Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Projects

Design and Access Statement (Onshore) (Revision B) (Clean)

Revision B
Deadline 3
May 2023
Document Reference: 9.3
APFP Regulation: 5(2)(q)

China Resources
Better Life Together

Masdar
A MUBADALA COMPANY

equinor

Title: Sheringham Shoal and Dugeon Offshore Wind Farm Extension Projects DCO Application Onshore Design and Access Statement (Revision B) (Clean)	
PINS no.: 9.3	
Document no.: C282-RH-Z-GA-00115	
Revision: B	
Date: May 2023	**Classification:** Final
Prepared by: LDA Design	**Approved by:** Sheery Atkins, Equinor
Date: 01/05/2023	

Contents

Glossary of Acronyms

AIS	Air Insulated Substation
AONB	Area of Outstanding Natural Beauty
DCO	Development Consent Order
DEFRA	Department for the Environment and Rural Affairs
DEP	Dudgeon Offshore Wind Farm Extension Project
DOW	Dudgeon Offshore Wind Farm
EIA	Environmental Impact Assessment
ES	Environmental Statement
ETG	Expert Topic Group
EU	European Union
GHG	Greenhouse Gas
GIS	Geographical Information System
HDD	Horizontal Directional Drilling
HVAC	High-Voltage Alternating Current
HVDC	High-Voltage Direct Current
km	Kilometre
kV	kilovolt

MCZ	Marine Conservation Zone
MW	Megawatts
NIC	National Infrastructure Commission
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
OS	Ordnance Survey
OSP	Offshore Substation Platform/s
OWF	Offshore Wind Farm
PEIR	Preliminary Environmental Information Report
PPG	Planning Practice Guidance
SAC	Special Area of Conservation
SEP	Sheringham Offshore Wind Farm Extension Project
SNS	Southern North Sea
SoS	Secretary of State
SSSI	Site of Sepcial Scientific Interest
UK	United Kingdom
UN	United Nations

Glossary of Terms

Dudgeon Offshore Wind Farm Extension site	The Dudgeon Offshore Wind Farm Extension offshore lease area.
Dudgeon Offshore Wind Farm Extension Project (DEP)	The Dudgeon Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
DCO boundary	The area subject to the application for development consent, including all permanent and temporary works for SEP and DEP.
European site	Sites designated for nature conservation under the Habitats Directive and Birds Directive. This includes candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas, and is defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017.
Evidence Plan Process (EPP)	A voluntary consultation process with specialist stakeholders to agree the approach, and information to support, the EIA and HRA for certain topics.
Horizontal directional drilling (HDD) zones	The areas within the onshore cable route which would house HDD entry or exit points.
Infield cables	Cables which link the wind turbine generators to the offshore substation platform(s).
Interlink cables	Cables linking two separate project areas. This can be cables linking: 1) 10 DEP South and DEP North 2) DEP South and SEP 3) DEP North and SEP 1 is relevant if DEP is constructed alone or first in a phased development. 2 and 3 are relevant in an integrated construction.
Integrated Grid Option	Transmission infrastructure which serves both extension projects.
Jointing bays	Underground structures constructed at regular intervals along the onshore cable route to join sections of cable and facilitate installation of the cables into the buried ducts.
Landfall	The point at the coastline at which the offshore export cables are brought onshore and connected to the onshore export cables.
Offshore export cables	The cables which would bring electricity from the offshore substation platform(s) to the landfall. 220 – 230kV.

Offshore scoping area	An area that encompasses all planned offshore infrastructure, including landfall options at both Weybourne and Bacton, and allows sufficient room for receptor identification and environmental surveys. This has been refined following further site selection and consultation.
Offshore substation platform	A fixed structure located within the wind farm area, containing electrical equipment to aggregate the power from the wind turbine generators and convert it into a more suitable form for export to shore.
Onshore cable corridor	The area between the landfall and the onshore substation sites, within which the onshore cable circuits will be installed along with other temporary works for construction.
Onshore export cables	The cables which would bring electricity from the landfall to the onshore substation. 220 – 230kV.
Onshore Substation	Compound containing electrical equipment to enable connection to the National Grid.
PEIR boundary	The area subject to survey and preliminary impact assessment to inform the PEIR.
Separated Grid Option	Transmission infrastructure which allows each project to transmit electricity entirely separately.
Study area	Area where potential impacts from the project could occur, as defined for each individual EIA topic.
Sheringham Shoal Offshore Wind Farm Extension site	Sheringham Shoal Offshore Wind Farm Extension lease area.
Sheringham Shoal Offshore Wind Farm Extension Project (SEP)	The Sheringham Shoal Offshore Wind Farm Extension onshore and offshore sites including all onshore and offshore infrastructure.
The Applicant	Equinor New Energy Limited.
Transition joint bay	Connects offshore and onshore export cables at the landfall. The transition joint bay will be located above mean high water.

1.0 Introduction

1.0 Introduction

1.0.1 This Onshore Design and Access Statement (DAS) has been prepared on behalf of the Equinor New Energy Limited (the Applicant) in support of the application for a Development Consent Order (DCO) for the proposed Sheringham Shoal Offshore Wind Farm Extension Project (SEP) and Dudgeon Offshore Wind Farm Extension Project (DEP).

1.1 Purpose of Document

1.1.1 This Onshore Design and Access Statement for SEP and DEP is prepared pursuant to Regulation 5(2)(q) of The Infrastructure Planning (Applications: Prescribed Forms and Procedures) Regulations 2009 (APFP Regulations) and forms part of a suite of supporting documents for the DCO application.

1.1.2 The purpose of this Onshore Design and Access Statement is to demonstrate how SEP and DEP will fulfil the requirement for good design as set out within the Overarching National Policy Statement for Energy (2011) and the emerging draft Overarching NPS for Energy (2021). It explains the design evolution of the onshore works to date and the considerations that will inform the detailed design of the final onshore works in a clear and structured way. This statement addresses the operational phase of SEP and DEP. It does not cover the offshore environment or the construction stages of the project, which are described in **ES Chapter 4 Project Description** (document reference 6.1.4) and the **Offshore Design Statement** (document reference 9.26).

1.1.3 This document also highlights the important role played by consultation and the way in which it has influenced the indicative layout and design of the proposed offshore works, including particularly Natural England, the MCA, the Norfolk Coast Partnership and the relevant local authorities.

FIGURE 1.1: Location plan

1.2 Document Structure

1.2.1 This report has been subdivided into the following sections:

- **Design Framework:** establishes how the project will fulfil the criteria of 'good design' through clearly defined vision and objectives.
- **Site Context:** an overview of the physical, environmental, social and cultural context of the onshore works.
- **Delivering Good Design:** establishes the key design principles for the onshore works.
- **Landfall Design:** summary and justification of the landfall design proposals relating to the cable route.
- **Cable Corridor Design:** summary and justification of the onshore cable corridor design proposals.
- **Substation Design:** summary and justification of the onshore cable corridor design proposals.
- **Conclusion:** Summary of the SEP and DEP onshore works design proposals.

1.3 Project Overview / Description

1.3.1 A description of the key components of the proposed SEP and DEP, as well as details of how the wind farms will be constructed, operated, maintained and decommissioned is provided in **ES Chapter 4 Project Description** (document reference 6.1.4).

1.3.2 SEP and DEP will each have a maximum export capacity greater than 100 megawatts (MW). The SEP and DEP wind farm sites are 15.8 kilometres (km) and 26.5km from the coast for SEP and DEP respectively at their closest point (refer to **Figure 1.1 and 1.2**).

1.3.3 SEP and DEP will be connected to shore by offshore export cables installed to the landfall at Weybourne, on the north Norfolk coast. From there, the onshore export cables travel approximately 60km inland to a new high voltage alternating current (HVAC) onshore substation near to the existing Norwich Main substation. The onshore substation will be constructed to accommodate the connection of both SEP and DEP to the transmission grid.

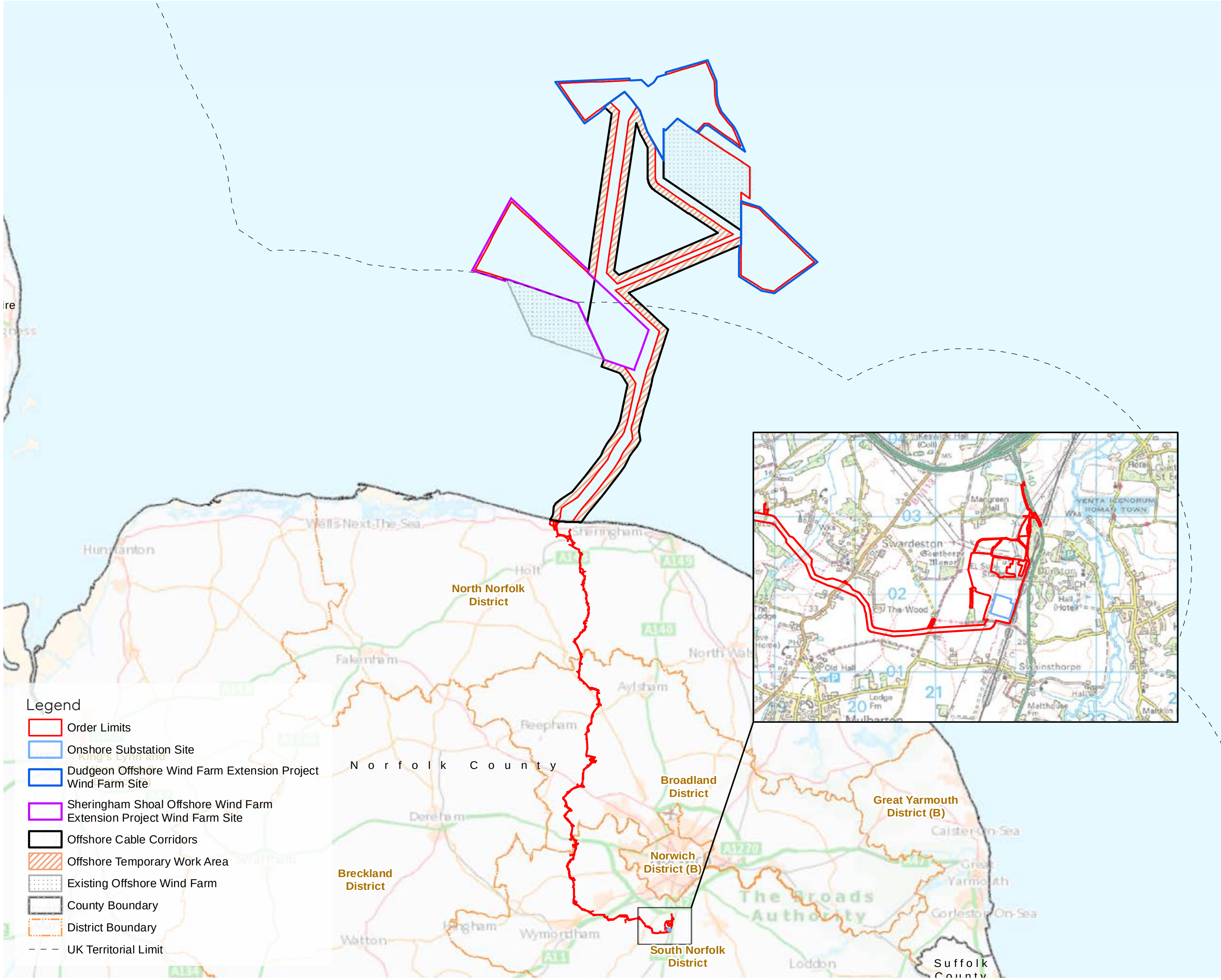


FIGURE 1.2: Overview of the project

1.3.4 The key offshore components comprise:

- Wind turbines;
- Offshore substation platform/s (OSP);
- Foundation structures for wind turbines and OSP/s;
- Infield cables;
- Interlink cables; and
- Export cables from the wind farm sites to the landfall.

1.3.5 The key onshore components comprise:

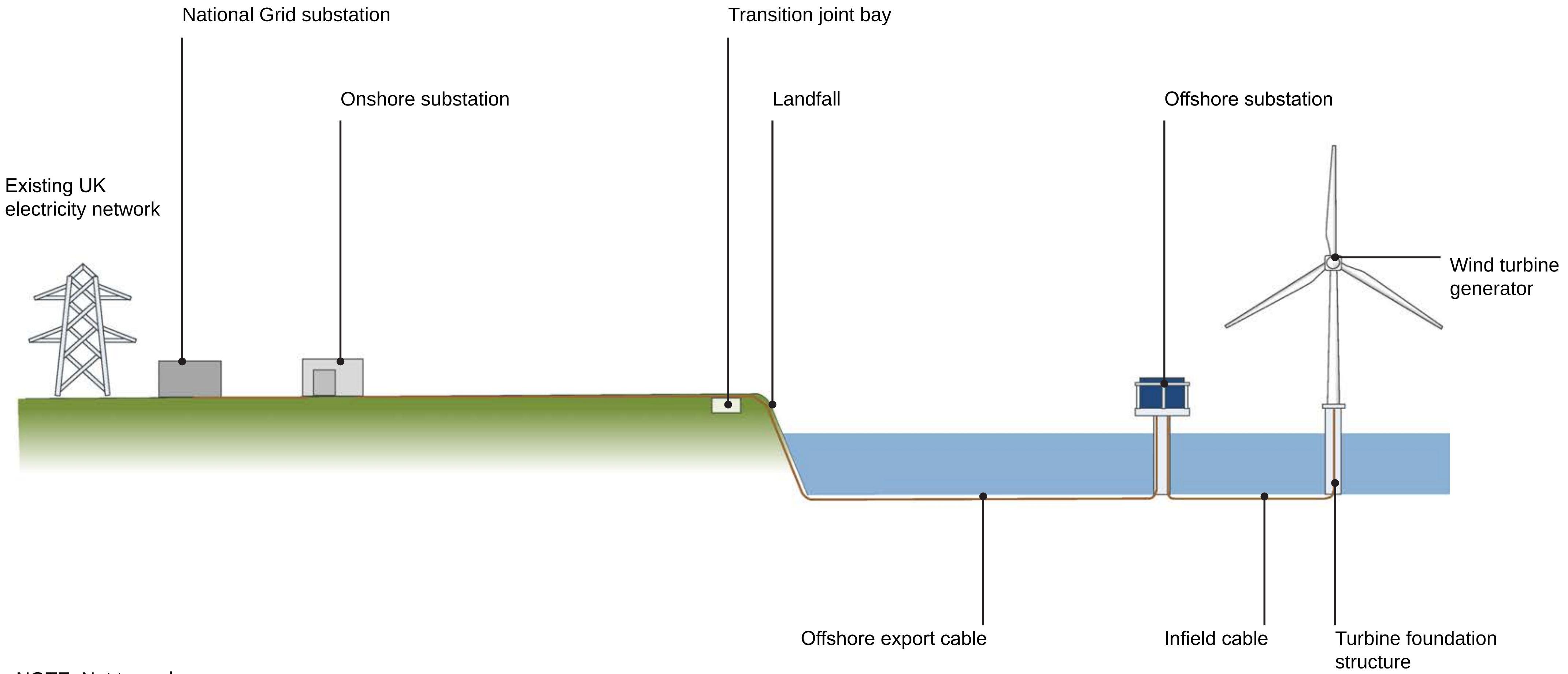
- Landfall and associated transition joint bay/s;
- Onshore export cables installed underground from the landfall to the onshore substation and associated joint bays and link boxes;
- Onshore substation and onward 400 kilovolt (kV) connection to the existing Norwich Main substation;
- Trenchless crossing zones (e.g. Horizontal Directional Drilling (HDD));
- Construction and operational accesses; and
- Temporary construction compounds.

1.3.6 An overview schematic of the key offshore and onshore project infrastructure is shown in **Figure 1.3**).

1.3.7 The onshore works are the primary focus of this document and are described in detail in the subsequent chapters.

1.3.8 The design proposals outlined in this Design and Access Statement are indicative but they are based on the maximum parameters set out in the DCO which would occur as a result of the maximum land take; longest durations of operation, and maximum height / size of development.

FIGURE 1.3 : Overview schematic of the key offshore and onshore project infrastructure



NOTE: Not to scale

1.4 Project Development Scenarios

1.4.1 As set out in the **ES Chpater 4 Project Description** (document reference 6.1.4), whilst SEP and DEP have different commercial ownerships and are each Nationally Significant Infrastructure Projects (NSIPs) in their own right, a single application for development consent is being made for both wind farms, and the associated transmission infrastructure for each. A single planning process and Development Consent Order (DCO) application is intended to provide for consistency in the approach to the assessment, consultation and examination, as well as increased transparency for a potential compulsory acquisition process.

1.4.2 The Applicant is seeking to coordinate the development of SEP and DEP as far as possible. The preferred option is a development scenario with an integrated transmission system, providing transmission infrastructure which serves both of the wind farms. However, given the different commercial ownerships of each Project, alternative development scenarios such as a separated grid option (i.e. transmission infrastructure which allows each Project to transmit electricity entirely separately) will allow SEP and DEP to be constructed in a phased approach, if necessary. Therefore, the DCO application seeks to consent a range of development scenarios in the same overall corridors to allow for separate development if required, and to accommodate either sequential or concurrent build of the two projects.

1.4.3 Reasons for the requirement to retain separate and phased (sequential) development scenarios alongside more coordinated approaches are further described in **Scenarios Statement** (document reference 9.28).

1.4.4 The range of development scenarios considered for SEP and DEP can be broadly categorised as:

- In isolation – where only SEP or DEP is constructed;
- Sequential – where SEP and DEP are both constructed in a phased approach with either SEP or DEP being constructed first; or
- Concurrent – where SEP and DEP are both constructed at the same time.

1.4.5 Whilst SEP and DEP are the subject of a single DCO application (with a combined Environmental Impact Assessment (EIA) process and associated submissions), the assessment considers both projects being developed in isolation, sequentially and concurrently, so that mitigation is specific to each development scenario.

1.4.6 In the concurrent development scenario there will need to be collaboration between the two projects to optimise construction logistics and to share certain temporary works such as the haul road and construction compounds. This applies to a concurrent build regardless of whether the transmission systems are integrated. The extent of coordination will be determined post consent.

1.4.7 Each of the development scenarios offer a range of benefits, with the preferred option particularly benefitting the planning and construction of the projects, being likely to reduce the overall environmental impact and disruption to local communities, and responding to concerns regarding the lack of a holistic approach to offshore wind development in general. For example, the preferred option would only require one haul road for construction activities, half the number of work fronts.

2.0 Design Framework

2.0 Design Framework

2.1 Project Vision

2.1.1 The **Project Vision** (document reference 9.27) sets out the vision and objectives for SEP and DEP.

> The Sheringham Shoal and Dudgeon Offshore Wind Farm Extension Project will double the generation capacity of the existing assets by 2030, making a meaningful contribution to the UK's offshore wind and decarbonisation targets.
>
> As a result of our long-term presence in Norfolk, Equinor has identified the need to take a coordinated approach to the development of the two projects, to minimise impacts on local communities and to maximise benefits for the area. As a result of this coordinated planning, the Project has proposed utilising a shared transmission asset through Norfolk, and has been selected as a Pathfinder project in coordinated offshore transmission development under the UK Government's Offshore Transmission Network Review. The design of the shared transmission asset will enhance the environment and create lasting value for local people and communities in Norfolk.

2.2 Design Objectives

2.2.1 Overarching Energy National Policy Statement EN-1 establishes the criteria for good design for energy infrastructure in its statement that (paragraph 4.5.1) "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

FIGURE 2.1 : Design objectives

an appearance that demonstrates good aesthetic as far as possible" and that (paragraph 4.5.2) "Good design is also a means by which many policy objectives in the NPS can be met, for example the impact sections show how good design, in terms of siting and use of appropriate technologies can help mitigate adverse impacts such as noise". The Statement requires the SoS (paragraph 4.5.3) "to be satisfied that energy infrastructure developments are sustainable and, having regard to regulatory and other constraints, are as attractive, durable and adaptable (including taking account of natural hazards such as flooding) as they can be. In so doing, the [SoS] should satisfy itself that the applicant has taken into account both functionality (including fitness for purpose and sustainability) and aesthetics (including its contribution to the quality of the area in which it would be located) as far as possible".

2.2.2 The National Infrastructure Commission (NIC) provide expert impartial advice to Government on major infrastructure projects. The NIC's Design Group has identified four principles to guide the planning and delivery of major infrastructure projects: Climate, People, Places and Value. These four principles have been used to develop design objectives for SEP and DEP. A fifth objective, Safety, has also been added to reflects Equinor's commitment to providing a safe and secure environment for everyone working at our facilities and job sites, as illustrated by **Figure 2.1**.

2.2.3 These objectives will ensure the project fits sensitively into the local context, mitigating and providing enhancements to community and environment where possible whilst achieving the requirements of energy production to help meet growing demand for low carbon energy.

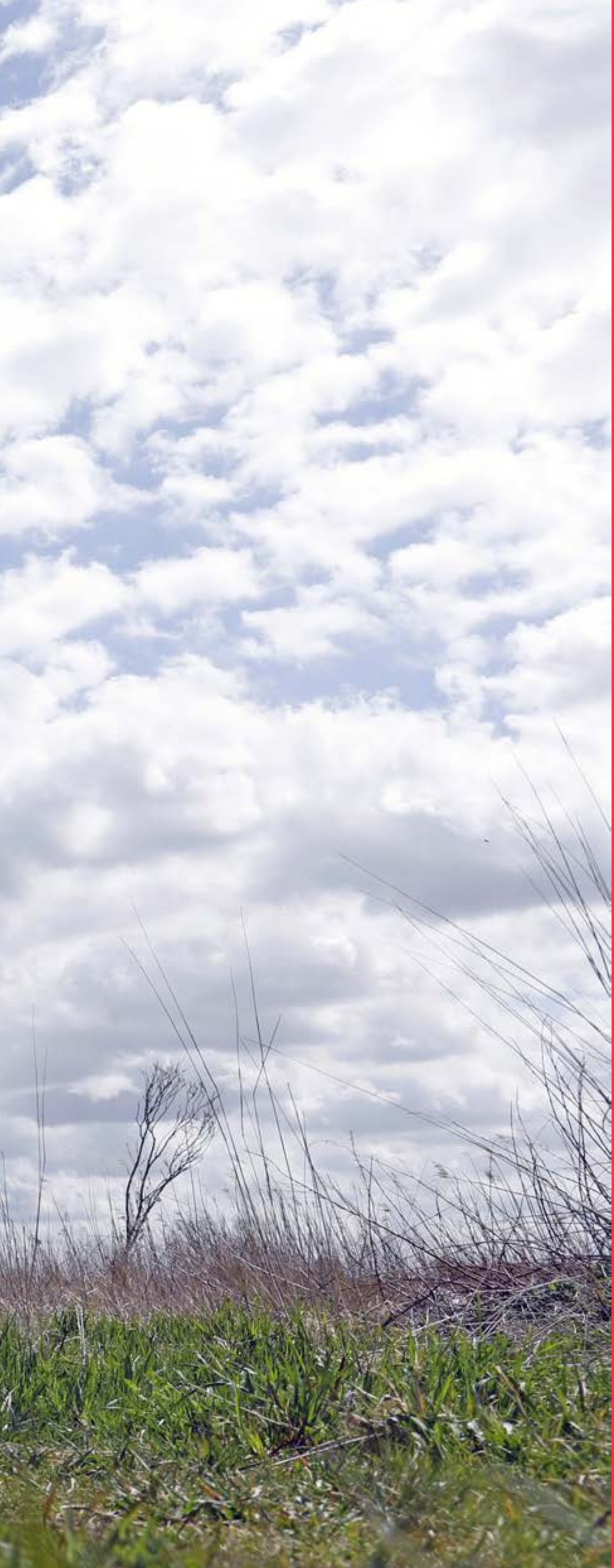
2.2.4 The following design objectives have been identified:

DESIGN OBJECTIVES	
SAFETY	
1	Always be safe and committed to preventing harm to people, to the environment and the communities we are a part of and comply with regulatory requirements in the construction, operation and decommissioning of the projects
CLIMATE	
2	Maximise generation capacity within constraints to positively contribute to the UK energy transition and net-zero target by 2050
3	Prioritise sustainable resource management and techniques and minimise carbon emissions throughout the project lifecycle
4	Design for resilience and adaptation to future climate change
PEOPLE	
5	Behave as a considerate neighbour through both construction and operation
6	Engage openly, transparently and meaningfully with stakeholders taking their feedback into account and making use of local knowledge to improve our projects
7	Be proactive and collaborative about developing local skills, jobs and employment opportunities throughout construction and operation of the wind farms

DESIGN OBJECTIVES	
VALUE	
8	Recognising the advancing nature of technology, coordinate project elements and their construction aim to serve multiple needs to maximise efficiency
9	Foster innovation and extend supply chain to leave a lasting legacy value for Norfolk and the UK
PLACE	
10	Protect the amenity of our neighbours and local communities and where possible enhance the environment and green infrastructure including protecting biodiversity and developing measures aiming to deliver Biodiversity Net Gain
11	Respond to the distinctive and unique character of the local landscape / seascape, including the Norfolk Coast AONB and views out to sea
12	Recognise and respect the history and settings of local historic and cultural assets

TABLE 2.1 : Design objectives

2.2.5 The project objectives and design objectives have set the framework for the development of SEP and DEP, and under which the projects will continue to evolve through detailed design work into construction and operation. More specific layout commitments and design principles have been considered for SEP and DEP, and these will guide the design of the onshore and offshore infrastructure for the projects.



3.0 Site Context

3.0 Site Context

3.1 Site Overview

3.1.1 The SEP and DEP wind farm sites are located in the Greater Wash region of the Southern North Sea (SNS), with the closest point to the coast being 15.8km from the SEP wind farm site and 26.5km from the DEP wind farm site. The onshore Order Limits cover a wide geographical area, extending approximately 60km inland from the North Norfolk Coast at Weybourne to a new onshore substation south of Norwich.

3.1.2 **Figure 3.1** shows the extent of the proposed onshore works, which would accommodate all the necessary land to build the onshore cable corridor and substation. A description of the site is provided as follows:

3.1.3 The offshore export cable would make landfall at Weybourne beach, to the west of Weybourne cliffs. From landfall, the onshore cable corridor travels south, crossing the A149, and the North Norfolk Railway line between Holt and Sheringham and continuing south to cross Cromer Road (A148) to the east of High Kelling. The cable corridor crosses underneath the commercial woodland (Weybourne Wood) to the south of the North Norfolk Railway line.

3.1.4 The cable corridor continues south, passing the villages of Oulton and Cawston and crossing the River Wensum near Attlebridge. It crosses the A47 between Hockering and Easton, before heading south east and crossing the A11 near Ketteringham. The cable corridor then continues to its preferred onshore substation site, which lies to the south of the existing Norwich Main substation.

3.1.5 The nearest settlements to the onshore works are Weybourne at the landfall, and Swainsthorpe at the substation. The onshore cable corridor passes in proximity to a small number of settlements including Little Barningham and Attlebridge.

FIGURE 3.1 : Extent of proposed onshore works

3.2 Landscape

3.2.1 The proposed onshore works are located within a landscape characterised by coastal and rural areas, incorporating the North Norfolk Coast; farmland and small settlements. The landform is typically flat or gently undulating with a long-settled agricultural character. The broadly arable landscape is enclosed by a combination of woodland, tree belts and hedgerows, which vary in size and frequency. There are also several areas of heathland throughout the landscape. Small to medium sized villages are typical, and isolated houses and farmsteads are frequent. Winding roads and lanes typically connect the settlements within the area.

3.2.2 National Character Areas (NCA) are shown in **Figure 3.2** and provide a broad overview of the landscape character across the county. Local character assessments are published by the local planning authority and provide a more detailed descriptions of landscape character. These are summarised in ES **Chapter 26 Landscape and Visual Impact Assessment** (document reference 6.1.26).

3.2.3 Within the extent of the Order Limits, the onshore works will interact with following designated landscapes (see **Figure 3.3**):

- **The Norfolk Coast Area of Outstanding Natural Beauty (AONB)** The Norfolk Coast AONB is a landscape of national importance with the primary purpose to conserve and enhance the natural beauty of the landscape. The onshore cable corridor runs through the Norfolk Coast AONB for approximately 4.8km.

- **Policy DM 4.5 – Landscape Character and River Valleys** A landscape of local importance, it aims to protect the distinctive characteristics, special qualities and geographical extents of the locally identified Rural River

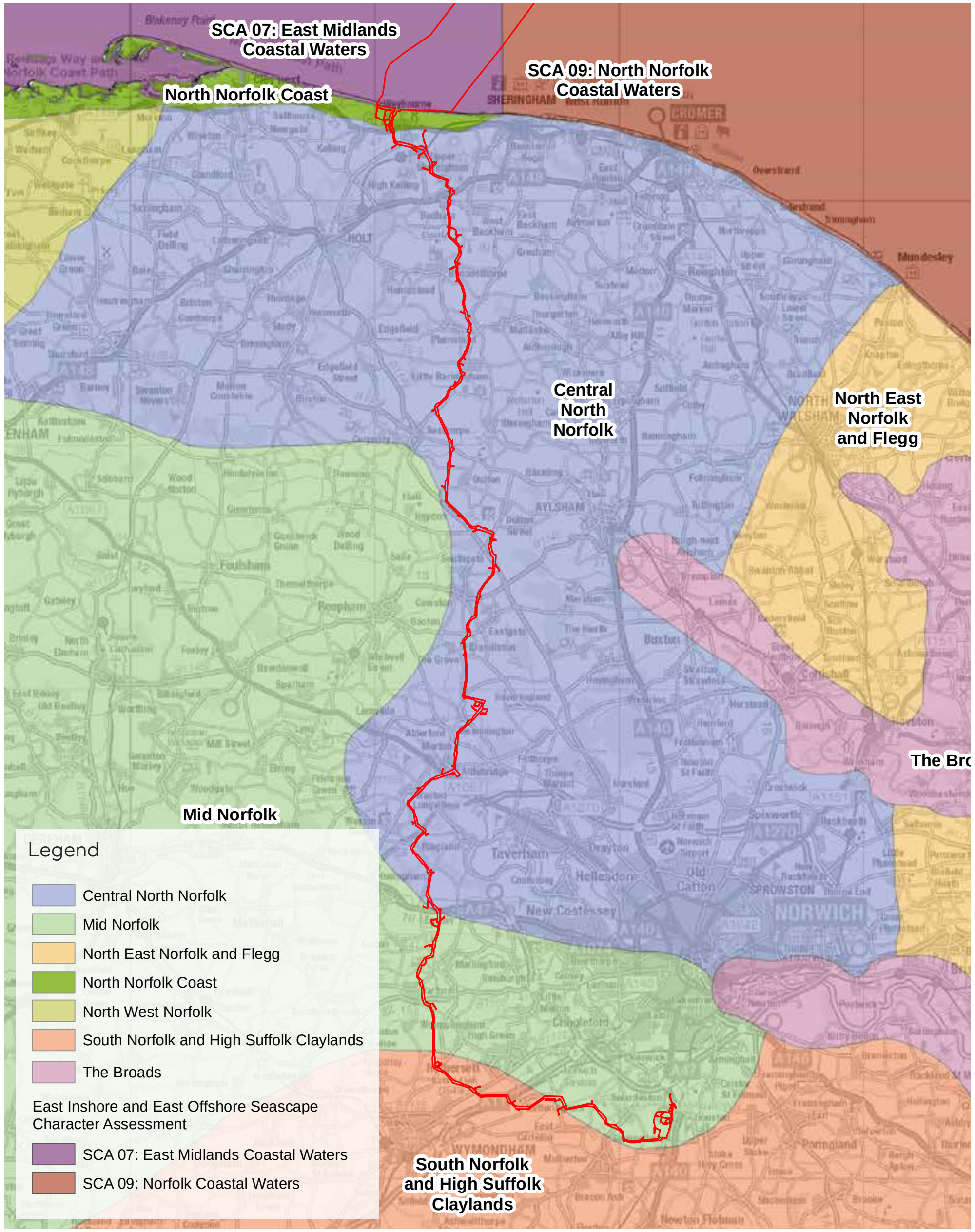


FIGURE 3.2 : National Character Areas

Valleys and Valley Urban Fringe landscape character. The onshore cable corridor would not significantly interact within this designated landscape.

- **Policy DM 4.6 – Landscape Setting of Norwich** A landscape of local importance, it aims to protect the openness of a zone around the Southern Bypass, avoid undermining the rural character of undeveloped approaches to Norwich and specific 'Key Views' of Norwich City. It is primarily a spatial planning or land use policy which is not intended to protect the inherent qualities of the landscape itself, but to protect landscape from the encroachment of new development. The onshore cable corridor would not significantly interact within this designated landscape.

3.2.4 Beyond the Order Limits lies the North Norfolk Heritage Coast (NNHC), which is located approximately 0.6km west of the onshore cable corridor on the coast. The NNHC is a non-statutory landscape definition, although it is recognised in the statutory planning system that this section of coastline as one of the finest stretches of undeveloped coast in England and Wales. NNHC objectives relevant to the project include:

- *"to conserve protect and enhance the natural beauty of the coasts, including their terrestrial, littoral and marine flora and fauna, and their heritage features of architectural, historical and archaeological interest;* and
- *to facilitate and enhance their enjoyment, understanding and appreciation by the public by improving and extending opportunities for recreational, educational, sporting and tourist activities that draw on, and are consistent with the conservation of their natural beauty and the protection of their heritage features." (Norfolk Coast Partnership Website, Dark Sky Discovery Sites webpage (accessed November 2021)).*

3.2.5 Further details of the existing landscape character and designations are provided in **Chapter 26 Landscape and Visual Impact Assessment** (document reference 6.1.26).

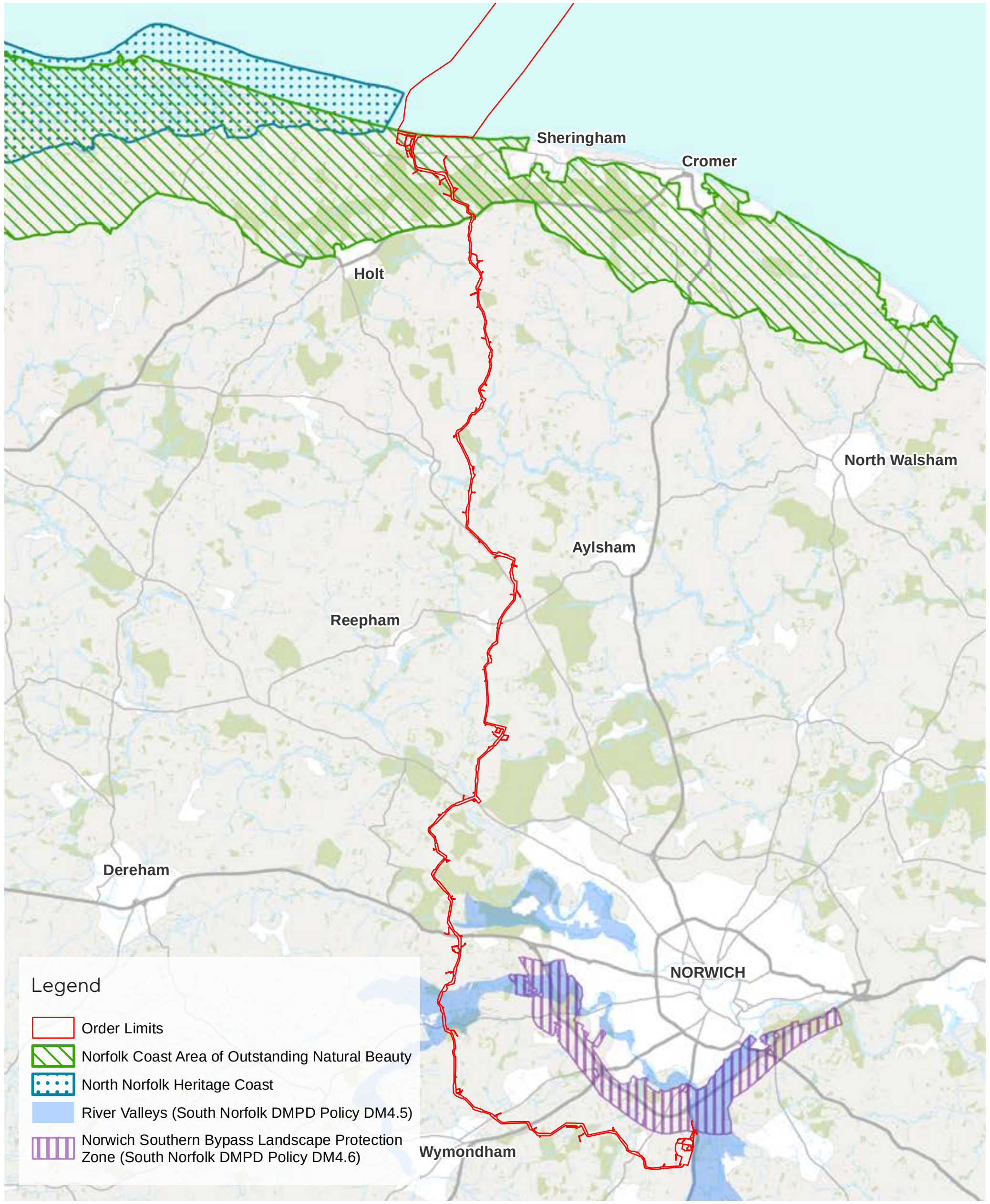


FIGURE 3.3 : Landscape designations

3.3 Terrestrial Ecology and Ornithology

3.3.1 The predominant habitat within the Order Limits is arable fields with most field boundaries marked by hedgerows. Some boundaries are marked by ditches (dry/seasonal and wet), verges/field margins, fences and tree-lines/shelter-belts. Arable fields are typically of low biodiversity value and are suboptimal for use by most protected and notable species. However, for ground-nesting birds such as skylark Alauda arvensis, arable fields do provide nesting habitat. Terrestrial mammals such as brown hares Lepus europaeus also use arable fields for foraging and shelter.

3.3.2 Other habitats within the Order Limits include woodlands, grasslands, ponds and chalk streams. Most woodlands are either semi-natural or plantation broad-leaved woodland, although there are some large blocks of conifer plantation woodland, namely at Weybourne Woods.

3.3.3 There are a small number of semi-improved neutral grasslands within the Order Limits and specifically within the landfall area. These grassland habitats are less common than improved grasslands and are considered to be of high sensitivity.

3.3.4 Some of the most diverse habitats recorded within the Order Limits are located along the river corridors of the Rivers Bure, Wensum, Tud, Yare and Tiffey and comprise a mosaic of grasslands, woodlands, scrub, hedgerows, ditches and ponds (amongst other habitats). All these rivers are either classified as chalk streams or are tributaries of/part of the same river systems as rivers which are classified as such.

3.3.5 Designated nature conservation sites located partly within the Order Limits include the Weybourne Cliffs SSSI and River Wensum SAC / SSSI (see Figure 3.4). Weybourne Cliffs SSSI is located at the North Norfolk coast and is designated principally for its geological and paleontological interest. Ecological interest is provided by colonies of sand martins Riparia riparia in the cliff face and fulmars Fulmaris glacialis on the cliff ledges.

3.3.6 The River Wensum SSSI and SAC also partially intersects with the Order Limits where the cable corridor crosses the river at Attlebridge to the north-west of Norwich. The river is primarily designated for the protection of special habitats and species including *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation and white-clawed crayfish *Austropotamobius pallipes*.

3.3.7 Other non-statutory designated nature conservation sites wholly or partially within the Order Limits, include nine County Wildlife Sites.

3.3.8 Protected species surveys established the presence or likely absence of various protected species throughout the Order Limits. Surveys recorded the presence of breeding and wintering birds, great crested newts Triturus cristatus, badgers Meles meles, bats (roosting and foraging/commuting), reptiles, otters Lutra lutra, water voles Arvicola amphibius and white-clawed crayfish at selected survey sites within, or in proximity to, the Order Limits. However, no signs of protected species presence were detected at many of the surveyed parts of the Order Limits (for example, great crested newt presence was not detected at multiple ponds, there were large sections of the Order Limits where no signs of badger presence were recorded etc.).

3.3.9 National Vegetation Classification and invertebrate surveys were completed at the landfall location where there was considered to be potentially high sensitivity for these receptors.

3.3.10 Further details of the existing ecology and ornithology are provided in **Chapter 20 Onshore Ecology and Ornithology** (document reference 6.1.20).

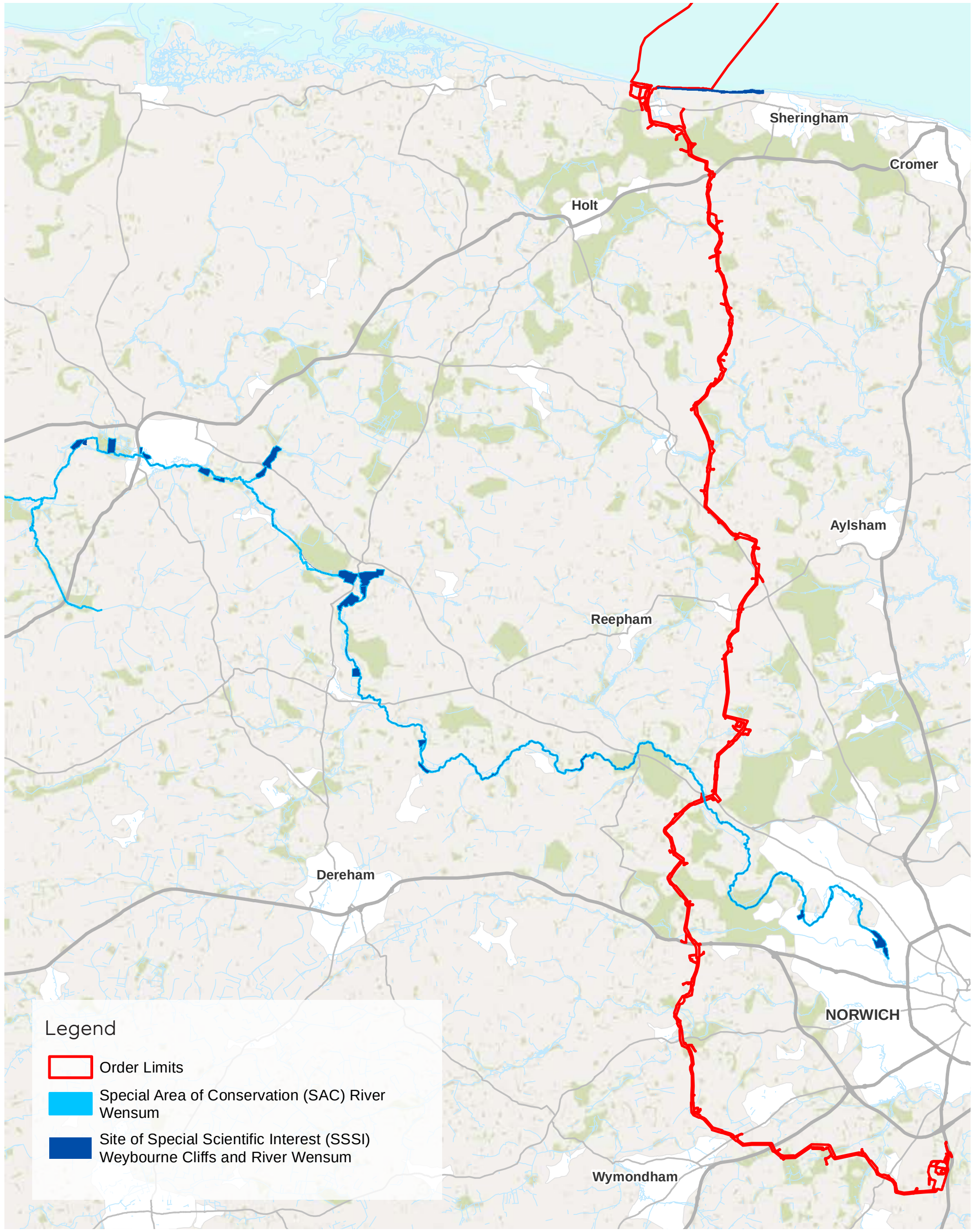


FIGURE 3.4 : River Wensum and Weybourne Cliffs

3.4 Historic Environment

3.4.1 The Order Limits falls within the western extent of Mannington and Wolterton Conservation Area; a large 'rural' Conservation Area set within the River Bure valley landscape. The Conservation Area incorporates the Registered Park and Garden of Mannington Hall and a number of Listed Buildings primarily centred around the villages of Mannington, Wolterton and Calthorpe (see **Figure 3.5**).

3.4.2 No other designated heritage assets are located within the Order Limits.

3.4.3 The character of the historic landscape is mostly related to the period of Enclosure during the 18th to 19th century mostly as a result of parliamentary planned enclosure. There are some links to the earlier history of the landscape, including the medieval moated site south-west of Weybourne, as well as a number of surviving historic structures relating to religious buildings (all out with the Order Limits).

3.4.4 The proposed onshore works pass through fields of distinctly modern agricultural character, with large fields that have developed since the period of Enclosure, most often amalgamated from smaller fields from the mid-20th century onwards. This predominantly arable landscape has provided an optimal environment for recording buried archaeological features in the form of cropmarks and for retrieving artefacts as evidence of potential buried archaeology.

3.4.5 The archaeological evidence within the Order Limits reflects a human presence from the Palaeolithic period to the present day. Finds and sites dating to the prehistoric period suggest that the area presented an environment suitable for exploitation during the Palaeolithic and Mesolithic period. The archaeological record suggests a prevalence of activities associated with subsistence, reflective of a nomadic existence of a hunter-gatherer lifestyle.

3.4.6 Activity of an increasingly sedentary nature is represented by the archaeological record from the Neolithic period onwards. The archaeological record also indicates the presence of military-related activity from the Romano-British period.

3.4.7 Settlement, agricultural and religious activities continued to dominate the archaeological record within the Order Limits from the Saxon period onwards. Agricultural activities continued to be the predominant activity during the medieval and post-medieval periods although evidence of a commercial and industrial nature is recorded within the towns.

3.4.8 Evidence of 20th century military activity and defence measures are also represented within the Order Limits, primarily towards the coast.

3.4.9 Further details of the existing historic environment and archaeological potential are provided in **Chapter 21 Onshore Archaeology and Cultural Heritage** (document reference 6.1.21).

FIGURE 3.5 : Historic environment


YH2442
239169

4.0 Delivering Good Design

4.0 Delivering Good Design

4.1 What is Good Design?

4.1.1 In United Kingdom the design of infrastructure projects is the subject of key policy documents and guidance notes, which have been used to help inform the principles of 'good design'. These include the Overarching National Policy Statement for Energy (2011), the emerging draft Overarching NPS for Energy (2021), the National Infrastructure Commission's 'Design Principles for National Infrastructure' report (2020) and NatureScot's Siting and Designing Wind Farms in the Landscape Guidance (2017).

4.1.2 Overarching National Policy Statements for Renewable Energy (EN-3) (2011) states that *"Proposals for renewable energy infrastructure should demonstrate good design in respect of landscape and visual amenity, and in the design of the project to mitigate impacts such as noise and effects on ecology."*

4.1.3 The draft Overarching National Policy Statement for Energy (2021) states that *"the visual appearance of a building, structure, or piece of infrastructure, and how it relates to the landscape it sits within, is sometimes considered to be the most important factor in good design. But high quality and inclusive design goes far beyond aesthetic considerations … [good design of 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."*

4.1.4 The draft NPS for Energy further highlights the need to consider good design from the early stages of a project stating that *"Design principles should be established from the outset of the project to guide the development from conception to operation."*

4.1.5 In line with the draft NPS for Energy this document sets out a series of design principles which have been used to inform the planning and design process to date and which will continue to inform the design at later stages of the project.

4.1.6 Further consideration of SEP and DEP compliance with the NPS is set out within the **Planning Statement** (document reference 9.1).

4.2 Sustainable design

4.2.1 SEP and DEP are expected to be operational for 40 years and will represent a significant contribution towards net zero targets over the majority of the lifetime of the projects.

4.2.2 The Applicant has undertaken a **Greenhouse Gas Assessment** (document reference 9.2) that provides a quantified assessment of greenhouse gas emissions over the lifetime of SEP and DEP.

4.2.3 The assessment considered emissions from the extraction and manufacture of materials, marine vessel and road traffic movements, and the use of plant and equipment.

4.2.4 Greenhouse gas emissions from construction, operation and decommissioning of the SEP or DEP. DEP in isolation are predicted to be 0.69 and 0.82 million tonnes of CO2e, respectively. Both SEP and DEP concurrently scenarios are anticipated to release 1.39 – 1.48 million tonnes CO2e, depending on whether the projects are concurrent or sequential. The largest GHG contribution to SEP and DEP is embodied emissions within materials to be used during construction, particularly in the offshore components of the project.

4.2.5 The greenhouse gas intensity of energy produced by SEP and DEP project anticipated to range between 8.9 to 10.2 g CO2e/kWh depending on the scenario constructed. This is around the midrange of previous studies for offshore wind farms and therefore the GHG payback of emissions is likely to be less than 1.1 years from when SEP and DEP start to produce electricity for the UK grid.

4.3 Consultation

4.3.1 The Applicant has undertaken an extensive programme of community and stakeholder consultation to inform the EIA process and the design of SEP and DEP. This has included consultation with Expert Topic Groups (ETG), as detailed in the ES topic chapters, where the design of various elements was discussed. As an example, the emerging design of the substation was discussed several times at the landscape ETG meetings.

4.3.2 **The Consultation Report** (document reference 5.1) provides full details of the consultation process and includes a description of key design decisions that have been made by the Applicant as a result of feedback received to dat. Details of how the Applicant has taken account of the comments received are also provided in each assessment topic chapter of the ES where relevant.

4.3.3 A summary of the most salient design decisions that have been made by the Applicant as a result of the consultation process relating to the onshore works are summarised below:

- The Applicant selected a landfall option at Weybourne to avoid impacts to The Cromer Chalk Beds MCZ.
- The applicant has committed to the use of long HDD at the landfall (exiting approximately 1,000m from the coastline) in order to avoid works such as trenching on the beach and cliffs and the complete avoidance of the sensitive outcropping chalk feature in the nearshore section of the Cromer Shoal Chalk Beds Marine Consultation Zone (MCZ). This was a particular concern of a number of stakeholders who expressed to avoid disturbance to the beach and cliff areas of the Norfolk Coast AONB.
- location of the onshore substation was subject to an extensive site selection process comprising technical and environmental assessment and consultation feedback. The site selection process began with a 3 km search area from the existing Norwich Main Substation, which was presented at scoping. Following a comparative assessment of a total of 17 options, the process identified five shortlisted fields for the onshore substation area. In response to phase one consultation feedback, and further environmental and technical assessments, the Applicant selected two preferred site options for the location of the onshore substation area. Following phase two consultation the Applicant selected the preferred onshore substation site (described in Section 7).
- Following feedback on the local sensitivities of Beach Lane and Beach Lane car park, the Applicant sought to avoid utilising these locations for construction traffic routing.
- Following feedback from the local authority and residents in the village of Cawston, the Applicant has committed to avoiding utilising roads through Cawston Village for HGV construction traffic.

- In response to feedback from stakeholders and the community on the need for environmental enhancements as well as mitigation, the Applicant has actively engaged with the landscape and onshore ecology ETGs to discuss its aim of delivering biodiversity net gain onshore.
- The Applicant has committed to locating the cable corridor away from local communities and business properties. The site selection process has looked to avoid sensitive areas wherever possible and where this has not been possible opted to minimise impacts by committing to trechless crossings (e.g. HDD through Weybourne Woods).
- Following feedback from consultees that utilising proposed access option from the B1113 would be unacceptable, the Applicant ruled out this access when refining its access options.

4.4 Onshore Design Principles

4.4.1 The following onshore design principles have been adopted during the design process in accordance with the Project Objectives outlined in **Section 2**. A description of each Design Principle is provided in **Table 4.1**.

- Coordinated Development
- Underground cables
- Avoidance of sensitive features
- Trenchless crossings
- Reduced working widths
- Landscape restoration
- Ecological enhancement

4.4.2 National Policy Statement for Electricity Networks Infrastructure (EN-5) (2021) refers to Section 4.5 of NPS EN-1 which sets out the principles for good design that should be applied to all energy infrastructure. Draft NPS EN5 also highlights the fact that the functional design constraints of safety and security may limit an applicant's ability to influence the aesthetic appearance of electrical infrastructure. Good Design including the avoidance and/or mitigation of potential adverse impacts has been applied in the design of the electrical infrastructure for the project wherever possible, albeit recognising the functional performance of the infrastructure in respect of security of supply and public and occupational safety must not thereby be threatened, as highlighted in the Draft NPS.

4.4.3 The following sections outline the design proposals for landfall, the onshore cable corridor and the substation design. They describe how the design has evolved, and will continue to evolve, in response to the site context, project requirements and the design principles.

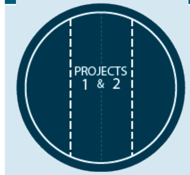
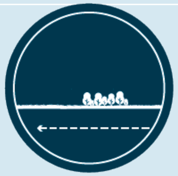
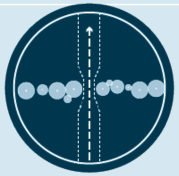
KEY DESIGN PRINCIPLES		
SYMBOL	**KEY PRINCIPLE**	**DESCRIPTION**
	Coordinated Development	The intention to coordinate the development of SEP and DEP as far as possible with the preferred option of developing the integrated electrical infrastructure system (providing transmission infrastructure which serves both of the wind farms) which would be constructed concurrently. This benefits the planning and construction of the electrical infrastructure system, is likely to reduce overall levels of environmental impact and disruption, and helps to respond to any concerns regarding the lack of a holistic approach to offshore wind development.
	Underground cables	Onshore cables will be buried to reduce the need for permanent above ground infrastructure, thus avoiding the visual intrusion of new pylons and overhead cables during the operational phase.
	Avoid sensitive features	Cable routing has been designed to avoid sensitive features including settlements, landscape and habitat features (including designated nature conservation sites), and designated landscapes, such as NNHC.
	Trenchless crossings	Trenchless crossing will be utilised to minimise disturbance to above ground features where it is not possible to avoid them
	Reduced working widths	Reduced work widths will be adopted to minimise disturbance to above ground features where trenchless crossings are not used.
	Landscape restoration	Where landscape features have been removed, they will be restored wherever possible.
	Ecological enhancement	Design proposals will seek to deliver a biodiversity net gain using the current Defra Metric. Compensation and enhancements which will achieve net gains for biodiversity will include reinstating habitats such as trees, hedgerows and grasslands where these are impacted during construction, infill planting of existing gaps in hedgerows and planting of trees and shrubs in suitable locations within the Order Limits (subject to landowner agreements).

TABLE 4.1 : Key design principles

5.0 Landfall Design

5.0 Landfall Design

5.1 Overview

5.1.1 Electricity generated by SEP and DEP will be brought onshore via subsea cables, which will reach the coastline at a point known as landfall.

5.1.2 The proposed location for landfall is at Weybourne, to the west of Weybourne beach car park near to the Muckleburgh Military Collection. This location was chosen following an extensive site selection process considering environmental and technical constraints which is described in **Chapter 3 Site Selection and Assessment of Alternatives** (document reference 6.1.3).

5.1.3 The landfall area of the Order Limits is shown on **Figure 5.1** and comprises a 1km stretch of coastline. The majority of this area is required for construction purposes with only a relatively small area (two adjacent areas of 26m x 10m) required for the operational easement of the joint transition bay.

5.2 Infrastructure

5.2.1 The cables would be installed in ducts under the beach using a horizontal directional drilling method (HDD). One HDD duct will be required for each of the SEP and DEP export cables. This technique has been selected by the Applicant to minimise any construction activity on the beach and to avoid any impact to the outcropping feature associated with the Cromer Shoal Chalk Beds MCZ and Weybourne Cliffs SSSI.

5.2.2 The offshore and onshore cables will be jointed together in one or two underground transition joint bays located approximately 150m inland, beyond any areas at risk of natural coastal erosion. This would comprise an excavated area of up to 52m x 20m (for the worst-case SEP and DEP sequential scenario) with a

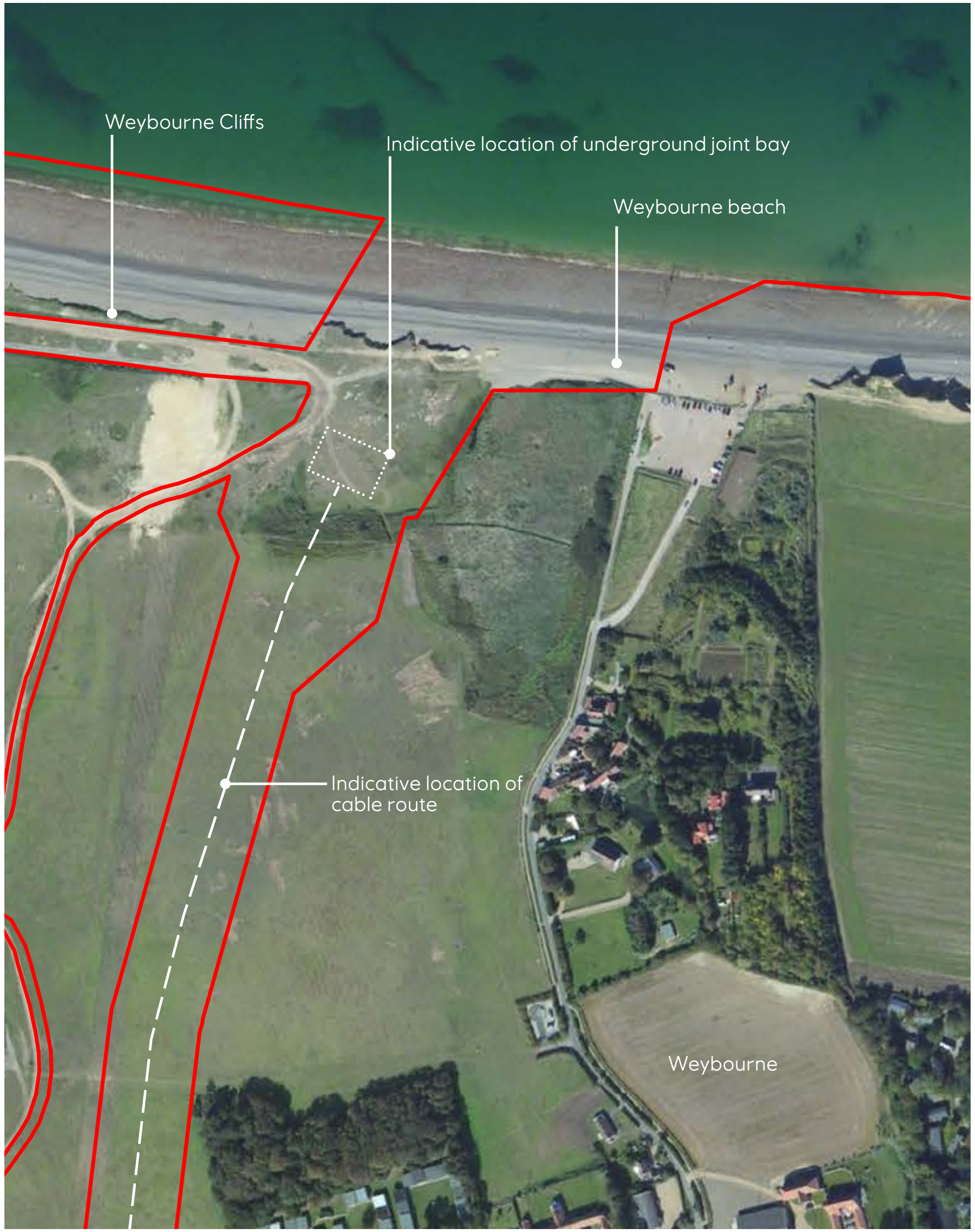


FIGURE 5.1 : Landfall location

reinforced concrete floor to allow winching during cable pulling and a stable surface to allow jointing.

5.2.3 Following construction activity (cable pulling and jointing), the joints would be buried to a depth of up to 3m using stabilised backfill, pre-excavated material or a concrete box. The remainder of the transition joint bay will be backfilled with the pre-excavated material and returned to the pre-construction condition, in so far as is reasonably possible. The transition joint bays would not be visible above ground during operation.

5.3 Landscape and Ecology

5.3.1 The primary (embedded) mitigation measure for avoiding direct impacts to the intertidal beach and Coastal Path has been avoidance through the use of HDD. The schematic section shown in **Figure 5.2** illustrates the indicative approach to HDD undergrounding at landfall.

5.3.2 During construction, some temporary disturbance will occur at the landfall compound located inland from the beach and Coastal Path. These areas will be backfilled with site won subsoil and topsoil and reinstated to pre-construction condition, in so far as reasonably possible following construction activity.

5.3.3 In areas comprising well-established and ecologically valued grassland swards that cannot be avoided by the footprint of the construction works, seeds or green hay from the existing and surrounding vegetation would be collected and spread once the works are complete. This is expected to be the best solution to reinstate affected areas of grassland, particularly at the landfall area where the coastal grassland generally consists of open, short turf.

5.3.4 Specific replanting specifications will be set out within the final Ecological Management Plan produced post-consent for each stage of the works, depending on the habitats that are being restored or created. An **Outline Ecological Management Plan** (document reference 9.19) has been prepared and is a submitted document **Table 6.1** in this document provides a list of typical native species likely to be included.

5.3.5 Further details relating to reinstatement of such habitats is provided in the **Outline Landscape Management Plan** (document reference 9.18).

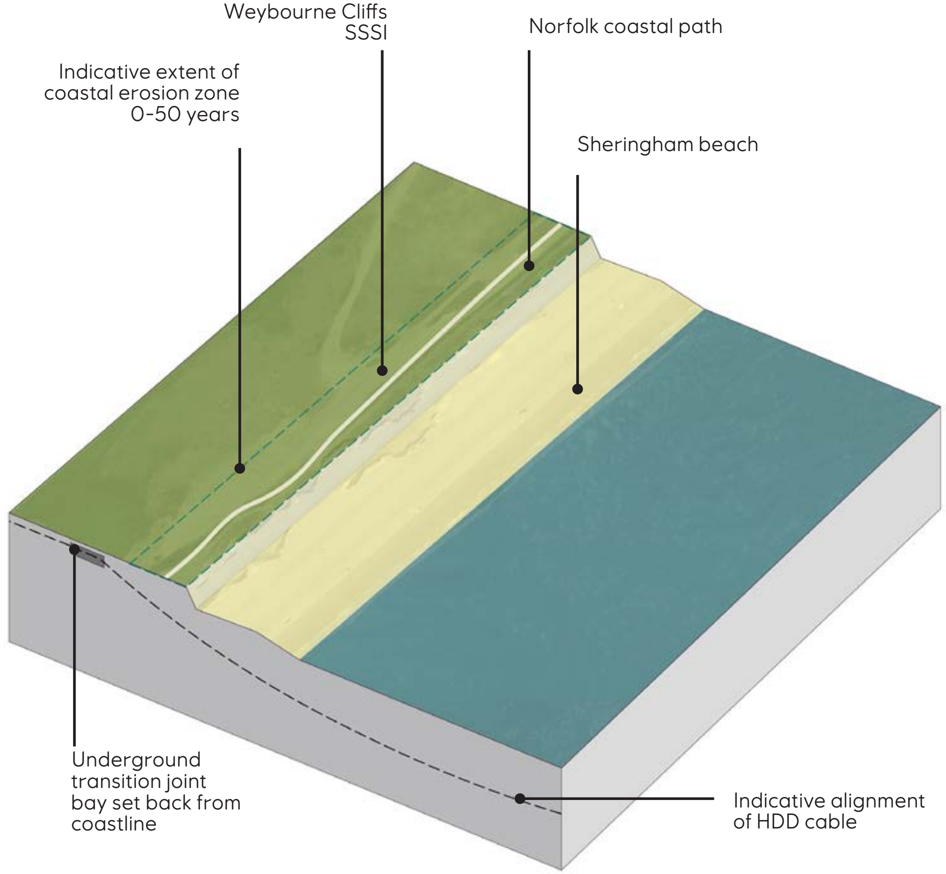


FIGURE 5.2 : Landfall illustrative axonometric

6.0 Cable Corridor Design

6.0 Cable Corridor design

6.1 Overview

6.1.1 The onshore cable corridor is required to transfer the electricity generated by SEP and DEP to a new onshore substation site south of Norwich.

6.1.2 The route of the cable corridor (**Figure 3.1)** has been subject to an extensive site selection process (see **Chapter 3 Site Selection and Assessment of Alternatives)**, which has sought to avoid settlements, sensitive habitats and other technical and environmental constraints where possible.

6.2 Infrastructure

6.2.1 The SEP and DEP export cables and associated fibres optic cables would not be visible during the operation, as they will be housed in ducts and buried a minimum of 1.2m below the ground. The appearance of the cable corridor (above ground) will be dependent on the installation method that is used (see **ES Chapter 4 Project Description**) and are described as follows:

- For open cut trenching, existing vegetation would need to be cleared during construction. One trench will be required per Project which will be backfilled with site won subsoil and topsoil following cable installation and reinstated to pre-construction condition, in so far as reasonably possible.

- For trenchless crossings (such as HDD), above ground features would not be disturbed for the length of drilling, albeit a temporary construction compound would be required at entry and exit points.

6.2.2 Joint bays would be required every 1km along the route of the onshore export cables to connect sections of cable. Joint bays would be installed at least 1.2m below ground and would be of a similar design to the transition joint bay described in Section 5. The joint bays would typically be up to 16m long and 3.5m wide, comprising a concrete raft floor, battered sides or sheet piled and a containerised enclosure. Earth mats will be installed within the joint bays to provide a low resistive connection to earth. The joint bays will be backfilled with cement bound sand (CBS) to ensure that the cables are stabilised from future thermo-mechanical movement. Following CBS backfill subsoil and topsoil would be reinstated above the joint bay, which would not be visible.

6.2.3 One link box per circuit is required in proximity (within 10m) to the jointing bay locations to allow the cables to be bonded to earth to maximise cable ratings, as described above. The link boxes would require periodic access by technicians for inspection and testing during operation. Link boxes, similar to joint bays, are typically constructed from concrete and buried below ground with an above ground marker post to locate them, and a secured metal access panel at ground level (see **Figure 6.1**). The below ground dimensions would be up to 2.6m x 2m x 1.5m.

6.2.4 Link boxes would not be required at all jointing bay locations but as a worst-case it is assumed that they could be required up to a frequency of one every 1km. The number and placement of the link boxes would be determined as part of the detailed design. Where possible, the link boxes would be located close to field boundaries and in accessible locations.

FIGURE 6.1 : Precedent image of above ground marker and access panel

6.3 Flood Risk

6.3.1 The onshore cable corridor will primarily cross through Flood Zone 1 (low risk of flooding from rivers or the sea), with some locations in Flood Zone 2 (medium risk of flooding) and 3 (high risk of flooding in any given year). Areas of flood risk are primarily associated with points along the cable corridor that cross watercourses, i.e. floodplains of rivers.

6.3.2 The use of HDD, or other trenchless techniques, has been embedded into the scheme design for Main Rivers (those managed by the Environment Agency) and those managed by the Internal Drainage Board, and as such the flood risk in these locations would remain low.

6.3.3 Trenched crossings will be carried out on other watercourses (which are typically agricultural drains) that are crossed by the onshore cable corridor. Any temporary damming and re-routeing of watercourses along the onshore cable corridor will be designed such that the original flow volumes and rates are maintained to ensure flood risk is not increased.

6.3.4 Once operational there will be no flood risk posed to the onshore export cables from sources of flooding.

6.4 Landscape and Ecology

6.4.1 From the outset, the Applicant has committed to a 'mitigation by design' approach to the design of the onshore works. This process has carefully considered a multitude of engineering constraints, environmental factors and feedback from the local community throughout the evolution of the design.

6.4.2 A key design decision, established at the outset of the Project, is to underground the export cables for the entire length of the onshore cable corridor between the landfall site at Weybourne and the Norwich Main substation, rather than install new pylons and overhead cables, which would be more visually intrusive during the operational phase.

6.4.3 A subsequent decision is to design the route of the underground cable to avoid sensitive features, such as crossing woodlands and areas or groups of trees, where possible. Settlements are also avoided to reduce potential visual effects and minimise (in so far as possible) possible disruptions to local residents during the construction period.

6.4.4 Where it is has not been possible to route the cable corridor around sensitive features – such as the crossing of the Norfolk Coast AONB, woodlands (including Weybourne Wood), local roads, railways and/or watercourses (including the River Wensum SSSI and SAC) – the cables would be installed via trenchless crossing techniques such as HDD (see **Figure 6.2**).

6.4.5 **ES Chapter 4 Project Description** (document 6.1.4) and **Appendix 6.1.4.1 Crossing Schedule** outline all of the onshore areas where the Applicant has committed to HDD, including where the cable route interacts with all significant woodlands within the Norfolk Coast AONB, and numerous smaller woodlands and areas of trees and scrub along the route of the cable corridor. The only exception would be the localised removal of vegetation at the HDD launch and reception pit and access routes within Weybourne Wood, where it is necessary, for engineering reasons, to clear a small area of vegetation to permit the safe installation of the onshore cables through this area (the HDD compound would be up to approximately 100m x 50m). Further details on the cable route within the Norfolk Coast AONB are set out below.

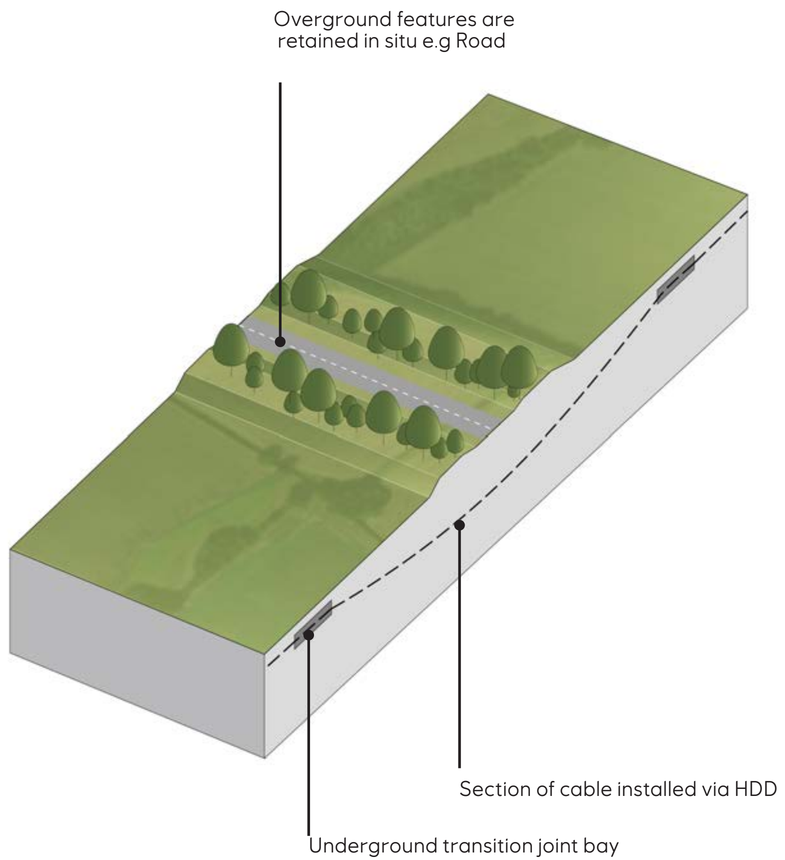


FIGURE 6.2: Approach to undergrounding of sensitive features (trenchless crossing)

Designing within the AONB

Where the cable corridor route passes through the Norfolk Coast AONB, the following design principles will be implemented, as described below and shown on **Figure 6.3**:

- Where the cable corridor is routed across open farmland, open cut installation techniques are preferred. These are deemed to be less intrusive (physically and visually) to HDD, which requires large entry and exit compounds (up to approximately 75m x 60m) during construction;
- The majority of open cut areas are located within areas of open arable land, and therefore can be easily reinstated, restoring the prevailing characteristics and nature of the landscape;
- Approximately 50% of the cable corridor within the Norfolk Coast AONB will be installed via trenchless crossing techniques in order to minimise any disturbance to the most sensitive landscape features. This will include crossing the beach and Coastal Path, the A149, Spring Beck and the road south from Weybourne, the North Norfolk Railway, Weybourne woods, and the A148;
- The use of trenchless crossings within the AONB is limited to 400m long sections. This is the maximum length of HDD that can be safely drilled within the underlying geology (comprising sands and gravels); and
- With regard to Weybourne Wood, due to its width (i.e. greater than 400m), an entry and exit compound is required within the woodland to ensure a safe trenchless crossing. As a result, some localised vegetation removal is required within the wood. The compound will be located in a less sensitive area of the wood, where approximately 60% of existing trees are either dead or dying (see **Chapter 20 Onshore Ecology and Ornithology** (document reference 6.2.20, **Appendix 20.15 Arboricultural Report**)). Following construction activity, this area will be converted to mixed scrub, which provides enhanced biodiversity relative to the existing conifer plantation.

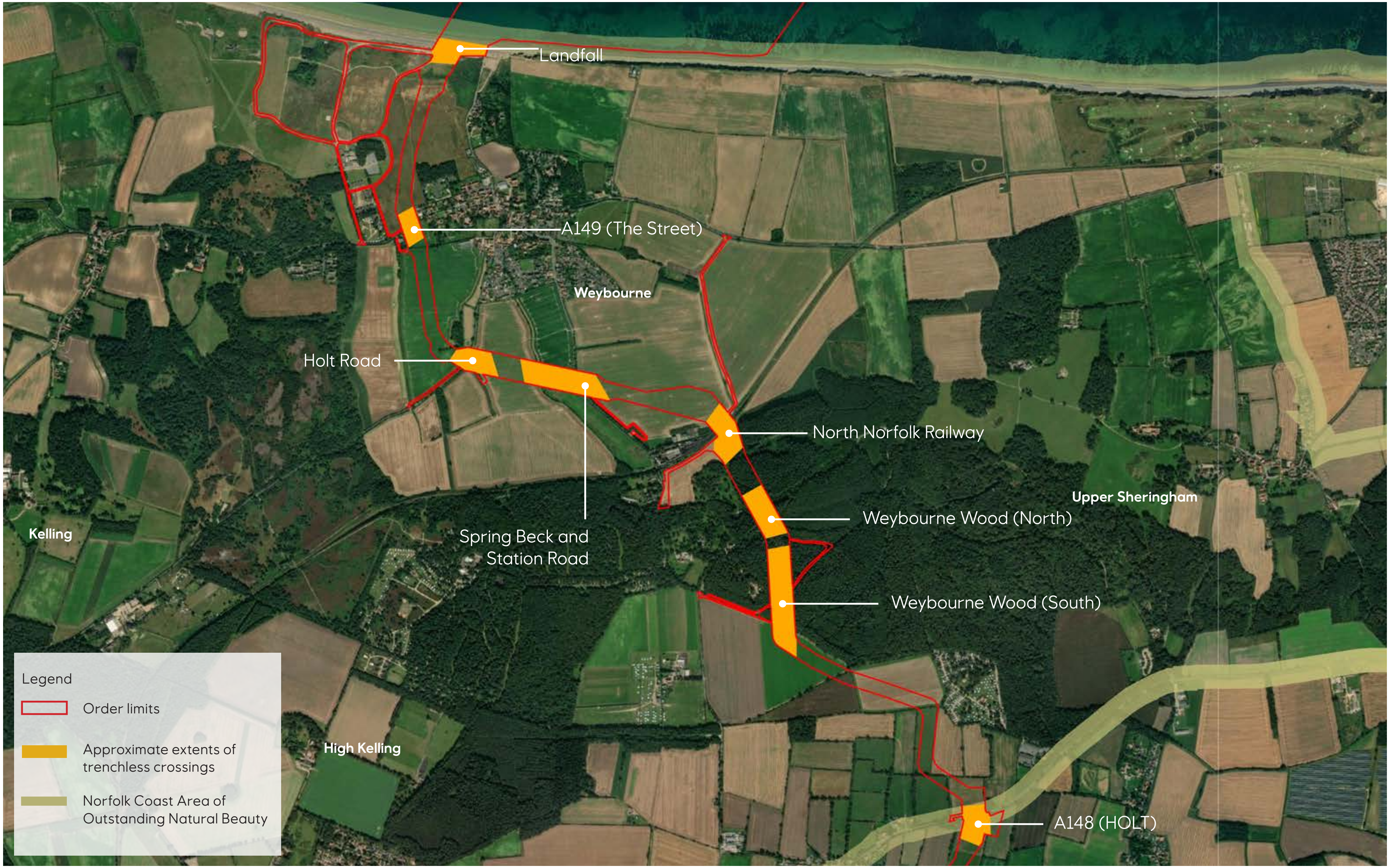


FIGURE 6.3 : Approach to cable routing through the AONB

6.4.6 Where cables are installed via open cut trenching, existing vegetation such as hedgerows, trees and field margin habitats would need to be removed within the temporary construction area. In order to minimise the loss of existing vegetation, the Applicant has committed to a reduced working width at field boundary crossing points (typically 20m wide for two projects and 12m wide if either SEP or DEP is constructed in isolation).

6.4.7 During the operational phase of SEP and DEP, a permanent easement would be maintained along the cable corridor. This would be 20m wide where both SEP and DEP are built (concurrently or sequentially), and 10m wide where only one Project is constructed. No trees could be planted above the buried cables within this operational easement, but other habitats and the existing previous land uses can otherwise be restored.

6.4.8 Restoration and enhancement of the construction corridor would be on the following basis (refer to **Figure 6.4**):

- Trees and woodland will be replanted within the construction corridor / Order Limits but outside the final permanent cable corridor easement;
- Hedges will be re-planted in all scenarios on their original alignment, wherever possible
- Where practicable and as agreed with the landowner, ecological enhancement will be undertaken within the construction working corridor. This would include new planting to infill existing gaps in existing hedgerows and create new hedgerows along currently un-hedged boundaries to create new habitats and improve habitat connectivity; and
- Areas of farmland will be reinstated to pre-construction condition to maintain the character and nature of the landscape.

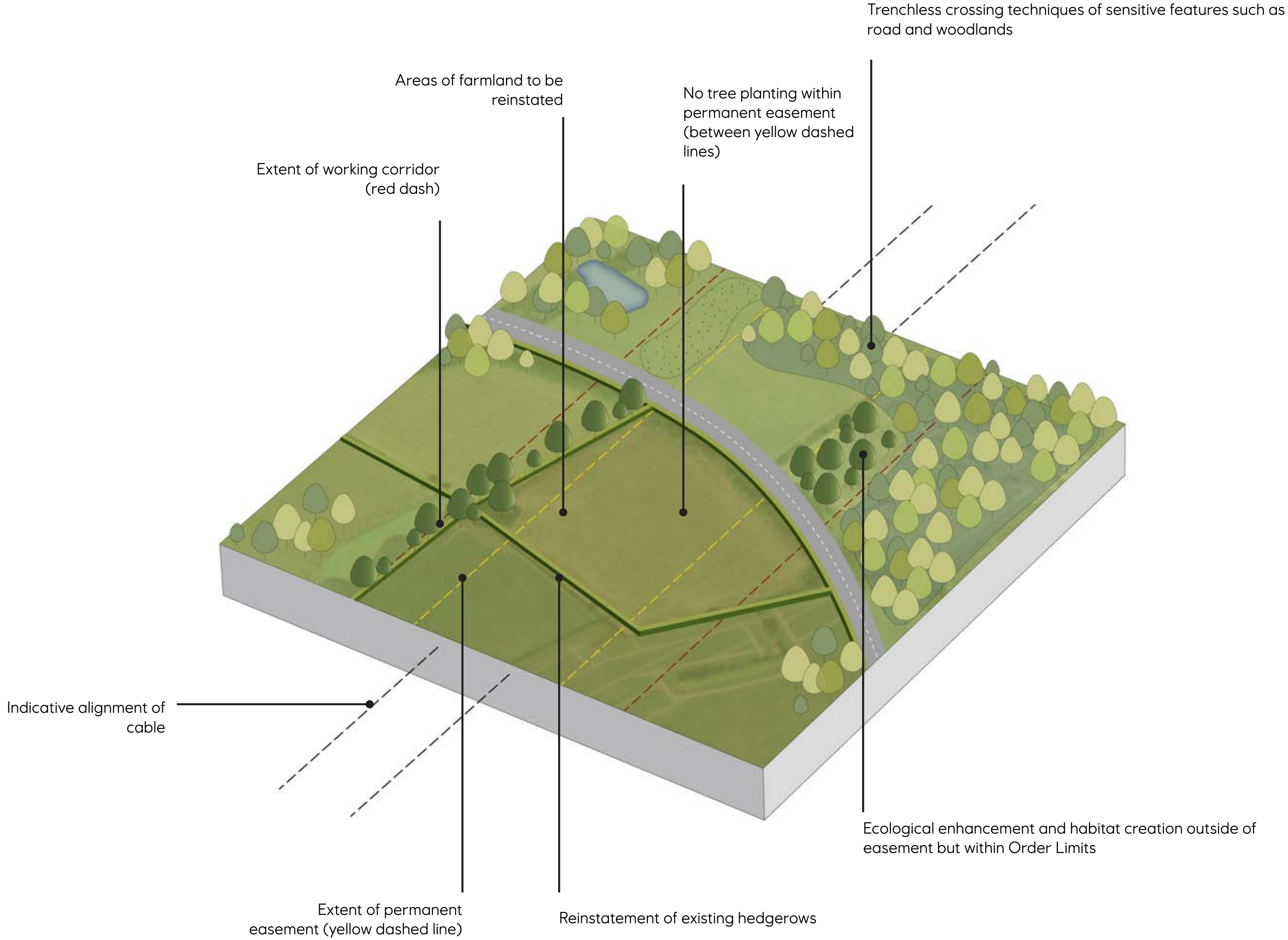


FIGURE 6.4 : Typical landscape treatment of the cable corridor

6.4.9 A suitable list for planting (that comprises UK and local provenance species) would be provided for each section of hedgerow or hedgerow tree to be reinstated, to ensure continuity and suitability. **Table 6.1** provides a list of typical native species likely to be included. It is likely that most replanting of hedgerow trees will use pedunculate oak (Quercus robur), although the species selected will depend on the species of tree being removed, with like for like replacement considered where ecologically suitable.

6.4.10 All planting would be implemented during the first planting season following the completion of entire construction of the cable installation works, of either DEP or SEP (subject to landowner agreements), whether constructed together or sequentially, and maintained for ten years.

6.4.11 Further details on hedgerow and tree removal, retention, replacement and management are presented in the **Outline LMP** (document reference 9.18) and **Outline EMP** (document reference 9.19) submitted with this DCO application.

TREE AND WOODLANDS	
LATIN NAME	COMMON NAME
Alnus glutinosa	Alder
Corylus avellana	Hazel
Crataegus monogyna	Hawthorn
Euonymus europaeus	Spindle
Ilex aquifolium	Holly
Malus sylvestris	Crab Apple
Prunus avium	Cherry
Prunus spinosa	Blackthorn
Quercus robur	Pedunculate Oak
Salix caprea	Goat willow
Silver birch	Betula pendula
Sorbus aucuparia	Rowan
Viburnum opulus	Guelder rose

HEDGEROWS AND HEDGEROW TREES	
LATIN NAME	COMMON NAME
Acer campestre	Field Maple
Cornus sanguinea	Dogwood
Corylus avellana	Hazel
Crataegus monogyna	Hawthorn
Ilex aquifolium	Holly
Malus sylvestris	Crab Apple
Prunus spinosa	Blackthorn
Quercus robur	Pedunculate Oak
Rosa canina	Dog Rose

NATIVE SCRUB	
LATIN NAME	COMMON NAME
Corylus avellana	Hazel
Crataegus monogyna	Hawthorn
Euonymus europaeus	Spindle
Ilex aquifolium	Holly
Malus sylvestris	Crab Apple
Prunus spinosa	Blackthorn
Rosa canina	Dog Rose
Viburnum opulus	Guelder rose

TABLE 6.1 : Indicative planting palette

7.0 Substation Design

7.0 Substation Design

7.1 Overview

7.1.1 The onshore substation is required to transfer electricity generated by SEP and DEP to the electricity transmission network, operated by National Grid.

7.1.2 The substation will be situated in arable land approximately 250m south of Norwich Main substation, immediately west of the Norwich to Ipswich rail line, and approximately 600m north of the nearest village (Swainsthorpe). The location of the substation site is shown in **Figure 7.1**.

7.1.3 The location of the onshore substation was subject to an extensive site selection process accounting for various technical and environmental constraints in accordance with National Grid's Guidelines on Substation Siting and Design ('The Horlock Rules'). The site selection process was underpinned by a series of design assumptions and site selection principles which were used as a transparent framework for making site selection decisions.

7.1.4 Full details of the site selection process are provided in **Chapter 3 Site Selection and Assessment of Alternatives** (document reference 6.1.3) and the **Onshore Substation Site Selection Report** (document reference 6.3.3.1), including the role of community consultation and feedback.

Site selection rationale

The preferred substation site was identified for the following key reasons:

- It provides a short distance for onward cabling for the 400kV cable connection to Norwich Main.
- The site is not located within any international and national designated areas.
- The site is located adjacent to existing infrastructure (Norwich Main substation, pylons and overhead wires, railway lines, the A140 and A47).
- The site is currently agricultural land of low biodiversity value.
- The site is located at a natural low point within the landscape, enclosed by mature trees and woodland, reducing visual impact to the Tas Valley (a locally designated landscape).
- There are few residential receptors in close proximity to the site.
- The site has been assigned a low perceived heritage significance.
- The site is accessible via the A140 and then Mangreen Lane (currently part of the operational access to Norwich Main).
- There was a slight preference for this site from community feedback due to its proximity to the A140 and the presence of existing screening features.

FIGURE 7.1 : Substation location and flood zone

7.2 Function

7.2.1 The onshore substation will be open terminal Air Insulated Substation (AIS) with two 220kV incoming export cable circuits from the offshore substation and a single (or double) 400kV outgoing circuit to the National Grid substation at Norwich Main. The import and export cables to the substation will be generally contained in underground ducts.

7.2.2 The main purpose of the substation is to step-up the electrical voltage (via transformers) to 400kV, suitable for connecting to the Norwich Main substation. The substation will also include equipment to facilitate protection, control and switching.

7.2.3 During normal operation, the substation would be unmanned, albeit routine maintenance activities would be required at an estimated average of one visit per week.

7.2.4 The substation would not require lighting during normal operation, although low level movement detecting security lighting may be utilised for health and safety purposes. Temporary lighting during working hours will be provided during maintenance activities only.

7.2.5 The operational lifetime of the onshore substation is expected to be 40 years for each project, but the substations could be in place for a total of a 44 years period if the projects are built sequentially and the substations are removed and site reinstated at the end of the life of the second project.

7.3 Layout

7.3.1 The substation platform is of sufficient size (6ha) to accommodate the maximum footprint required for both SEP and DEP and allow for different project development scenarios. If only one project comes forward the compound will be up to 3.25ha in size.

7.3.2 The layout of electrical infrastructure is driven by the technical and functional requirements of the substation and must be set out in sequential order in accordance with all electrical transmission systems. **Figure 7.2** shows an indicative layout for the electrical equipment.

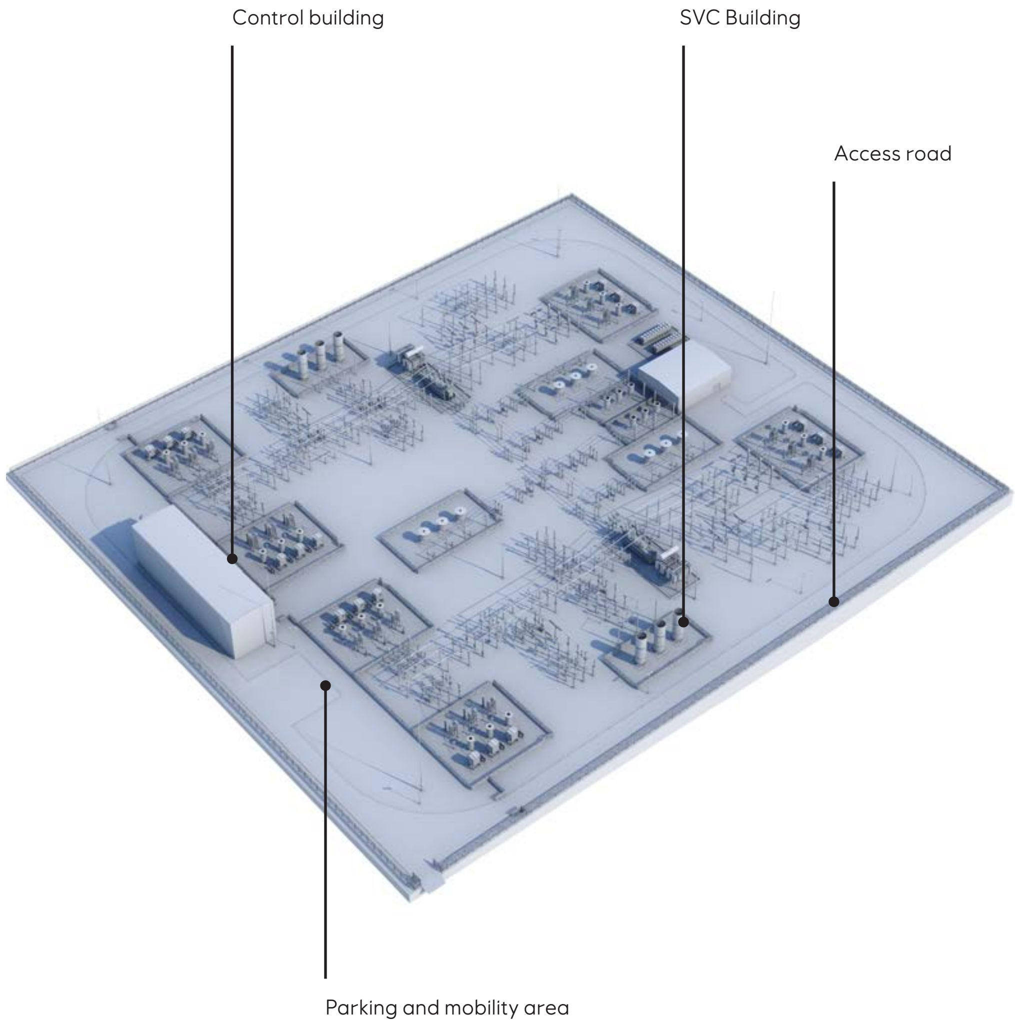


FIGURE 7.2 : Indicative layout of electrical equipment

Dudgeon substation

SVC building

Transformer

FIGURE 7.3 : Typical buildings and structures

7.4 Buildings and Structures

7.4.1 The onshore substation will be an AIS switchgear design, consistent with the existing Norwich Main substation, where the high voltage equipment is installed outdoors with open air terminations. The substation would compromise the following buildings and structures:

- Up to 2 Control buildings;
- Up to 2 Static var compensator (SVC) buildings if required;
- Transformers;
- Switchgear;
- Shunt reactors;
- Harmonic filters if required; and
- Associated connections between equipment via busbar and cabling, including lightning protection and buried earthing system.

7.4.2 All substation buildings will comply with technical standard NG TS 2.10.10 – 'GIS and Other Substation Building Design' with a minimum design working life of 40 years. **Figure 7.3** shows some precedents images of the types of buildings and structures proposed.

7.4.3 The largest buildings within the onshore substation will be the control building and SVC building with a maximum height of 15m. Both buildings are anticipated to be single storey, cube or cuboid shaped, with minimal external projections. This simple form is driven by the functional requirements of the substation and is typical of the building infrastructure already found at the Norwich Main substation.

7.4.4 The choice of materials for the proposed substation buildings is driven by their functional and structural requirements. The buildings are anticipated to comprise a steel framed structure, with roofs and walls constructed of prefabricated, insulated panels.

7.4.5 The tallest features within the onshore substation site will be the lightning protection masts at a height of 30m above ground level. These are included as part of the worst case scenario and are subject to detailed lightning protection study – they may not be required in the final design.

7.4.6 If required, acoustic enclosures would be installed around the transformers to mitigate potential noise impacts to residential properties.

7.5 Security Fencing

7.5.1 Security fencing is required around the perimeter of the substation to prevent unauthorised access onto potentially dangerous areas. The fencing will be robust, fit for purpose and comply with the following technical standards: National Grid TS 2.10.02 Generic Electricity Substation Design Manual for Civil, Structural & Building Engineering – Perimeter Security; and BS 1722-12 – 'Fences. Specification for steel palisade fences'. This is defined as a 3m high fence that can be either physical mesh or palisade barrier with electric pulse fence. Access into the substation will be through inward opening double swing gates of similar construction to the perimeter fence.

7.6 Colour

7.6.1 The final design of the substation will be informed by a colour study of the local landscape undertaken post-consent. The purpose of the colour study will be to inform the external appearance of the substation buildings and structures where it is

FIGURE 7.4 : Illustrative masterplan of onshore substation

reasonably practicable to so. This would include the identification of prominent colours within the existing landscape to inform a possible colour palette that could be applied to the substation design. It would support the integration of the substation into the local landscape and setting.

7.7 Flood Risk

7.7.1 The onshore substation site is located within Flood Zone 1, which represents a low risk of flooding from rivers. However, there is a risk of surface water flooding in proximity to the onshore substation, in the form of a natural hollow and an historic overland flow pathway that is evident from topographical surveys of the wider area.

7.7.2 The substation footprint has been designed such that it is located away from the surface water overland flow pathway and a field hollow identified as at risk of ponding water. Furthermore, alteration of ground levels within the overland flow pathway will be avoided.

7.7.3 The operational access road will need to cross an overland flow pathway, however, the road will be designed to avoid interaction with the flood risk areas either by elevating the road over this pathway or including features at the crossing point that would not impound water, i.e. culverts. This would ensure that safe access and egress to the onshore substation platform would remain available during a surface water flood event.

7.7.4 Further details of the flood risk assessment are provided in **Chapter 18 Water Resources and Flood Risk** (document reference 6.1.18, **Appendix 18.2**).

7.8 Landscape and Ecology

7.8.1 Earthworks

7.8.2 Preliminary analysis has identified an operational substation platform level at approximately 28.23m AOD, including a build-up of 400mm stone and 75mm chippings. This has been informed by cut and fill analysis to keep the platform above the surface flood risk zone and minimise the need for import or export of material from site.

7.8.3 Topsoil would be stripped from the substation site prior to construction resulting in approximately 21,851 m3 volume of material. In a worst case scenario this material would be removed offsite however the intention is to re-use as much as possible on site as part of an integrated landscape and ecology strategy including the softening of the embankments surrounding the substation platform to 1:3 slopes in order to facilitate the establishment of vegetation and present a more naturalistic landform where it is visible from adjacent footpaths. **Figures 7.6 to 7.9** show some typical cross sections for the substation platform and tie-in to the existing landscape.

7.9 Substation Compound

7.9.1 For operational, safety and maintenance reasons the landscape treatment within the substation platform is functional and defined by a very limited material palette of hard materials, typically comprising concrete pavers, concrete hard-standing, shingle and asphalt.

7.10 Substation Surrounds

7.10.1 Landscape treatment of the areas surrounding the substation platform is designed to integrate the substation with its surrounding context and create new habitats providing biodiversity enhancements to the existing site (refer to **Figure 7.4 and 7.5**).

7.10.2 The majority of the existing vegetation (including woodland, trees and hedgerows) will be retained, except where access or enabling works are required.

7.10.3 New areas of planting, including woodland, tree belts, scrub and scrubby grassland, will provide landscape and ecological enhancements to the substation surrounds which is currently an arable site. Planting will be appropriate to the local landscape character and is intended to improve the green infrastructure network (as identified within the South Norfolk District Ecological Network Summary Map 2007), helping to screen and filter views of the onshore substation from surrounding landscape and visual receptors, and integrate it into its landscape context. Table 6.1 provides a list of typical native woodland, tree and hedgerow species likely to be included.

7.10.4 Existing hedgerows will be enhanced by planting gaps with new native species hedge plants and hedgerow trees that would provide further screening and filtering of views, enhance landscape character and provide enhanced habitats and habitat connectivity for wildlife.

7.10.5 Scrubby grassland planting will comprise a varied, tussocky grassland sward with wildflowers and a low density of scattered shrubs throughout the area. This botanically and structurally varied habitat will support a range of invertebrate species including moths, butterflies, beetles, spiders, bees and damselflies, amongst others. The habitat is also expected to support terrestrial mammals possibly including hedgehogs, voles, badgers and brown hare, breeding and foraging birds, foraging bats, reptiles and terrestrial activity by amphibians. Surveys have confirmed slow worms (Anguis fragilis) and common lizards (Zootoca vivipara) in similar habitat bordering the substation site. The presence of other enhanced and existing habitats nearby (including those outlined above) will further contribute to the overall attractiveness of the general areas around the substation site for a range of wildlife.

7.10.6 Further details relating to the strategy for ecological enhancement are provided in **Chapter 20 Onshore Ecology and Ornithology** (document reference 6.1.20).

FIGURE 7.5 : Visualisation of substation

KEY PLAN

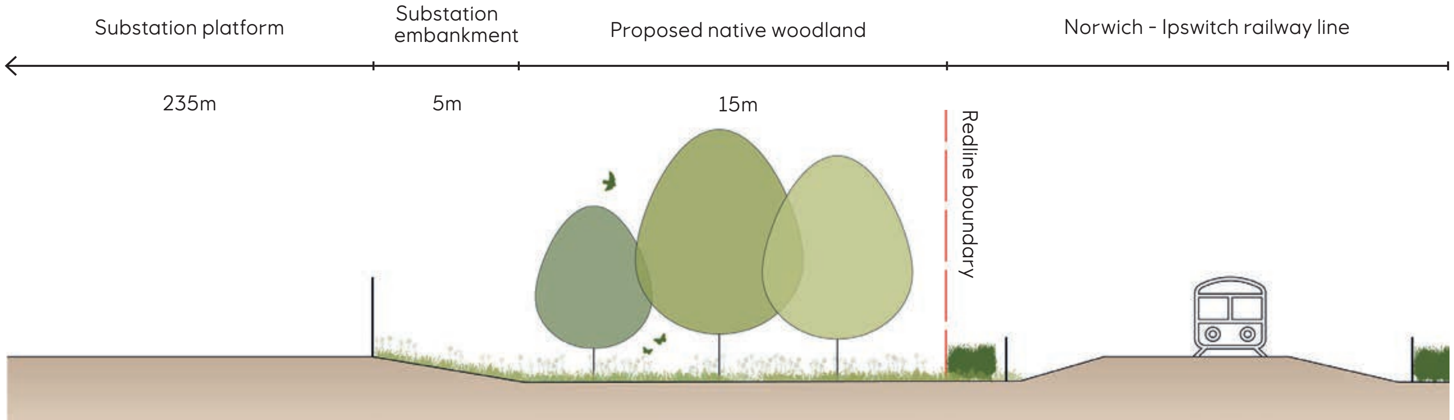


FIGURE 7.6: Indicative substation section A

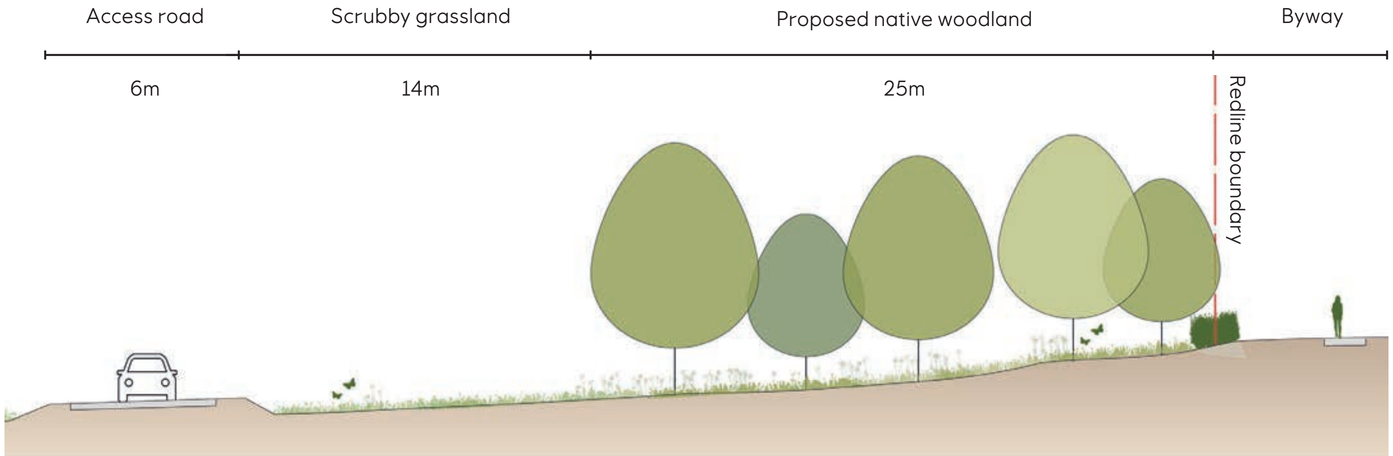


FIGURE 7.7 : Indicative substation section B

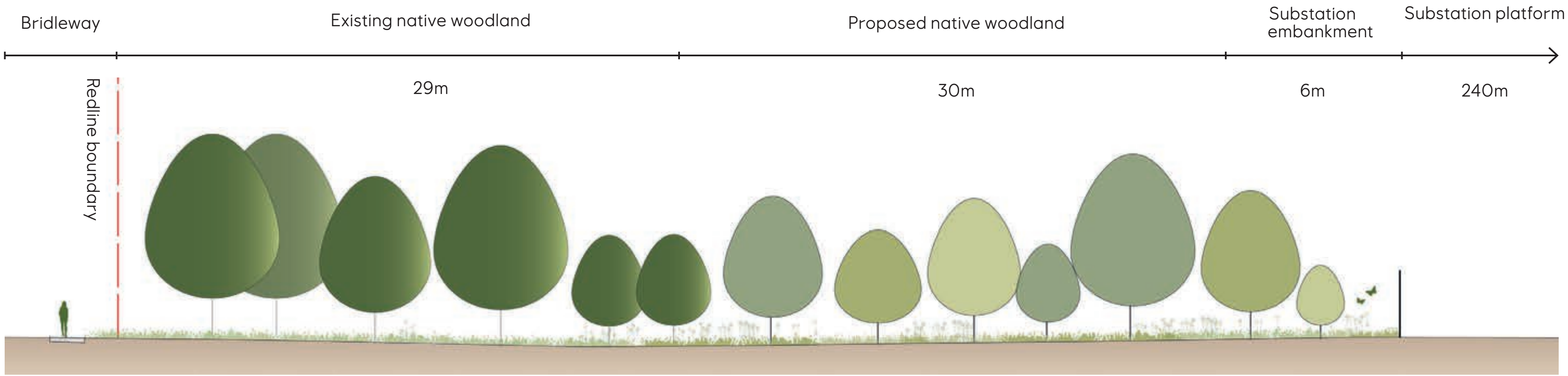


FIGURE 7.8 : Indicative substation section C

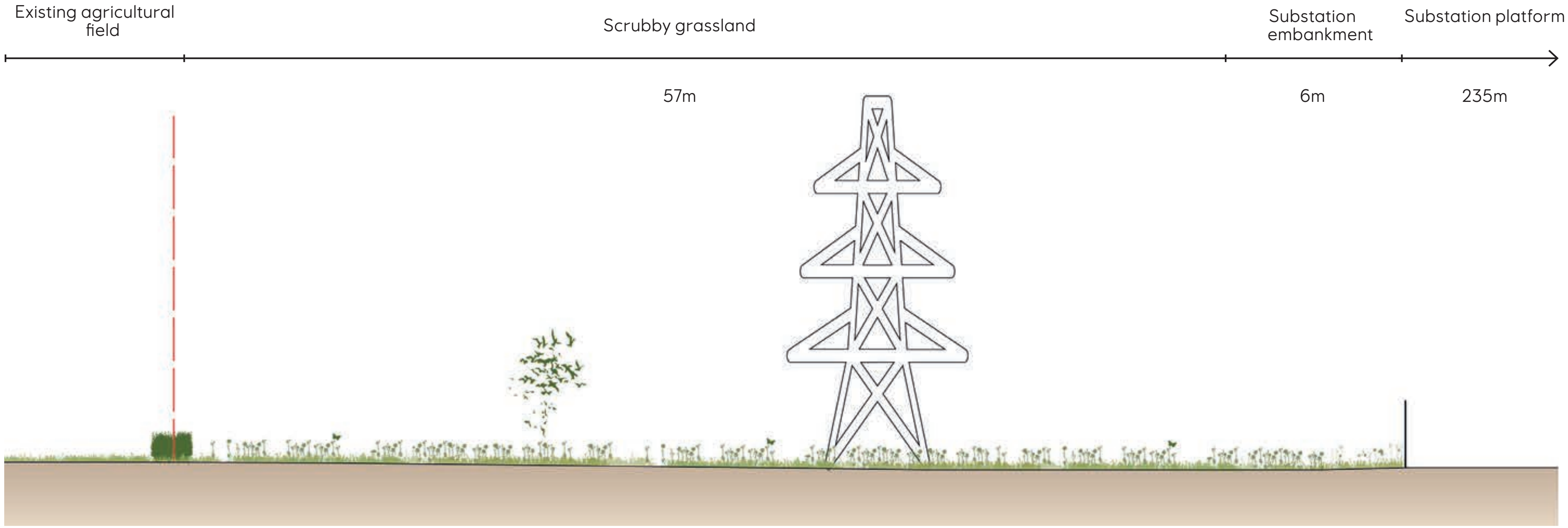


FIGURE 7.9 : Indicative substation section D

7.11 Access

7.11.1 The operational site layout will include a small car parking area for approximately 6 cars. Internal roads will allow for access to equipment and the installation, removal and possible emergency replacement of transformers and other high voltage plant as required. Roads will have a bitumen finish with raised kerbs to protect HV equipment from accidental vehicle impact.

7.11.2 Vehicular access to the substation will be required for routine operation and maintenance, estimated at an average of one visit per week. The majority of vehicles accessing the substation will be vans and cars, however, the access must be able to accommodate larger vehicles that may be required for the removal and replacement of larger substation equipment such as transformers. Access will be via the A140 and fields to the north of the substation (as shown on **Figure 7.10)**.

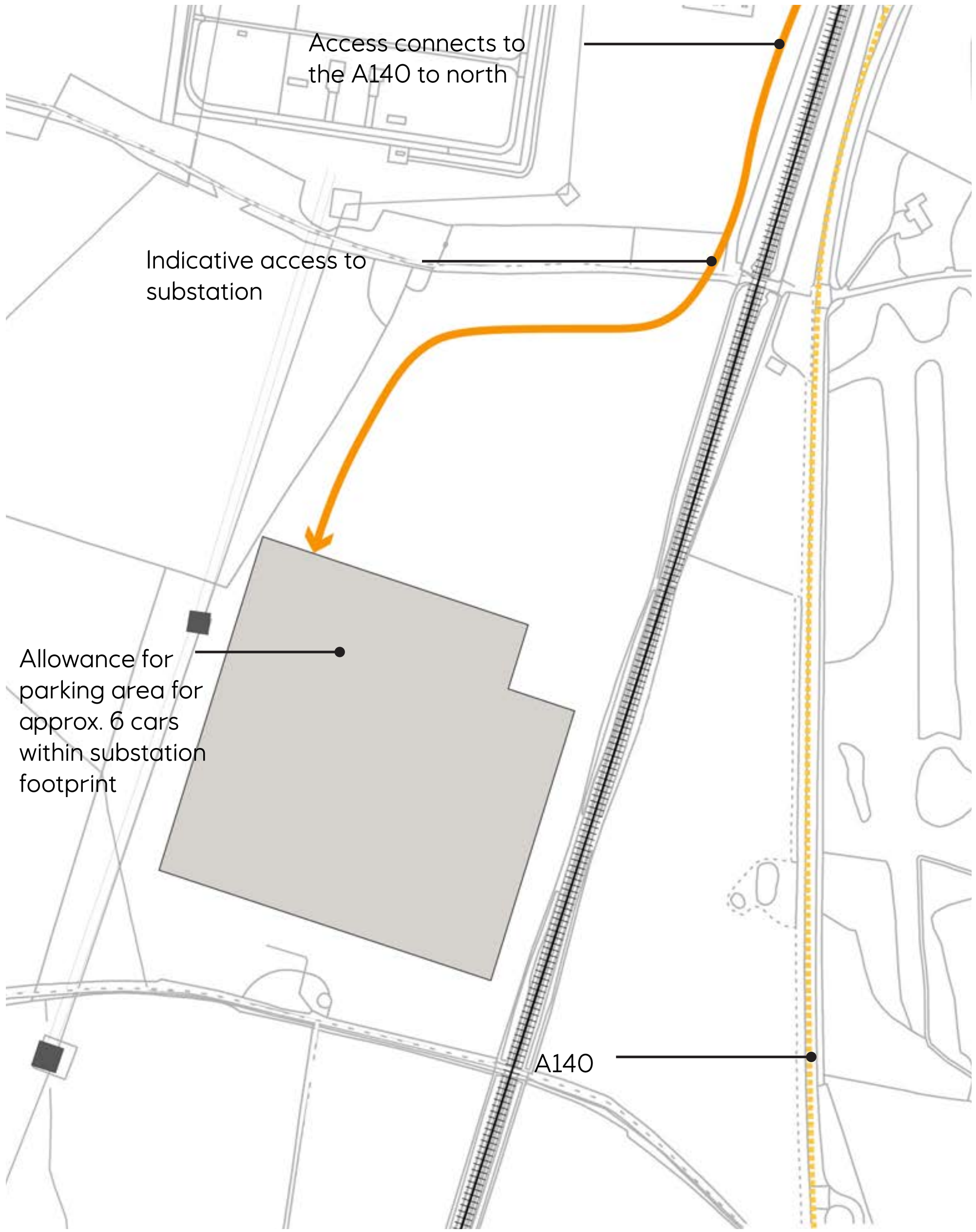


FIGURE 7.10 : Access diagram

Blank Page

8.0 Conclusion

8.1 Conclusion

8.1.1 This Onshore Design and Access Statement forms part of a suite of supporting documents for the SEP and DEP DCO application, and sets out the approach to securing the delivery of good design in accordance with the Overarching National Policy Statement for Energy (2011) and the emerging draft Overarching NPS for Energy (2021).

8.1.2 The Applicant has clearly stated a commitment to good design quality based on a clear Project Vision, and a defined set of Design Objectives (described in **Section 2**) and onshore design principles (**Section 4**) which have guided the design development process to date. This has ensured mitigation and compensation are at the heart of the SEP and DEP proposals, embedding environmental principles as part of good design.

8.1.3 The design has been informed by extensive statutory and informal consultation with stakeholders to ensure amongst other things, that the appreciation of the site's varied context is agreed and that the Applicant has explored design flexibility and design rationale in an open and transparent manner. A summary of the key onshore design decisions that have been made by the Applicant as a result of the consultation process are provided in **Section 4**.

8.1.4 Although indicative at this stage, the design for the onshore works will set out to achieve a high standard of design whilst at the same time balancing the operational requirements of the works with the character and appearance of the existing environment.

8.1.5 The final design of SEP and DEP will depend on the final development scenario and confirmed through detailed engineering design studies that will be undertaken post-consent to enable the commencement of construction. The Applicant will continue to be dedicated to good design throughout this process and for the duration of the construction, operation and decommissioning of SEP and DEP.

References

- Department of Energy and Climate Change (2011) National Policy Statement for Energy (EN-1) [online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf [Accessed 9 December 2021]
- Department of Energy and Climate Change (2011) National Policy Statement for Renewable Energy Infrastructure (EN-3) [online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47856/1940-nps-renewable-energy-en3.pdf [Accessed 9 December 2021]
- Department of Energy and Climate Change (2021) Revised Draft National Policy Statement for Energy [online]. Available at: [redacted] [Accessed 08 August 2022]
- National Grid (2009) NGC Substation and the Environment: Guidelines on Siting and Design [online]. Available at: [redacted] [Accessed 08 August 2022]