2 Buoy over Steart Flats, they nevertheless propose to discuss the sufficiency of the existing system with the Port of Bridgwater.

ii. Passage of Dredging Plant to/from the Offshore Disposal Site (Cardiff Grounds)

26.7.10 To reduce the risk to navigation associated with the passage of plant between the temporary jetty and the Cardiff Grounds offshore disposal site, should this occur, the following measures are proposed to reinforce good practice for navigation under COLREGS:

- dredging plant should not cross vessels that may be restricted by their draught or restricted by their ability to manoeuvre due to being in a narrow channel; and
- all dredging plant should, at all times, pass to the west of Gore Buoy and Cobbler Patch, with due regard given to the shoal patch of 1_8m.

26.7.11 These recommendations will also be incorporated within the SMS for the Temporary Jetty.

26.7.12 During the dredging works national level Notice to Mariners will be issued by the UKHO and local level Notices and directives will be issued by the Harbour Authority for the Temporary Jetty.

iii. Construction Plant for the Jetty and Cooling Water Intake and Outfall Structures Interfering with Activities at the Lilstock Range Firing Area

26.7.13 On the basis of informal consultation with the MoD (see paragraph 26.4.7), it is proposed that the potential interference with activities at the Lilstock Range firing area by navigation is managed through the implementation of an approved communications management plan between EDF Energy and the MoD. With the implementation of this plan, EDF Energy and the MoD believe that conflict would be avoided and that both parties' activities could successfully co-exist. The following key elements of the communications management plan have been discussed between EDF Energy and the MoD:

- regular provision of planned vessel movement information from EDF Energy to the MoD. This information is to be provided on a monthly basis (outline of planned movements), weekly basis (details of planned movements) and daily basis (confirmation of all anticipated movements);
- establishment of clear procedures and channels of communication between EDF Energy and the MoD in relation to any difficulties or emergencies that require a rapid departure from planned movements;
- use of passage plans wherever possible that avoid the area of potential conflict or, where this is unavoidable, establishment of predictable planned movements at given times of day; and
- procedures for escalation of concerns where necessary or appropriate.

iv. Construction Plant in the Water at Combwich Wharf

26.7.14 In order to mitigate the potential risk to navigation during the construction phase at Combwich Wharf, a number of mitigation measures have been identified for further consideration with Sedgemoor District Council since Combwich Wharf is situated within the Port of Bridgwater's harbour limits.

26.7.15 Firstly, the use of a temporary exclusion zone is recommended at relevant times to safeguard construction personnel and plant and to safeguard passing commercial and recreational vessels. EDF Energy acknowledge that the exclusion zone would have to be sanctioned and applied by the Port of Bridgwater and that the extent of the exclusion zone would have to take into account existing navigation requirements in relation to the Port of Bridgwater. For example, Sedgemoor District Council and West Somerset Council have advised "an exclusion zone…could be problematic if it extended into the River [Parrett] beyond the existing dolphins as an open port duty applies to the Port of Bridgwater and vessels bound to Dunball have to pass Combwich".

26.7.16 Other measures include:

- Notices to Mariners, as issued on a weekly basis by the UKHO;
- 'M' Notices issued by the MCA;
- Local Notices to Mariners, port directives and public notices, as appropriate and issued by the Port of Bridgwater;
- re-positioning of the anchorage area to increase distance from the head structures; and
- traffic supervision in Bridgwater Bay (e.g. via VHF communications) by the Harbour Authority for the jetty, potentially in collaboration with the Harbour Authorities for the Port of Bridgwater and the Port of Bristol.

b) Mitigation during Operation

i. Presence of the Temporary Jetty

26.7.17 In accordance with the advice from Trinity House, the Temporary Jetty would have to be marked appropriately for safety. Whilst Trinity House would confirm the marking required, the general marking would be as follows for the lights on the jetty head:

- single flash green; and
- two fixed green lights vertically disposed 2m apart.

ii. Presence and Movement of Vessels Using and Maintaining the Jetty

26.7.18 To reduce the risk to navigation associated with the presence and movement of vessels using the jetty, it is recommend that navigation information be clearly documented in each vessel's SMS. The SMS should document the following information:

- utilisation of appropriate anchorages;
- avoidance of close proximity with anchorage and crossing approach channel;
- prioritisation of suitable tidal windows;
- documentation of procedures for berthing in relation to wind and current parameters; and
- documentation of procedures in relation to vessel emissions.

iii. Jetty and Cooling Water Intake and Outfall Operation Interfering with Activities at the Lilstock Range Firing Area

26.7.19 On the basis of informal consultation with the MoD (see paragraph 26.4.8), it is proposed that the communications management plan to be implemented during the construction phase for the Lilstock Range Firing Area is maintained through the operational phase.

iv. Presence of the Intake and Outfall Head Structures

26.7.20 The intake and outfall head structures would have to be marked appropriately for safety in accordance with guidelines and recommendations established by the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA). Whilst Trinity House would confirm the marking required, the general marking would be as follows for the lights on the structures:

- either Green or Yellow Conical Buoys (Fl.G or Fl.Y) to mark the extreme seaward end; or
- a Green Conical Buoy (Fl.G) marking the extreme seaward end and Yellow Conical Buoys (Fl.Y) spaced intermittently along the line of the Intake/ Outfall trench.

26.7.21 In order to mitigate the potential risk to navigation during the operational phase, a similar set of mitigation measures to those proposed in the construction phase have been identified for further consideration. They are:

- revision of the position of the Gore Buoy and hence the recommended route for vessels navigating toward the River Parrett;
- charting and marking the structures appropriately could result in the inlets and outfall heads encased in fort like structures;
- notices to Mariners, as issued on a weekly basis by the UKHO;
- local Notices to Mariners, port directives and public notices, as issued by the Harbour Authority for the Temporary Jetty;
- re-positioning of the anchorage area to increase distance from the head structures;
- protection of head structures; and
- traffic supervision in Bridgwater Bay (e.g. via VHF communications) by the Harbour Authority for the jetty (for the period that the Harbour Authority exists/that the jetty is present) in collaboration with the Harbour Authorities for the Port of Bridgwater and, potentially, the Port of Bristol. This will be incorporated within the SMS for the Temporary Jetty.

v. Presence and Movements of Vessels maintaining the Cooling Water Intake and Outfall Head Structures

26.7.22 To reduce the risk to navigation associated with the presence and movement of vessels used during any necessary maintenance of the structures, it is recommend that navigation information be clearly documented in the vessels' SMS. The SMS should document the following information:

- utilisation of appropriate anchorages;
- avoidance of close proximity with anchorage and crossing approach channel;
- prioritisation of suitable tidal windows; and
- documentation of procedures for berthing in relation to wind and current parameters.

vi. Presence of the Refurbished and Extended Combwich Wharf

26.7.23 The newly refurbished and extended wharf would be marked appropriately for safety in accordance with guidelines and recommendations established by the IALA as directed by Trinity House and discussed with the Port of Bridgwater (since Combwich Wharf is situated within the harbour limits of the Port of Bridgwater).

26.7.24 In addition, berthing procedures would need to be reviewed with respect to the new wharf to ascertain that there is no appreciable change in the value of current effect post construction. Passage planning would need to be reviewed and agreed for each shipment/delivery.

vii. Presence and Movements of Vessels using Combwich Wharf

26.7.25 Good passage planning is essential to ensure all marine operations are carried out safely and efficiently. Operations on the River Parrett are undertaken under difficult conditions due to the extreme tidal range, winding river and constantly changing channels which consequentially contribute to a small tidal window for berthing at facilities on that river and in particular Combwich Wharf.

26.7.26 All vessel movements to and from Combwich Wharf will be within the harbour limits of the Port of Bridgwater and, therefore, will be subject to the controls and requirements of the harbour authority, including the need for pilotage and compliance with the Port of Bridgwater's SMS and Operations Plan, as appropriate. It should be noted that EDF Energy operate the existing facility at Combwich Wharf for the delivery of AILs and, accordingly, EDF Energy and the vessel operators using Combwich Wharf already communicate and work with the Port of Bridgwater on such matters.

26.7.27 In addition, to reduce the risk to navigation associated with the presence and movement of vessels used using Combwich Wharf, it is recommend that navigation information be clearly documented in the vessels' SMS. The SMS should document the following information:

- utilisation of appropriate anchorages;
- avoidance of close proximity with other vessels within the anchorage and crossing approach channel;
- utilisation of suitable tidal windows;
- documentation of procedures for berthing in relation to wind and current parameters;
- strict adherence to the Port of Bridgwater's Approaches Plan; and
- strict adherence to the contingency plan and Emergency Anchorages.

viii. Maintenance of the Berth at Combwich Wharf

26.7.28 In advance of maintenance works a local Notice to Mariners would be issued, together with general guidance to advise local mariners of, for example, the presence of an excavator on the berthing platform in Combwich Wharf.

26.7.29 In addition, it might be necessary to restrict access to Combwich Pill for recreational craft during the works to safeguard against accidents or injuries that could occur in the immediate proximity of the workplace.

26.8 Residual Risks

26.8.1 With the mitigation measures in place - including good practice, previously established methods and lines of communication between EDF Energy and key parties (e.g. the Port of Bridgwater and the MoD) - the residual risks to navigation would be reduced to levels that are either moderate/ALARP or low/acceptable. The following paragraphs summarise the assessments of residual risks.

a) Residual Construction Risks

i. Construction and Dismantling of the Temporary Jetty and Construction of the Cooling Water Intake and Outfall Head Structures

26.8.2 With suitable mitigation measures in place, the residual risks associated with the construction plant during the construction of the jetty are considered to be:

- **moderate/ALARP** for commercial vessels;

- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in Bridgwater Bay; and
- **moderate/ALARP** for the Port of Bridgwater and SDC's interests.

ii. Passage of Dredging Plant to/from the Offshore Disposal Site (Cardiff Grounds)

26.8.3 With the mitigation measures in place, the residual risks are predicted to be:

- **moderate/ALARP** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in Bridgwater Bay; and
- **moderate/ALARP** for the Port of Bridgwater and SDC's interests.

iii. Construction Plant for the Jetty and Cooling Water intake and Outfall Structures Interfering with Activities at the Lilstock Range Firing Area

26.8.4 With the mitigation measures in place, the residual risk is predicted to be **low/acceptable**.

iv. Construction Plant in the Water at Combwich Wharf

26.8.5 With suitable mitigation measures in place, the residual risks associated with the construction plant during the refurbishment and extension of Combwich Wharf are considered to be:

- **moderate/ALARP** for commercial vessels accessing berths in the River Parrett.
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in Bridgwater Bay;
- **moderate/ALARP** for recreation vessels in the River Parrett; and
- **moderate/ALARP** for the Port of Bridgwater and SDC's interests.

b) Residual Operational Risks

i. Presence of the Temporary Jetty

26.8.6 With the mitigation measures in place, the residual risks associated with the presence of the temporary jetty are considered to be:

- **moderate/ALARP** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in Bridgwater Bay; and

- **low/acceptable** for the Port of Bridgwater and SDC's interests.

ii. Presence and Movement of Vessels Using and Maintaining the Jetty

26.8.7 With the mitigation measures in place, the residual risks associated with the presence and movement of vessels using the temporary jetty are considered to be:

- **moderate/ALARP** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in Bridgwater Bay; and
- **low/acceptable** for the Port of Bridgwater and SDC's interests.

iii. Jetty and Cooling Water Intake and Outfall Operation Interfering with Activities at the Lilstock Range Firing Area

26.8.8 With mitigation measures in place, the residual risk is predicted to be **moderate/ALARP**.

iv. Presence of the Intake and Outfall Head Structures

26.8.9 With suitable mitigation measures in place, the residual risks associated with the presence of the intake and outfall head structures are considered to be:

- **moderate/ALARP** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in Bridgwater Bay; and
- **moderate/ALARP** for the Port of Bridgwater and SDC's interests.

v. Presence and Movements of Vessels Maintaining the Intake and Outfall Head Structures

26.8.10 With suitable mitigation measures in place, the residual risks associated with the presence and movements of vessels maintaining the intake/outfall head structures are considered to be:

- **low/acceptable** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in Bridgwater Bay; and
- **low/acceptable** for the Port of Bridgwater and SDC's interests.

vi. Presence of the Refurbished and Extended Combwich Wharf

26.8.11 In summary, the risks associated with the presence of refurbished Combwich Wharf remain as:

- **low/acceptable** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in the River Parrett; and
- **low/acceptable** for the Port of Bridgwater and SDC's interests.

vii. Presence and Movements of Vessels using Combwich Wharf

26.8.12 With suitable mitigation measures in place, the residual risks associated with the presence and movement of vessels using Combwich Wharf are considered to be:

- **moderate/ALARP** for commercial vessels;
- **low/acceptable** for military vessels;
- **low/acceptable** for fishing vessels;
- **low/acceptable** for recreation vessels in Bridgwater Bay;
- **moderate/ALARP** for recreation vessels in the River Parrett; and
- **moderate/ALARP** for the Port of Bridgwater and SDC's interests.

viii. Maintenance of the Berth at Combwich Wharf

26.8.13 Based on the assumption that an excavator would be used to clear the silt off the berthing platform and into the adjacent River Parrett, the residual risks associated with the hazards posed by the maintenance works at Combwich Wharf are considered to be:

- **low/acceptable** for commercial traffic;
- **low/acceptable** for military activity;
- **low/acceptable** for fishing activity;
- **low/acceptable** for recreation vessels in the River Parrett; and
- **low/acceptable** for the Port of Bridgwater and SDC's interests.

26.9 Summary of Risks

Table 26.4 presents a summary of the risks associated with the construction and operation of the proposed development on navigation with respect to the temporary jetty, the intake and outfall head structures and the refurbishment and extension of Combwich Wharf. It also summarises the risks associated with the dismantling/restoration of the temporary jetty. The table summarises the risks prior to mitigation, the mitigation measures proposed and the residual risks.

Table 26.4: Summary of the Potential Risks to Navigation

Risks: H = high, M = moderate, L = low

Potential Hazard	Potential Consequence	Predicted Risk			Mitigation Measure	Residual Risk		
		CRN	LRN	Risk		CRN	LRN	Risk
Construction and Dismantling of the Temporary Jetty and Construction of the Cooling Water Intake and Outfall Head Structures								
Commercial vessels	Frequent interference	4	4	H	Use of an exclusion zone and possible use of a small patrol vessel, to be implemented through a SMS.	4	2	M
Military vessels	Minor interference	2	2	L		2	2	L
Fishing vessels	Minor interference	2	2	L		2	2	L
Recreation vessels (Bridgwater Bay)	Minor interference	2	2	L		2	2	L
Port of Bridgwater's interests	Liability, stakeholder concerns	4	4	H		4	2	M
Passage of Dredging Plant between Jetty and Cardiff Grounds Disposal Site								
Commercial vessels	Frequent interference	4	4	H	Robust operational procedures for dredging plant, to be implemented through a SMS.	4	2	M
Military vessels	Minor interference	2	2	L		2	2	L
Fishing vessels	Minor interference	2	2	L		2	2	L
Recreation vessels (Bridgwater Bay)	Minor interference	2	2	L		2	2	L
Port of Bridgwater's interests	Liability, stakeholder concerns	4	4	H		4	2	M
Construction Plant for the Jetty and Cooling Water Intake and Outfall Structures Interfering with Activities at the Lilstock Range Firing Area								
Lilstock Range Firing Area	Frequent interference with military exercises and training	4	2	M	Implementation of an approved communications management plan between EDF Energy and the MoD.	2	2	L
Presence of Construction Plant in the Water at Combwich Wharf								
Commercial vessels	Frequent interference	4	4	H	Use of an exclusion zone, charting and marking of head structures, use of Notice to Mariners, port directives, public notices, repositioning of anchorage area, and traffic supervision to be implemented through a SMS.	4	2	M
Military vessels	Minor interference	2	2	L		2	2	L
Fishing vessels	Minor interference	2	2	L		2	2	L
Recreation vessels (Bridgwater Bay)	Minor interference	2	2	L		2	2	L

Potential Hazard	Potential Consequence	Predicted Risk			Mitigation Measure	Residual Risk		
		CRN	LRN	Risk		CRN	LRN	Risk
Recreation vessels (River Parrett)	Frequent interference	4	4	H		4	2	M
Port of Bridgwater's interests	Liability, stakeholder concerns	4	4	H		4	2	M
Risks during Operation								
Presence of the Jetty								
Commercial vessels	Frequent interference	4	4	H	The jetty would be marked appropriately.	4	2	M
Military vessels	Minor interference	2	2	L		2	2	L
Fishing vessels	Minor interference	2	2	L		2	2	L
Recreation vessels (Bridgwater Bay)	Minor interference	2	2	L		2	2	L
Port of Bridgwater's interests	Minor interference (possible benefit)	2	2	L		2	2	L
Vessels using and Maintaining the Jetty								
Commercial vessels	Frequent interference (anchorages, transits, approaches, departures, tidal windows, aids to navigation, berthing and mooring	4	4	H	Use of anchorages, use of tidal windows, use of procedures for berthing to be implemented through a SMS.	4	2	M
Military vessels	Minor interference	2	2	L		2	2	L
Fishing vessels	Minor interference	2	2	L		2	2	L
Recreation vessels (Bridgwater Bay)	Minor interference	2	2	L		2	2	L
Port of Bridgwater's interests	Minor interference (possible benefit)	4	4	H		4	2	L
Jetty and Cooling Water Intake and Outfall Operation Interfering with Activities at the Lilstock Range Firing Area								
Lilstock Range Firing Area	Frequent interference with military exercises and training	4	4	H	Implementation of an approved communications management plan between EDF Energy and the MoD.	4	2	M

Potential Hazard	Potential Consequence	Predicted Risk			Mitigation Measure	Residual Risk		
		CRN	LRN	Risk		CRN	LRN	Risk
Presence of the Intake/Outfall Structures								
Commercial vessels	Frequent interference	4	4	H	The structures would be marked appropriately. Use of an exclusion zone, charting and marking of head structures, use of Notice to Mariners, port directives, public notices, repositioning of anchorage area, and traffic supervision to be implemented through a SMS.	4	2	M
Military vessels	Minor interference	2	2	L		2	2	L
Fishing vessels	Minor interference	2	2	L		2	2	L
Recreation vessels (Bridgwater Bay)	Minor interference	2	2	L		2	2	L
Port of Bridgwater's interests	Liability, stakeholder concerns	4	4	H		4	2	M
Presence and Movement of Vessels Maintaining Intake/Outfall Structures								
Commercial vessels	Frequent interference	4	2	M	Use of anchorages, use of tidal windows, use of procedures for berthing to be implemented through a SMS.	3	2	L
Military vessels	Minor interference	2	2	L		2	2	L
Fishing vessels	Minor interference	2	2	L		2	2	L
Recreation vessels (Bridgwater Bay)	Minor interference	2	2	L		2	2	L
Port of Bridgwater's interests	Liability, stakeholder concerns	4	2	M		3	2	L
Presence of the refurbished and extended Combwich Wharf								
Commercial vessels	Minor interference	2	2	L	The refurbished **and extended** wharf would be marked appropriately. Passage planning and berthing procedures.	2	2	L
Military vessels	Minor interference	2	2	L		2	2	L
Fishing vessels	Minor interference	2	2	L		2	2	L
Recreation vessels (River Parrett)	Minor interference	2	2	L		2	2	L
Port of Bridgwater's interests	Minor interference	2	2	L		2	2	L
Presence and Movement of Vessels using Combwich Wharf								
Commercial vessels	Frequent interference	4	4	H	Use of anchorages, use of tidal windows, use of procedures for	4	2	M
Military vessels	Minor interference	2	2	L		2	2	L

Potential Hazard	Potential Consequence	Predicted Risk			Mitigation Measure	Residual Risk		
		CRN	LRN	Risk		CRN	LRN	Risk
Fishing vessels	Minor interference	2	2	L	berthing to be implemented through a SMS.	2	2	L
Recreation vessels (Bridgwater Bay)	Minor interference	2	2	L		2	2	L
Recreation vessels (River Parrett)	Frequent interference	4	4	H		4	2	M
Port of Bridgwater's interests	Liability, stakeholder concerns	4	4	H		4	2	M
Maintenance of the Berth at Combwich Wharf								
Commercial vessels	Minor interference	2	2	H	Notice to Mariners, potential for restricted access to recreational moorings during dredging operations.	2	2	L
Military vessels	Minor interference	2	2	L		2	2	L
Fishing vessels	Minor interference	2	2	L		2	2	L
Recreation vessels (River Parrett)	Minor interference	4	2	M		2	2	L
Port of Bridgwater's interests	Minor interference	2	2	H		2	2	L

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26.2 DfT. A Guide to Good Practice on Port Marine Safety Operations: A Companion to the Port Marine Safety Code. Amended September 2009.

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26.5 SDC. Port of Bridgwater Trade Figures. 2008.

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CHAPTER 27: SUMMARY OF ENVIRONMENTAL MITIGATION

CONTENTS

APPENDICES

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27. SUMMARY OF ENVIRONMENTAL MITIGATION

27.1 Introduction

27.1.1 This chapter summarises the significant environmental impacts predicted as a result of the construction and operation (including the landscaping works when the construction works are complete) of the proposed new nuclear power station known as Hinkley Point C (HPC). Full details of the predicted impacts and corresponding mitigation measures are described in **Volume 2** of the Environmental Statement (ES).

27.1.2 Significant environmental impacts and proposed mitigation measures for each of the associated development sites are summarised in **Volumes 3** to **10** of the ES.

27.1.3 A summary of predicted impacts on local residents ('community impacts', in terms of transport, amenity, noise and air quality impacts, and socio-economic issues), and a summary of proposed mitigation measures, is provided in the **Community Impact Report** (see **Appendix 27A**).

a) Hinkley Point C Development Site

27.1.4 The development site for HPC is located at Hinkley Point on the Somerset coast, in a predominantly rural location within the District of West Somerset. The site is located approximately 13km north-west of Bridgwater and approximately 17km from Junction 24 of the M5 motorway.

27.1.5 The on-shore area of the HPC development site comprises 175.2 hectares. This area comprises both the permanent HPC development site (67.5ha), and the land required for the construction phase which will include contractor working and material stockpile areas, a temporary accommodation campus and early landscaping works and screening.

27.1.6 Immediately to the east of the HPC development site, the land is occupied by two existing nuclear power stations, Hinkley Point A and Hinkley Point B (HPA and HPB), which together are referred to as the Hinkley Point Power Station Complex.

27.1.7 The topography of the HPC development site is typical of that in the wider locality, consisting of gently rolling, mixed lowland farmland with a series of east-west ridges. The ground falls through several west-east undulations from Green Lane (which occupies the highest ridge within the HPC development site) towards the coastal cliffs and Bridgwater Bay. There are a number of small watercourses within the development site, including Holford Stream and Bum Brook to the south of the site, and the HPC Drainage Ditch.

b) Hinkley Point C

27.1.8 The new nuclear power station would comprise two UK EPR reactor units (Units 1 and 2) and shared infrastructure and facilities. The generator would be capable of producing around 1,630 megawatts (MW) of electrical power for each reactor giving a total site capacity of 3,260MW.

27.1.9 The two UK EPR reactor units would be constructed 18 months apart with Unit 1 scheduled for operation in 2019 and Unit 2 in 2020. Prior to operation each reactor will undergo commissioning which involves a series of tests to demonstrate that HPC is capable of performing in accordance with its design specification, safety and environmental requirements.

27.1.10 HPC would have an operational lifetime of 60 years before being decommissioned. HPC would have a permanent workforce of approximately 900 staff during normal operations.

c) Environmental Impacts and Mitigation

27.1.11 Environmental impacts which are predicted to be of negligible or minor adverse significance have not been assigned specific mitigation measures. However, management and control measures have already been built into the project design which in many cases has reduced potential impacts to a "not significant" level. Compliance with regulatory requirements and standard good construction and operational practices are also part of the project design, and are not considered as formal mitigation.

27.1.12 Mitigation measures have been proposed where there is likely to be a significant adverse impact of greater than minor significance and the impact magnitude, spatial scope and temporal nature make it appropriate to do so. Predicted significant impacts and the measures proposed to mitigate these are summarised in this chapter and are identified by project phase: construction and operation. All impacts listed are adverse unless otherwise stated.

27.2 Socio-economics

a) Construction Phase Impacts and Mitigation

27.2.1 The construction phase is likely to have the widest range of impacts on the local labour market, economy, availability of accommodation and provision of public services as a result of the large workforce required to build HPC.

27.2.2 The size of the construction workforce would vary at different stages of the construction period, with a peak in 2016 of around 5,600 workers. This construction worker demand would bring significant benefits to the local area in terms of local recruitment and supply chain opportunities for Somerset businesses. These benefits would likely provide £45 million per year in wages and multiplier impacts and £45 million per year of construction supply chain benefits. EDF Energy has developed a **Construction Workforce Development Strategy** and **Local Procurement Strategy** to enhance these positive impacts and would also make a financial contribution to the marketing and promotion of Somerset.

27.2.3 At the peak construction phase, approximately 3,700 workers are expected to move to the area temporarily. This demand for places could potentially have a significant impact upon the supply of accommodation. EDF Energy has therefore planned a campus based **Accommodation Strategy** to minimise pressure on local housing markets, providing 1,510 campus places across three sites, including an on-site HPC campus and two campuses in Bridgwater. These accommodation campuses would ensure that the HPC workforce does not exceed available capacity in the area. EDF Energy has also proposed additional precautionary mitigation through a £5 million housing fund, which could be used to support the provision of additional accommodation in the wider area equivalent to 1,000 spaces.

27.2.4 The socio-economic assessment also considered the potential impacts on the full range of public services including emergency services, health services, education, and leisure. Because of the worker profile, i.e. mainly single persons of working age, impacts on these local services are likely to be negligible. EDF Energy has nevertheless taken additional steps to ensure that any potential change or impacts would be mitigated. The proposed mitigation measures include on site provision of sports pitches and other amenities at accommodation campuses.

27.2.5 EDF Energy would also take measures to mitigate potential impacts to local communities. These measures include contributions to emergency service and health providers based upon the numbers of workers assumed for their area. For education it would include contributions towards additional school places should these be required; and for leisure, EDF Energy also plans to make contributions to enhance the local recreational facilities.

27.2.6 It is recognised that a concentration of workers could have an impact on the quality of life of some residents. Therefore EDF Energy is proposing a Neighbourhood Support Scheme for residents immediately around the HPC development site and a wider Community Fund to spend on local initiatives which would enhance the quality of life in local settlements. In addition, a Worker Code of Conduct would be implemented.

b) Operational Phase Impacts and Mitigation

27.2.7 The 60 year operation of HPC would also bring major benefits to the area. It is expected that it will employ around 900 people in normal operation, generating a contribution to GDP of £144 million per annum, wages of £30 million per annum, and indirect long term effects of £40 million supporting 360 jobs. It is estimated that around half of the employees will be initially recruited locally. By the time the plant is fully operational virtually the entire workforce are expected to live in the three districts of West Somerset, Sedgemoor and Taunton Deane. This will be of significant benefit to the area providing highly skilled and well paid jobs and injecting significant annual expenditure to the local economy.

27.2.8 In addition to this permanent employment there will also be regular outage periods (for essential maintenance works and refuelling of the reactors) which will bring a further temporary workforce of up to 1,000. The majority of this workforce would be likely to come from outside the area but will bring additional expenditure to accommodation providers and local businesses.

27.2.9 EDF Energy is also committed to enhancing benefits through work with schools to encourage young people to study STEM (Science, technology, engineering and mathematics subjects) through its Education Inspire Strategy (a strategy to invest in skills and employment in the area) and operating an apprenticeship programme for young people.

27.2.10 The HPC development will also include a Public Information Centre (PIC) which is expected to attract up to 250,000 visitors per year, which would make it the equal most popular tourist attraction (with West Somerset Railway) in the Somerset County Council area.

27.3 Transport

a) Construction and Operational Phase Impacts for the Road Network

27.3.1 The key transport impacts during HPC construction are expected to be related to severance and pedestrian amenity. Severance refers to the feeling of separation in a community caused by changes in traffic flow. Pedestrian amenity refers to the pleasantness of the journey by foot alongside a road.

27.3.2 The ES considers three representative years for the assessment of impacts a being:

- 2013 when HPC construction has commenced but all the associated development sites are not operational. At this stage park and ride and freight management facilities along with the temporary Induction Centre are operational at Junction 24, but the Cannington bypass is still under construction.
- 2016 is the assessment of peak construction impacts. At this stage all highway improvement measures are in place, including the Cannington bypass. Based on the workforce and freight movement profiles, the fourth quarter is the period when traffic impacts are likely to be at their greatest.
- In 2021 the HPC development site is fully operational and some of the associated development sites are being dismantled and removed. Junction 24 and Cannington park and ride are still operational. In addition some construction activity would still be ongoing on the HPC development site (mainly the construction of the Intermediate Spent Fuel Store and the final landscaping works). The quarter used for assessment is a combination with the worst case for freight movements and workforce.

27.3.3 Given that 2021 is not just an operational year, comment is made in the analysis about the likely effects when all construction activity ceases and there are just the operational staff on site. This occurs at the end of 2022.

27.3.4 During construction, there will be significant increases in flows on EDF Energy's designated HGV routes from Junction 23 and 24 of the M5 and onwards through Bridgwater. The route from Junction 23, uses the A38 Bristol Road and Western Way (Northern Distributor Road (NDR)) to the Quantock roundabout and then the A39 to Cannington. From Junction 24, the route uses Taunton Road and then Broadway before passing through the Quantock roundabout on the way to Cannington. These routes are all on 'A' roads with high existing traffic flows. Given the nature and character of the routes and the temporary nature of the peak construction phase, there is considered to be a significant impact on severance and pedestrian amenity. There would be some improvement to journey times through Bridgwater due to the proposed highway improvements package.

27.3.5 In 2013, significant impacts are predicted in Bridgwater but these would be less than in later years since there would be less construction workers required at this time. The Cannington bypass will be under construction and therefore all HPC construction traffic would be passing through Cannington resulting in a substantial impact. However, this will be for a limited period and once the bypass is constructed there will be significant benefits to the majority of the village inhabitants. The bypass would not only remove HPC traffic but also non-HPC traffic.

27.3.6 In 2021 the level of construction activity at HPC development site would be much less with only the ongoing construction interim spent fuel store and landscaping works remaining, and off-site the post-operational use of the associated developments including the dismantling, removal and reinstatement of some associated development sites. During this time, there would be still HGV flows in Bridgwater. Once the associated development sites have been removed and reinstated then there would be no material impacts on severance and pedestrian amenity. At this early operational stage of HPC, there would be benefits to journey times within Bridgwater due to the proposed highway improvements which would remain.

27.3.7 A number of road safety improvements are planned along the A38, A39 and Northern Distributor Road. In addition to the proposed highway improvements, EDF Energy propose to contribute to potential safety enhancements and pedestrian and cycle improvements within Bridgwater that Somerset County Council are progressing as part of their ongoing programme of improvements. In addition, the effects of the construction of the HPC Project would be monitored throughout and if any unforeseen impacts are identified then EDF Energy would work with the authorities to mitigate their impact.

27.4 Noise and Vibration

a) Construction Phase Impacts and Mitigation

27.4.1 The assessment of potential HPC construction noise impacts has used computer modelling to determine impacts at and around the site. The greatest potential for significant impacts is from short-term activities associated with the emergency access road construction and landscaping close to the southern site boundary. These activities could result in a slight noise increase at the nearest residential dwellings. These occurrences would however be of short duration and landscaping works to the south of the site early in the construction programme would help to reduce the noise impacts of subsequent construction activities.

27.4.2 Visitors to Pixies Mound could experience significant noise impacts due to road upgrading works during the construction phase. These impacts would be of short duration due to length of time to complete the road works and transient nature of visitor trips to the mound.

27.4.3 Potential construction noise impacts from the generation of road traffic on local public highways during HPC construction have also been assessed. The assessment was based on traffic modelling predictions during two key construction phase years, 2013 and 2016. The main public highway access routes in 2013, prior to construction of the Cannington bypass by EDF Energy, are expected to experience high numbers of heavy goods vehicles (HGV) movements to and from the HPC site. During this period, construction of a number of the associated development sites would also be on-going. The daily road traffic noise impacts would be most significant between the A39 and the HPC development site (through Cannington High Street and on the C182 Rodway). During night-time shift changes, when buses are transporting construction staff to and from the HPC development site, the most significant noise impacts would occur between the A39 and the HPC site between the hours of 05:00-07:00 and 23:00-01:00. Other areas which are predicted to be adversely affected by the change in hourly road traffic noise are along the A39, notably between Cannington and Bridgwater, and North Street and Broadway in Bridgwater, as well as the NDR.

27.4.4 The peak of the HPC construction workforce would be in 2016. At this time, HGV movements would also be significant. In the day time, the new bypass around the village of Cannington would provide a beneficial change to Cannington High Street and the C182 road (south of the bypass roundabout). The assessment of hourly traffic noise impacts takes account of the freight management measures which restrict the movement of HGVs associated with HPC construction. HGV movements will be prohibited entirely between the hours of 22:00 and 07:00.

27.4.5 Without mitigation, significant impacts are predicted to occur along the A39 between Cannington and Bridgwater, within Bridgwater, Williton and along the main route connecting the Williton park and ride site with the HPC development site (through Stringston and Stogursey). These impacts (occurring as a result of changes from current conditions) would be primarily a result of the existing very low number of vehicle movements along these routes during the night time period.

27.4.6 In recognition of the duration of the proposed HPC development construction and its effects on sensitive receptors in proximity to the adopted transport routes, EDF Energy has committed to a Property Price Support Scheme and voluntary Transport Noise Insulation Scheme to mitigate adverse impacts arising during construction. This insulation scheme would allow eligible residential property owners along affected highways to apply for either secondary glazing or new double-glazing with acoustic ventilation to be fitted. EDF Energy also plans to monitor noise levels at representative residential properties in the villages of Knighton, Shurton, Burton and Wick. In addition, residents would be able to contact a 24-hour noise complaints telephone number so that appropriate response steps could be investigated. These schemes would be offered irrespective of the significance of the noise impacts as determined through the impact assessment and demonstrate a fair and responsible action as a commitment to being a good neighbour.

27.4.7 Significant adverse vibration impacts are not anticipated as a result of construction works at the HPC development site or from construction related traffic on the highway network.

b) Operational Phase Impacts and Mitigation

27.4.8 Significant noise impacts are not anticipated due to the operation of HPC. However, during the operational phase significant traffic noise impacts could occur to residences along the proposed Cannington bypass and at Cannington cemetery. The voluntary Transport Noise Insulation Scheme proposed to help mitigate these impacts is described above.

27.4.9 Cannington bypass would continue to provide significant road traffic noise benefits to Cannington village.

27.5 Air Quality

a) Construction Impacts and Mitigation

27.5.1 During construction, prior to mitigation significant impacts from fugitive dust and PM_{10} may occur at amenity and recreation locations at human receptor locations (residential properties) in close proximity to the HPC development site including Doggetts Farm, Bishops Farm House and residences in Shurton Village. Best practice guidance control methods and other mitigation measures would be implemented to manage fugitive nuisance dust and PM_{10} emissions during the construction works.

27.5.2 Typical good construction practice methods and dust mitigation that would be implemented where appropriate to control fugitive dust and PM_{10} generation during the construction works include:

- vehicles carrying loose aggregate and workings to be sheeted during periods of dry and windy weather, or if dust emissions become a problem;
- implementation of design controls for construction equipment and vehicles and use of appropriately designed vehicles for materials handling;
- completed earthworks/stockpiles to be covered or seeded as soon as is practicable in order to stabilise surfaces (finished platforms would be covered, external slopes would be seeded and vegetated);
- use of mobile or fixed spray units to dampen surfaces as dictated by weather conditions;
- provision and use of wheel washing facilities at exits onto the public highway as well as procedures for effective cleaning and inspection of vehicles, which should include total vehicle washing and ticketing of vehicles;
- regular inspection and, if necessary, cleaning of local highways and site boundaries to check for dust deposits (and removal if necessary);
- use of dust-suppressed tools for all operations, and use of dust extraction techniques where available;
- ensuring that all construction plant and equipment is maintained in good working order and not left running when not in use; and
- regulating on-site movements to keep dust generating activities to a minimum.

27.5.3 A formal system would be put in place during the works which identifies the roles and responsibilities of site staff regarding the procedures to be applied to respond to any complaints relating to air quality. Site logs would be maintained, detailing any complaints received relating to air quality, investigations of the complaints, and the corresponding action taken including the response made to each complainant. The extent to which dust mitigation would be implemented on site during the construction works would be flexible and responsive, with additional measures introduced especially during particularly dust generating activities, particular weather conditions, or upon receipt of substantiated dust complaints or observations. Working practices would be systematically audited and revised where necessary in order to ensure fugitive dust impacts are mitigated to an acceptable level.

b) Operation Impacts and Mitigation

27.5.4 No significant air quality impacts requiring mitigation were identified with respect to human or ecological receptor locations during the operation (including commissioning) of HPC. This is because emissions from the plant would be limited in nature occurring, typically, for short lengths of time.

27.6 Soils and Land Use

a) Construction Phase Impacts and Mitigation

27.6.1 Prior to mitigation significant impacts on soil quality are predicted during construction due to vegetation removal, topsoil and subsoil stripping and stockpiling. To protect the physical condition of on-site soils during vegetation removal and soil stripping, access routes and working areas would be clearly delimited. Stripped and stored soil materials would be conserved for re-use during landscape restoration following construction for the creation of a variety of new wildlife habitats and agricultural land use. Measures that would be implemented include: segregation of topsoil and subsoil from other excavated materials, appropriate methods of stockpiling and criteria for cessation of works if prolonged wet weather conditions occur.

27.6.2 Habitats to be restored or created on site post-construction would include grassland, scrub, woodland, wetland and hedgerow. There would be monitoring of the condition of the soils which are placed within the restored areas over a minimum of three growing seasons (i.e. during the landscape planting establishment phase) to ensure that the aims of the landscape restoration strategy are achieved.

27.6.3 Prior to mitigation, significant impacts to field drainage within the HPC development site are predicted during construction due to disruption to the existing drainage infrastructure. Ahead of ground preparation works and soil stripping, inspections would be made of agricultural field drainage systems, both on site and adjacent to the site boundary. Inspections would assess whether any connections to adjacent drainage systems exist. If so, plans would be put in place to disconnect, block off and subsequently reinstate (as practical) adjacent drainage systems so as to prevent any waterlogging or flooding to off-site receptors from the HPC construction activities.

27.6.4 With these mitigation measures in place, impacts on soils, land use and agriculture during the HPC construction phase would not be significant.

b) Operational Impacts and Mitigation

27.6.5 Once the construction works are complete and both units operational, impacts on soil quality and soil profiles are predicted to be significant without prior mitigation. Impacts would arise from vehicle and plant activities during final landscaping in accordance with the landscape strategy. Mitigation measures would closely follow those to be used during initial site preparation works to ensure that there is minimal damage to soils due to the handling and removal of soils from stockpiles, soil transport, deposition and grading on previously stripped areas.

27.6.6 Prior to mitigation, significant impacts on field drainage as a result of disruption of drainage infrastructure or connections to adjacent agricultural drainage systems during restoration activities would be mitigated following those measures outlined for construction.

27.6.7 Normal operation of the HPC development would not prevent continued agricultural activity on adjacent land outside the boundary of the operational site and should not lead to any further impacts on soils and land use.

27.7 Geology and Land Contamination

a) Construction Phase Impacts and Mitigation

27.7.1 Construction of the sea wall, foreshore construction drainage outfall and temporary jetty will have an impact upon the geology of Hinkley Point. In particular the rock strata which are currently exposed in the cliffs at the northern boundary of the HPC development site will not be accessible due to the sea wall which is required to protect HPC from coastal erosion. The impact of the outfall and the jetty, will not be significant. Geological mapping survey has shown that the rock strata which are exposed at Hinkley Point are not unique and comparative or better examples which are accessible to the public exist along the coastline to the west.

27.7.2 There is no evidence of significant land contamination across most of the HPC development site and this reflects the previous agricultural land use. Within the north-east area the site (BDAE) localised contamination does exist principally in the form of asbestos containing materials (ACMs) and a small area of hydrocarbon contamination. Remediation of this contamination will be substantially complete prior to the commencement of construction of HPC. Remediation works will result in an overall beneficial impact with respect to land quality ahead of HPC construction.

27.7.3 As the geological units within the cliffs along the northern boundary of the HPC development site are fossiliferous, a watching brief would be maintained for identification of any finds of scientific importance during excavations associated with the cliffs. The foreshore along the northern boundary of the HPC development site is also fossiliferous, therefore, a pre-construction survey to identify any palaeontological finds of scientific importance is intended on the foreshore and intertidal wave-cut platform.

27.7.4 Materials arising from the construction works which are of suitable quality would be re-used for the proposed landscape restoration, and any unacceptable contaminated soils would be removed from site or remediated to render them suitable for use. It is intended to retain as much material on site for re-use as possible. Materials would be managed in accordance with a **Materials Management Plan**.

b) Operational Phase Impacts and Mitigation

27.7.5 Impacts associated with operational phase on the existing geology, or as a result of existing or potential land contamination are not considered to be significant and would be managed through legislative compliance, standard good practice and control measures.

27.8 Groundwater

a) Construction Phase Impacts and Mitigation

27.8.1 It will be necessary to dewater the deep excavations which are required for the foundations and below ground structures of HPC to create a safe working environment and allow construction works to progress under dry conditions. To do this, the groundwater level within the excavations will need to be lowered by up to 30m compared to current baseline conditions. Groundwater levels would be affected over a period of several years, leading to localised drawdown (a depression in the natural groundwater level).

27.8.2 It is anticipated that the influence of this drawdown will reach outside the HPC development area into the north-western part of the neighbouring HPA power station site. However, it is not anticipated that the dewatering will result in significant groundwater contamination being drawn into the dewatering zone for HPC.

27.8.3 There would be no significant increase in the salinity of groundwater as a result of dewatering, except immediately between the HPC development site excavations and the Bristol Channel.

27.8.4 Groundwater which is collected during dewatering will be discharged under controlled conditions to the Bristol Channel. Monitoring of the levels of contamination will be undertaken and treatment prior to discharge will be carried out if necessary to meet the requirements of an environmental permit that will be regulated by the Environment Agency.

27.8.5 Groundwater modelling has indicated that there will be no significant impact on groundwater levels away from the HPC development site to the west, south and south-east. Groundwater abstractions will not be affected and surface watercourses within Wick Moor (which is part of the Bridgwater Bay SSSI) are not anticipated to be subject to any reduction in flows due to dewatering activities. However, as a precautionary measure, EDF Energy has agreed with the Environment Agency to undertake a groundwater monitoring programme during construction.

b) Operational Phase Impacts and Mitigation

27.8.6 A passive drainage system would be installed during the construction phase that would control groundwater levels over the operational lifetime of the HPC. The influence of this drainage system (which will be regularly inspected and maintained) on groundwater levels will be localised and no effects outside the HPC development site boundary are anticipated. This system would discharge via the cooling water outfall.

27.9 Surface Water

a) Construction Phase Impacts on Surface Water and Mitigation

27.9.1 Bum Brook and Holford Stream are important water supply streams to the Bridgwater Bay SSSI and to freshwater wetland habitats which lie downstream and to the east of the HPC development site. Prior to implementation of mitigation, significant water quality impacts could result on these watercourses from:

- the generation of sediment-laden surface drainage water from a range of construction and earth working activities;
- surface drainage discharges with elevated concentrations of nutrients discharged into Holford Stream;
- discharges of low pH (acidic) drainage from rock stock piles into Holford Stream; and
- accidental spillages of chemicals, including hydrocarbons, during construction activities on the site.

27.9.2 The surface water drainage systems across all phases of the development will be fully compliant with applicable legislation, regulations and guidance and subject to environmental permitting. A key design feature of the construction phase drainage system is the inclusion of Water Management Zones (WMZ) to attenuate and treat to a suitable quality, water requiring discharge from the HPC development site into the local surface water features. A range of mitigation and controls would be implemented including the treatment of sewage effluent; measures to reduce the potential for sediment-laden water; and monitoring and treatment of surface waters for elevated nutrient concentrations, low pH and contamination through accidental spillages.

27.9.3 A range of techniques would be employed to reduce erosion and generation of sediment-laden surface drainage from newly excavated areas. These include locating stockpiles away from floodplains of surface watercourses where possible. Stockpiled areas would be ring fenced with either sediment fencing or sediment tubes to retain sediment run-off. Haul roads would be constructed for areas and routes of frequent plant movement and restrictions on traffic movements enforced so that there is no unnecessary access for vehicles or plant to areas of soft soils.

27.9.4 Main collection ditches that feed into settlement lagoons in the WMZs would be stone or geotextile lined to prevent bed erosion during periods of high flows. They would incorporate stepped weirs to encourage sediment settlement within the ditch. Temporary settlement lagoons to allow both the settlement of solids and attenuating flows.

b) Flood Risk during Construction and Operation

27.9.5 An assessment of flood risk to the development and arising from the development has been undertaken and reported in a Flood Risk Assessment (FRA). The FRA concluded that there is no significant flood risk to the development site during construction and operation and whilst there is the potential for occasional flood risk in the future (2100) of the main access road to the site, this would only be for a few hours during which time the site could be accessed by an alternative route.

27.9.6 Consideration of climate change predictions indicate that some local properties could be adversely impacted by flooding in the future due to the infilling of the Holford Stream valley. Predictive modelling for the year 2100 indicates that the levels of flooding would be increased slightly as a result of the HPC development. EDF Energy will develop an appropriate monitoring and compensatory management plan with the Environment Agency for managing potential flood risk impacts to third party receptors.

c) Operational Phase Impacts on Surface Water and Mitigation

27.9.7 Once HPC is operational, with the land restored, no significant impacts on surface water features are expected, particularly as the operational site would effectively be isolated from the local terrestrial surface water environment. Nonetheless, monitoring and maintenance of the drainage systems and surface water channels will continue during the operational phase.

27.10 Coastal Hydrodynamics and Geomorphology

a) Construction Phase Impacts and Mitigation

27.10.1 The construction components of the HPC development which have been identified as having a potential impact on coastal hydrodynamics and geomorphology are: positioning of the new sea wall; construction outfall drainage across the shore; construction, operation and dismantling of the temporary jetty; drilling of vertical shafts offshore for the cooling water intake and outfall structures; establishment of a discharge point for the fish recovery and return system; and dredging of the temporary jetty berthing pocket. Due to the short duration and localised nature of these activities, their impacts are assessed as being small in scale, or to interfere very little with the existing highly dynamic coastal processes (i.e. not significant).

27.10.2 Although no significant impacts are predicted due to the dynamic nature of the environment and protective measures included in the design, there are a number of best/protective practices which will be implemented during construction. These will include the use of pre-defined working zones only, limiting any damage caused to surface rock and seabed; restoring and remodelling disturbed features should this prove necessary and using 'microtunnelling' for the fish recovery and return system rather than excavating a route or laying pipe-work across the intertidal area. The main cooling water tunnels would likewise be tunnelled under the intertidal area and the seabed with no surface disturbance except at the locations of the intake and outfall structures themselves, several kilometres offshore. The effects associated with the temporary jetty and any associated dredging activities for the creation and maintenance of the berthing area for vessels are assessed as not significant.

b) Operational Phase Impacts and Mitigation

27.10.3 The operational components identified as having a potential influence on coastal hydrodynamics and/or coastal geomorphology are: the presence of the sea wall; the abstraction and discharge of cooling water; and the presence of cooling water intake and outfall structures on the seabed, including that for the fish recovery and return system. It is not anticipated that these features would have a discernable effect on the hydrodynamics and coastal geomorphology of the Inner Bristol Channel.

27.11 Marine Water and Sediment Quality

a) Construction Phase Impacts and Mitigation

27.11.1 No significant impacts on marine water or sediment quality are expected to occur during the construction phase. This conclusion reflects both the dynamic nature of the marine environment, with dominant tidal flows and high levels of suspended sediment, and the mitigation measures that are built into the design.

27.11.2 Even without mitigation, the assessment concluded that all discharges (of surface drainage, or groundwater, from temporary sewage works, commissioning test waters or accidental discharges) would not be significant. The assessment also concluded that excavation of the cooling water tunnels assuming the worst-case would still only have an impact of negligible significance.

b) Operational Phase Impacts and Mitigation

27.11.3 Potential operational impacts on marine water quality were considered insignificant even before mitigation. Thermal discharge (water that is warmer by 10-12.5°C than the intake water temperature) from HPC is arguably the most significant operational impact on marine water quality. For HPC operating on its own, the thermal discharge is assessed as being a minor impact, and if combined with the output from HPB, that impact is considered to remain the same. Nevertheless, monitoring of the thermal plume through the water column would be undertaken in the vicinity of the discharge point and at more remote monitoring locations.

27.12 Marine Ecology

a) Construction Phase Impacts and Mitigation

27.12.1 In terms of habitat loss, impacts are not predicted to be significant on intertidal and subtidal habitats, except for the potential significant impact of delivering rock armour for the sea wall construction. Landings of such material by sea going barge would be limited to a specific area to avoid sensitive habitats and minimise the area impacted.

27.12.2 Without mitigation, noise and vibration associated with piling was found by the assessment to pose a moderate, adverse impact on certain fish species and cetaceans (e.g. porpoises). An appropriate ‘soft-start’ protocol for piling would be adopted as a matter of precaution. Soft-start is the incremental increase in pile power over a set time period until full operational power is achieved. Once pile driving is initiated then the potential for physical damage effectively ceases as any fish within the zone of influence (ensonification) would move out of the area to avoid the increase in noise levels/pressure.

b) Operational Phase Impacts and Mitigation

27.12.3 There will be a need to route construction and commissioning discharges across the shore from a discharge point at the cliff face. Potential significant impacts could occur to intertidal habitats due to the disturbance from these discharges. In order to avoid areas of habitat that would be particularly sensitive to such flows, a number of possible outfall configurations have been tested in relation to biotope mapping. The route selected across the shore would avoid potentially sensitive and valuable biotopes.

27.12.4 Various waste waters will be discharged via the cooling water system, including, if necessary, residual biocides used to prevent the biological fouling of the cooling water circuits themselves. Without mitigation, a significant impact could occur due to the influence of the residual biocide on intertidal habitats. To mitigate this impact, a risk-based dosing strategy would be applied, limited to actual observation of need.

27.12.5 Species losses from the cooling water screens, without mitigation, were predicted as potentially significant for 14 species of fish, some of which are designated conservation species, and one crustacean. However, the combination of the introduction of a fish recovery and return system, the use of acoustic fish deterrent devices and an intake design that maintains a low intake velocity at all times, will reduce such impacts to a not significant level.

27.13 Terrestrial Ecology and Ornithology

a) Construction Phase Impacts and Mitigation

27.13.1 The proposals for HPC, including the early and final restoration landscaping, have been designed with consideration of existing sensitive ecological features, and include a wide range of measures to avoid or minimise potentially significant impacts on wildlife and to comply with protected species legislation. Extensive areas of new wildlife habitat will be provided.

27.13.2 One non-statutory designated site, the Hinkley County Wildlife Site (CWS) lies partly within the HPC development site. The habitats within this CWS include calcareous grassland (i.e. grassland growing on lime-rich soils), woodland, hedgerows and watercourses. The assessment of impacts during the construction phase concludes that the loss of part of the Hinkley CWS and of flower-rich calcareous grassland within the CWS, are likely to be significant. The landscape restoration proposals for the HPC development site include an extensive programme of habitat creation work. The habitats to be created would include calcareous grassland, woodland, wetland and hedgerows. Over time, these habitats would provide a significant ecological benefit to the site both in its own right and in relation to the Hinkley CWS.

27.13.3 A number of ecological measures have been incorporated as part of the iterative design process. Some measures have already been implemented, some would be implemented during the construction phase, and other measures would continue into the operational phase. Ecological measures include:

- management of hedgerows associated with the Green Lane to increase their biodiversity value;
- creation of areas of areas of woodland/grassland habitat mosaic near Benhole Lane And in the southern part of the development site;
- creation of small areas of wetland habitat, comprising ponds, and reedbeds adjacent to Bum Brook;
- collection of grass and wildflower seed from areas of calcareous grassland located within that part of the Hinkley CWS within the site during 2009 and 2010, for use during the restoration;
- planting of approximately 2.2ha of broad-leaved woodland planting, using a species-rich mixture of native whips and mature specimens, along the western part of Bum Brook at the beginning of 2011;
- planting of approximately 1.4ha of broad-leaved woodland/scrub on a created bund along the north-western boundary of the development site at an early stage of the construction phase. This would be connected to Green Lane and Benhole Lane by a retained species-rich hedgerow;
- seeding of a total of 25ha of arable land and/or improved pasture off-site with a native wildflower mix; and

- construction of a bat barn, erection of bat boxes and creation of bat hop-overs across construction haul roads. Design of the lighting strategy for the development site with reference to the Bat Conservation Trust's recommendations.

b) Operational Phase Impacts and Mitigation

27.13.4 Although no significant impacts are predicted on terrestrial ecology during the operation phase, a number of habitat creation and enhancement measures would be implemented. These measures are in many cases a continuation of measures implemented in the construction phase.

27.13.5 Once the site has been restored there would be monitoring of selected species and management of wildlife habitat to ensure that the biodiversity value is maintained over time.

27.14 Radiological

a) Construction Phase Impacts and Mitigation

27.14.1 The assessment has determined that there is no significant radiochemical contamination of soils within the HPC development site. Low levels of tritium (well below levels that would be of regulatory concern) have been found in groundwater samples taken from monitoring boreholes in the north-eastern area of the site close to the boundary with HPA. Predictive modelling has indicated that groundwater dewatering during the construction phase should not lead to a significant impact with respect to the quality of recovered groundwater that will be discharged to the marine environment.

27.14.2 Radiation doses to the construction workforce and members of the public during the construction phase will not be significant.

b) Operational Phase Impacts and Mitigation

27.14.3 The assessment considered the potential impact of discharges of radioactive liquids and gases and disposal of solid radioactive wastes during all routine operations of HPC.

27.14.4 The assessment considered the impacts of the discharges of radioactive gases and liquids from routine operation by identifying typical individuals who were representative of those receiving the highest radiation exposure as a result of the discharges and direct radiation. The radiation dose from the site is so small that it does not add measurably to their dose and is well below the regulatory dose constraints and far below the statutory dose limit.

27.14.5 The assessment found that the predicted short-term dose which accounts for the impact of large discharges made over shorter periods of time, is significantly less than that due to continuous long-term releases and again are significantly less than the relevant dose criteria.

27.14.6 Taking into account the discharges from the Hinkley Point Power Station Complex and HPC, the combined impact on dose levels is predicted to be well below the regulatory dose constraint.

27.14.7 The radiological impact on non-human species was assessed using internationally recognised methodology. The radiological impact on non-human species for continuous discharges was below relevant screening level and therefore the impacts are considered to be very low.

27.14.8 The facilities have been designed, and will be operated applying Best Available Techniques (BAT) so as to minimise the discharges of gaseous and aqueous effluents. BAT is the means by which an EDF Energy will operate HPC order to reduce and keep exposures from emissions into the environment as low as reasonably achievable (ALARA).

27.15 Landscape and Visual

a) Construction Impacts and Mitigation

27.15.1 The assessment acknowledges that the large scale nature of the development would have a significant adverse but temporary impact on landscape character and visual receptors during construction that cannot be completely mitigated by landscaping due to its scale.

27.15.2 The most significant landscape impacts would occur in the local landscape (Quantock Vale area) and site scale landscape character sub areas (in particular along the coastline and to the south of Green Lane), where HPC construction would lead to a locally significant loss of landscape features. However, the most valuable landscape features within the HPC development site, such as the locally prominent ridge of Green Lane or mature boundary vegetation, would be retained during construction. A temporary and significant adverse change in the local landscape and seascape character would occur.

27.15.3 Proposals for landscaping adjacent to the local settlements to the south of the site would also be implemented in the first phase of construction to provide early screening and reduce adverse impacts on the local community. These include temporary screening bunds along the north-western site boundary (during construction) and planting which would also be implemented in the early stages of construction to provide additional screening as soon as possible.

27.15.4 Construction machinery, including a number of tower cranes and other temporary structures of significant size, would lead to changes in views and affect the character of the local landscape and seascape. It would also have a significant temporary visual impact on viewers.

27.15.5 The most significant temporary visual impacts would be on the residents of Shurton, Burton, Knighton, Wick and local farms, and also on users of other elevated areas of landscape, such as the north-eastern summits of the Quantock Hills AONB. The temporary screening bund would offer some screening for Public Right of Way (PRoW) users to the west of the site during early phases of construction, and the early implementation of proposed landscaping in the southern part of the site would reduce visual impacts on the local residents.

27.15.6 The temporary visual impacts would decrease with distance (5km and above) but would still be significant in the southern areas of the Quantock Hills AONB and along the Burnham-on Sea to Brean Down coastline and would become minor adverse in more distant areas, including Exmoor National Park, Mendip Hills AONB and the coastline of South Wales.

b) Operation Impacts and Mitigation

27.15.7 Once the HPC development is complete the majority of landscape and visual impacts would decrease due to removal of construction machinery and restoration of the landscape. However, some significant impacts would remain in the local area due to the large scale of the completed HPC development which cannot be completely screened by landform or vegetation, particularly when viewed from elevated locations.

27.15.8 In the residential areas around the application site the visual impacts would remain significant, even though landscaping, including landform and vegetation, has the highest screening potential in these areas. Significant visual impacts would remain for users of PRoW along the coastline adjacent to the site due to the proximity of HPC. Some of these impacts would slightly decrease in the long term, when the planting proposals, including off-site mitigation measures, mature.

27.15.9 A localised area of significant visual impact would remain in the north-eastern part of the Quantock Hills AONB due to its high elevation and the angle of view.

27.16 Historic Environment

a) Construction Phase Impacts and Mitigation

27.16.1 Prior to mitigation a significant impact due to partial transformation of the setting of a Scheduled Monument, Wick Barrow (Pixies Mound) which is a prehistoric burial mound of Neolithic – Bronze Age date located to the east of the HPC site; is predicted. A **Monument Management Plan** has been prepared. It establishes the baseline condition of the monument and proposes a range of measures that will help to protect and preserve the surviving parts of the Scheduled Monument from long-term gradual deterioration. The level of interpretation information available to visitors to the monument will also be improved.

27.16.2 The majority of the heritage assets within the HPC development site would experience significant impacts during the construction phase. Due to the nature of the development and the medium to low importance of the archaeological remains, suitable mitigation would entail preservation by record. Preservation by record would comprise archaeological investigation and recording of specified site areas.

27.16.3 The following sites would be subject to set-piece excavation prior to their removal due to construction works: the Romano-British settlement; the middle-late Bronze Age enclosure; Bronze Age pottery assemblage; early Bronze Age cremation; possible burnt mound; the mid-late Iron Age settlement; and the medieval settlement.

27.16.4 Benhole Barn, Langborough Barn complex and Sidwell Barn (23) would not be retained, but would be preserved by record.

27.16.5 There would be partial loss of the east-west trackway Green Lane (known by EDF Energy as Green Lane) during construction which is considered a significant impact. The eastern section of the track that is to be removed would be preserved by record. Excavation and recording would also take place across the western section of the track where the track would be crossed by a temporary haul road. It is proposed that, where it is appropriate, optically stimulated luminescence (OSL) dating shall be used. The hedgerow and track way would be reinstated once the haul road has been removed.

27.16.6 The finds and records from the site would be archived in an appropriate museum. A programme of public outreach, a published booklet describing the archaeology and history of the site would be also undertaken in conjunction with Somerset County Council Historic Environment Service.

b) Operation Impacts and Mitigation

27.16.7 The HPC development would have a significant impact on the settings of certain designated heritage assets beyond the site boundary. These include Wick Barrow (Pixies Mound), Fairfield House and its registered park and garden located to the west of the HPC site, and Court House located on the East Quantoxhead Estate to the west of the HPC development site. There would be a lesser impact on the settings of Grade II Listed Buildings in Shurton and Burton and the Stogursey Conservation Area. The Quantock Hills (10km to the west of the proposed HPC site) are the location of many prehistoric sites. Although these sites are located at some distance from the HPC site, the development would have a significant impact on some of their settings.

27.16.8 Appropriate measures for the mitigation of impacts include screen planting and landscaping that has been designed to minimise visual impacts to the settings and preserve important views. The HPC site would not be fully screened but the landscaping and planting mitigation would soften the visual impact of the proposed development. In addition, the Scheduled Monuments on the Quantock Hills are at an elevation where it would be difficult to negate the visual impact to their setting.

27.17 Offshore and Intertidal Archaeology

a) Construction Phase Impacts and Mitigation

27.17.1 Significant impacts have been identified resulting from the construction of the temporary jetty. The combined footprint of the berthing pocket and piles for the jetty structure would remove less than 1% of the area of Holocene deposits identified during offshore surveys. Although the installation of the structures would represent a permanent impact of low magnitude, the importance of the deposits is high.

27.17.2 The mitigation of impacts to Holocene deposits will take the form of research and publication, to ensure preservation by record. Following the implementation of mitigation measures the residual impacts upon Holocene deposits during the construction phase would be reduced to not significant.

b) Operation Impacts and Mitigation

27.17.3 No impacts resulting from the operational phase of development have been identified on offshore or intertidal archaeology. This is because any scour pits associated with the proposed structures would not affect a potential wreck site and operational maintenance and dredging would be of a very low magnitude. The location of the proposed fish recovery and return system is on exposed Blue Lias bedrock and there are no recorded archaeological remains in the vicinity. Consequently no impact is predicted.

27.18 Amenity and Recreation

a) Construction Impacts and Mitigation

27.18.1 Amenity and recreation receptors (public rights of way (PRoW), sports and recreation facilities, public open space and open access land) could be affected by the HPC development, either through direct obstruction or disturbance (such as noise or changes in views), potentially detracting from the characteristics that give them their value for enjoyment in the first place.

27.18.2 During construction, all PRoW within the inner security fence of the HPC development site would be obstructed and public access would be prohibited for health and safety reasons for the duration of the construction works (i.e. for up to 11 years). During construction works on the jetty and sea wall, the West Somerset Coast Path which runs along the northern edge of the HPC development site would also be obstructed, for up to three years.

27.18.3 Mitigation measures would include the provision of a PRoW diversion route, wider network enhancements, and reinstatement of the West Somerset Coast Path on completion of the seawall. In addition, in response to request by local residents, a 13 hectare area of amenity grassland would be available to the public along a strip between the site and Shurton. As a result, a non-significant residual impact is predicted.

27.18.4 No loss or physical disturbance would occur to nearby areas of common land or any sports and recreation facilities during construction of Hinkley Point C. However, during construction of the temporary jetty and seawall, access to areas of the foreshore and offshore would be restricted. Given the limited extent of the foreshore and offshore areas affected, the presence of similar and as accessible areas immediately outside the area of exclusion, medium-term minor adverse impacts are predicted on angling, wildfowling and recreational boating.

b) Operational Impacts and Mitigation

27.18.5 During the operational phase, all PRoW within the HPC development site boundary would be permanently closed. This obstruction would result in a significant impact for about 4,700m of PRoW. Throughout the remainder of the construction site, PRoW would be reinstated on a rationalised pattern, as part of the landscape restoration. Several lengths of PRoW would be upgraded to bridleway to improve access to other recreational users such as equestrians and cyclists. In addition, several permissive footpaths and bridleways would be created and permissive access would be granted to land in excess of 100ha, forming a nature reserve between the permanent site and Shurton. As a result, a negligible residual impact is predicted for PRoW and a minor beneficial residual impact for equestrian use.

27.18.6 No loss or physical disturbance would occur to areas of Common Land, sports and recreation facilities or the foreshore and its associated recreational uses during the operational phase. However, the presence of the cooling water infrastructure offshore from the site would leave small areas of the estuary excluded from recreational boating and sailing. Given, the extremely small area excluded compared to the area available, a negligible residual impact is predicted.

27.19 Navigation

a) Construction Risks and Mitigation

27.19.1 Potential risks associated with the construction and dismantling of the temporary jetty and construction of the cooling water intake and outfall head structures would be managed through the implementation of an exclusion zone and possible use of a small patrol vessel.

27.19.2 Dredging plant used to create the berthing pocket for the temporary jetty would be routed for disposal off-shore at Cardiff Grounds. Through marine safety and management systems and the issue of a notice to Mariners, the potential risks of passage to other vessels in the area are considered to be low.

27.19.3 Construction of the jetty and cooling water intake and outfall structures could cause interference with the Lilstock range firing area exercises and training. However, the implementation of a communications management plan between EDF Energy and the MoD would ensure that any potential for significant disruption in use of the range would be avoided.

27.19.4 Presence of construction plant in the water at Combwich Wharf has the potential to interfere with, and pose a hazard to, commercial traffic and recreational users of the River Parrett. During the works, a temporary exclusion zone may be required to safeguard the passing of vessels subject to sanction by the Port of Bridgwater.

b) Operational Risks and Mitigation

27.19.5 Presence of the jetty has the potential to interfere with marine activities, however with appropriate signage this risk is considered to be low for most shipping and only a moderate risk is posed to commercial vessels.

27.19.6 The jetty would be used by vessels to import materials for construction and their presence and movement could pose a risk to navigation, however the jetty would be marked with navigational lights and a management system would be implemented to ensure vessels berth during suitable weather conditions and tidal conditions, and use appropriate anchorages.

27.19.7 The risk for the jetty and cooling water intake/outfall operations to interfere with the Lilstock Range firing area activities are not considered to be significant as a communications management plan would be implemented with the MoD.

27.19.8 The presence and movement of maintenance vessels for the intake and outfall structures and similarly, Combwich Wharf vessels and its berth would cause only minor periodic and short term interference and therefore present a low risk to the majority of marine activities. The risk to commercial vessels can be managed through:

- marking of structures and charted appropriately;
- the use of an exclusion zones, port directives, public notices and notice to Mariners;

- repositioning of anchorage areas and restricted access to recreational moorings during dredging operations; and
- traffic supervision, use of tidal windows and passage planning and berthing procedures.

27.19.9 In summary, all potential risks can be managed through good practice, previously established methods and lines of communication between EDF Energy and relevant parties.