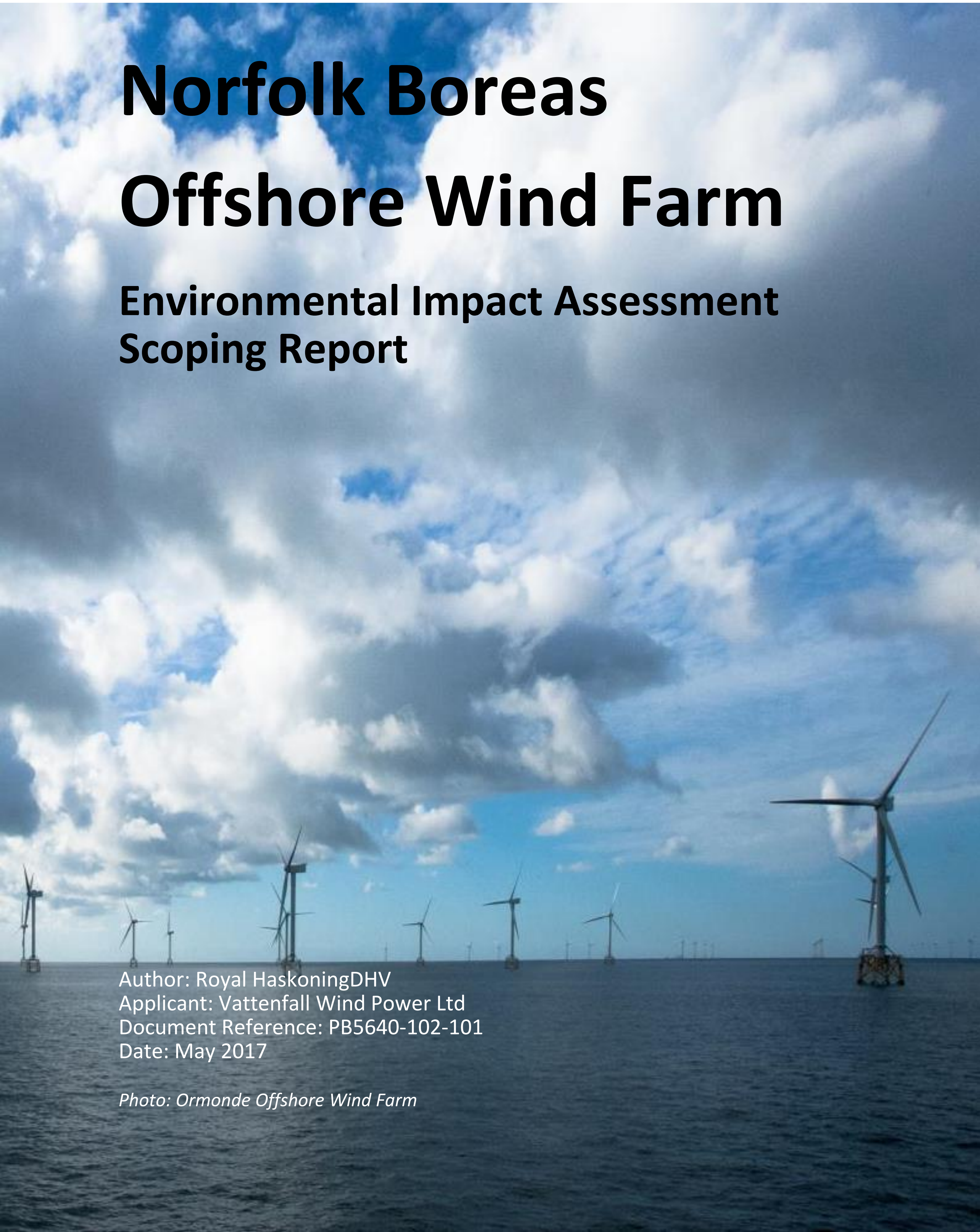

Norfolk Boreas Offshore Wind Farm

Environmental Impact Assessment Scoping Report

Author: Royal HaskoningDHV
Applicant: Vattenfall Wind Power Ltd
Document Reference: PB5640-102-101
Date: May 2017

Photo: Ormonde Offshore Wind Farm

Environmental Impact Assessment
Scoping Report

Document Reference: PB5640-102-101

May 2017

For and on behalf of Vattenfall Wind Power Limited

Approved by: Graham Davey

Signed:

[redacted]

Date: 27/04/17

For and on behalf of Royal HaskoningDHV

Drafted by: David Tarrant & Jen McMillan

Approved by: Alistair Davison

Signed:

[redacted]

Date: 18/4/2017

EXECUTIVE SUMMARY

This document supports a request by Vattenfall Wind Power Limited (VWPL) for an Environmental Impact Assessment (EIA) Scoping Opinion from the Planning Inspectorate for the Norfolk Boreas offshore wind farm. Norfolk Boreas is a Nationally Significant Infrastructure Project (NSIP) and as such an EIA is required as part of a Development Consent Order (DCO) application under the Planning Act 2008.

The key drivers for renewable energy, and therefore the Norfolk Boreas project, are reducing greenhouse gas emissions, providing energy security for the UK, and maximising economic opportunities through investment in the UK.

Norfolk Boreas is located 72km offshore (at the closest point). It will have a generation capacity of 1.8GW (1,800MW) and will produce enough energy to power 1.3million UK households[1]. The Norfolk Boreas site would comprise an array of offshore wind turbines and offshore substations which will be connected to the shore by offshore export cables installed within an offshore cable corridor.

The project will also require onshore infrastructure in order to transmit and connect the offshore wind farm to the National Grid, which in summary would comprise:

- Landfall;
- A cable relay station, if required;
- Underground cables;
- An onshore project substation; and
- Works at the Necton National Grid Substation (including extension of the existing substation and modification of the overhead powerlines).

A grid connection offer was provided by National Grid in October 2016 based on an onshore connection point at the existing Necton National Grid Substation. VWPL has taken up this offer and is committed to burying all the onshore cables for Norfolk Boreas project. This has the benefit of avoiding the landscape and visual impacts associated with the use of overhead lines.

Norfolk Boreas is the sister project to the proposed Norfolk Vanguard offshore wind farm project which is of the same capacity and located across two offshore wind farm sites, adjacent to the Norfolk Boreas site (Figure 1.1). Norfolk Vanguard is being developed first and its EIA and project design development are at a more advanced stage than for Norfolk Boreas. As both projects will connect to the Necton National Grid Substation, there has been a strategic approach to identifying locations for all onshore infrastructure with the aim of optimising overall design and reducing impacts where practical.

[1] http://www.renewableuk.com/page/UKWEDExplained assuming a load factor of 34.88

Norfolk Boreas is being developed by Vattenfall Wind Power Ltd (VWPL) (although the project will soon be transferred to a wholly owned subsidiary). VWPL has invested nearly £3bn in the UK, in onshore and offshore wind since 2008 and will have nearly 1GW in operation onshore and offshore by the end of 2017. Vattenfall plans to invest £5bn in renewables, mainly offshore wind, in Northern Europe by 2020 and Norfolk Boreas along with Norfolk Vanguard represent the next steps in the UK. VWPL has world leading experience in offshore wind, as owners of the Kentish Flats, Kentish Flats Extension, Ormonde (see front cover) and Thanet offshore wind farms, which are currently operational in the UK.

The EIA for Norfolk Boreas will be undertaken by experienced and well qualified technical specialists using best practice and following appropriate and relevant guidance. Key topics for investigation within the EIA are expected to be traffic and transport, onshore archaeology, noise, landscape and visual, tourism and recreation, commercial fisheries, other sea users, ornithology and marine mammals. This Scoping Report is the first stage of the EIA process, it outlines the receptors that will be considered during the EIA and the planned approach to data gathering and characterising the existing environment, assessing potential impacts associated with Norfolk Boreas and developing mitigation measures. A programme of consultation will be ongoing with stakeholders and communities throughout the EIA and DCO application process. VWPL is committed to engaging with the community and stakeholders. Section 5 of this Scoping Report provides an outline of the planned consultation associated with the project.

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Figures

Tables

Glossary of acronyms

µg l-1	Microgram per litre
AAC	Army Air Corp
ADR	Air Defence Radar
AEZ	Archaeological Exclusion Zone
AfL	Agreements for Lease
AGLV	Areas Of Great Landscape Value
AIS	Automatic Identification System
AIS	Air Insulation Switchgear
ALC	Agricultural Land Classification
AONB	Area of Outstanding Natural Beauty
ATC	Air Traffic Control
ATS	Air Traffic Services
BMAPA	British Marine Aggregate Producers Association
BODC	British Oceanographic Data Centre
CAA	Civil Aviation Authority
CAP	Civil Aviation Publication
CCS	Carbon Capture Storage
CCTV	Closed-Circuit Television
CD	Chart Datum
CFD	Contracts for Difference
CIA	Cumulative Impact Assessment
CIEEM	Chartered Institute for Ecology and Environmental Management
CoCP	Code of Construction Practice
COLREGS	International Regulations for Preventing Collisions At Sea
CoP	Conference of the Parties
CPT	Cone Penetrometer Tests
CPUE	Catch Per Unit Effort
CTMP	Construction Traffic Management Plan
CTV	Crew Transit Vessel
CWS	County Wildlife Sites
DCO	Development Consent Order
DECC	Department of Energy and Climate Change
DP	Dynamic Positioning
dSPA	Draft Special Protection Area
DWR	Deep Water Route
DWT	Deadweight Tonnes
EAOW	The Consortium Company, East Anglia Offshore Wind Ltd
EcIA	Ecological Impact Assessment
EEA	European Economic Area
EEEGR	East of England Energy Group
EIA	Environmental Impact Assessment
EIFCA	Eastern Inshore Fisheries Conservation Authority
EMF	Electromagnetic Interference
EMP	Ecological Management Plan
EPP	Evidence Plan Process

EPS	European Protected Species
EQS	Environmental Quality Standard
ER	Environmental Report
ERA	Environmental Risk Assessment
ERCoP	Emergency Response Co-Operation Plan
ES	Environmental Statement
EU	European Union
FIR	Flight Information Regions
FRA	Flood Risk Assessment
FSA	Formal Safety Assessment
GBS	Gravity Base Systems
GDP	Gross Domestic Product
GES	Good Environmental Status
GMSL	Global Marine Systems
GPS	Global Positioning System
GT	Gross Tonnes
GW	Gigawatt
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
HIR	Health Impact Review
HMR	Helicopter Main Route
HRA	Habitat Regulations Assessment
HSC	Historic Seascape Character
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IALA	International Association of Lighthouse Authorities
IBTS	International Bottom Trawl Survey
ICES	International Council for the Exploration of the Sea
ICZM	Inter Coastal Management Zone
ILT	Dutch Aviation Authority
IMO	International Maritime Organisation
JNCC	Joint Nature Conservation Committee
LEC	Levelised Energy Cost
LIDAR	Light Detection and Ranging
LSE	Likely Significant Effects
LVNL	Luchtverkeersleiding Nederland
m	Metres
MAIB	Marine Accident Investigation Branch
MCA	Maritime and Coastguard Agency
MCZ	Marine Conservation Zone
MGN 372 (M+F)	MCA Marine Guidance Note 372 (M+F)
MGN 543 (M+F)	MCA Marine Guidance Note 543 (M+F)
MHWN	Mean High Water of Neap tides
MHWS	Mean High Water of Spring tides
MLWN	Mean Low Water of Neap tides
MLWS	Mean Low Water of Spring tides
MMMP	Marine Mammal Mitigation Plan

MMO	Marine Management Organisation
MoD	Ministry of Defence
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
MSL	Mean Sea Level
MU	Management Units
MW	Megawatt
NATS	National Air Traffic Services
NDC	Nationally Determined Contribution
NERC	Natural Environment and Rural Communities
NERL	National Air Traffic Services En Route Ltd
ng l-1	Nanogram per Litre
Nm	Nautical Miles
NMFS	National Marine Fisheries Service
NMMP	National Marine Monitoring Programme
NNR	National Nature Reserve
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NRA	Navigational Risk Assessment
NSIP	Nationally Significant Infrastructure Project
NTS	Non-Technical Summary
NUC	Not Under Command
O&G	Oil and Gas
O&M	Operation and Maintenance
OEM	Original Equipment Manufacturer
OESEA	Offshore Energy Strategic Environmental Assessment
OFTO	Offshore Transmission Owner
OREI	Offshore Renewable Energy Installation
ORPAD	Offshore Renewables Protocol for Archaeological Discoveries
OWF	Offshore Wind Farm
PCOD	Population Consequences of Disturbance
PEI	Preliminary Environmental Information
PEIR	Preliminary Environmental Information Report
PEXA	Military Practice and Exercise Areas
PrOW	Public Right of Way
pSAC	Proposed Special Area Of Conservation
PSR	Primary Surveillance Radar
RAF	Royal Air Force
REZ	Renewable Energy Zone
RNLI	Royal National Lifeboat Institute
RYA	Royal Yachting Association
SAC	Special Area of Conservation
SAR	Search and Rescue
SCADA	System Control and Data Acquisition
SCI	Site of Community Importance
SCOS	Special Committee on Seals
SMRU	Sediment Management Research Unit

SPA	Special Protection Area
S-P-R	Source-Pathway-Receptor
SPZ	Source Protection Zone
SSC	Suspended Sediment Concentrations
STATCOM	Static compensator
SVC	Static Var Compensator
TEU	Treaty on European Union
TOPA	Technical and Operational Assessment
TSS	Traffic Separation Scheme
UK	United Kingdom
UK CAA	United Kingdom Civil Air Authority
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
UXO	Unexploded Ordnance
VMS	Vessel Monitoring Systems
VWPL	Vattenfall Wind Power Limited
WFD	Water Framework Directive
ZAP	Zone Appraisal and Planning
ZDA	Zone Development Agreement
ZEA	Zone Environmental Appraisal
ZTA	Zone Technical Appraisal

Glossary of Project Terminology

Array cables	Cables which link the wind turbine generators to the offshore substation platforms.
Cable relay station	Primarily comprised of an outdoor compound containing reactors (also called inductors, or coils) and switchgear to increase the power transfer capability of the cables.
Cable relay station zones	The areas being considered within which the cable relay station would be located (if required). A single cable relay station location will be identified prior to PEIR.
Evidence Plan Process	A voluntary consultation process with specialist stakeholders to agree the approach to the EIA and information to support HRA.
Horizontal directional drilling (HDD) zones	The areas within the onshore cable corridor which would house HDD entry or exit points.
Interconnector cables	Buried offshore cables which link offshore substation platforms
Interface cables	Buried high-voltage cables linking the onshore substation to the Necton National Grid substation.
Jointing pit	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	Where the offshore cables come ashore.
Landfall location areas of search	Areas considered during the landfall site selection process.
Landfall zones	The areas being considered within which the landfall would be located. A single landfall location will be identified prior to PEIR.

Link boxes	Underground chambers or above ground cabinets next to the cable trench housing low voltage electrical earthing links.
Mobilisation zone	Area within which mobilisation areas, required for servicing the cable installation, would be located. These will be refined to mobilisation areas prior to PEIR.
National Grid substation extension zone	Area within which the National Grid substation extension would be located. This will be refined to a National Grid substation extension location prior to PEIR
Necton National Grid Substation	The grid connection location for Norfolk Boreas; also the grid connection location for Norfolk Vanguard.
Norfolk Boreas site	The Norfolk Boreas offshore wind farm boundary.
Offshore accommodation platform	A fixed structure (if required) providing accommodation for offshore personnel. An accommodation vessel may be used instead.
Offshore export cables	The cables which would bring electricity from the offshore substation platform(s) to the landfall.
Offshore project area	The Norfolk Boreas site and provisional export cable corridor. When reference is made to the Norfolk Vanguard offshore project area it is the overall area of Norfolk Vanguard East, Norfolk Vanguard West and the provisional offshore cable corridor
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	200m wide onshore corridor within which the onshore cable route will be located.
Onshore cable route	50m wide (easement) strip which would contain the buried export cables as well as temporary running track, topsoil storage and excavated material during construction.
Onshore cables	The cables which would bring electricity from landfall to the onshore project substation.
Onshore infrastructure	The combined name for all onshore infrastructure associated with the project from landfall to grid connection.
Onshore project substation	An onshore compound containing electrical equipment to enable connection to the National Grid. In an HVAC solution the substation steps up the exported power from 220kV (export cable voltage) to 400kV (grid voltage). In an HVDC system the substation would convert the exported power from HVDC to HVAC, with a step up to 400kV (grid voltage). For both options this also contains equipment to help maintain stable grid voltage.
Onshore project substation zone	An area within which the onshore substation is likely to be located. Further iterations of this zone will be developed during 2017 following review of feedback from public drop-in exhibitions and other input from other stakeholders. An onshore project substation location will be defined prior to PEIR.
Onshore scoping area	An area that encompasses all planned onshore infrastructure and allows sufficient room for receptor identification and environmental surveys. This will be refined following further site selection and consultation.
Overhead line modification zone	An area within which the work would be undertaken to complete the necessary modification to the existing 400kV overhead lines.
Provisional offshore cable corridor	The area where the offshore export cables would be located. This would be refined following the offshore geophysical surveys.
Safety zones	An area around a vessel which should be avoided during offshore construction.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the foundations as a result of the flow of water.
Substation search area	The 3km circle around the Necton National Grid Substation which was considered in the site selection process.

The Applicant	Vattenfall Wind Power Ltd (although the project will be transferred to a wholly owned subsidiary).
The Project	The Norfolk Boreas site as well as all onshore and offshore infrastructure.
Transition pit	Underground structures that house the joints between the offshore export cables and the onshore cables.

1 PART 1: INTRODUCTION

1.1 Introduction

1. This Scoping Report supports a request for a formal Environmental Impact Assessment (EIA) Scoping Opinion from the Planning Inspectorate for the Norfolk Boreas offshore wind farm ("the project"). The document provides the first stage of the EIA. As a Nationally Significant Infrastructure Project (NSIP), an EIA is required as part of a Development Consent Order (DCO) application under the Planning Act 2008 (see further information on the scoping process and EIA process in Sections 1.1.6 and 1.6 respectively).

2. The project would have a capacity of 1,800MW which is enough to power 1.3 million UK households[1]. The offshore wind farm comprises offshore wind turbine generators within an area of sea (the 'Norfolk Boreas site') connected to the shore by offshore export cables installed within the offshore cable corridor (currently termed provisional as some refinement will take place during the development process). The Norfolk Boreas site and provisional offshore cable corridor are shown in Figure 1.1. The Norfolk Boreas site and the provisional offshore cable corridor combined are referred to hereafter as the 'offshore project area'. Plate 1.1 provides an overview of the project components.

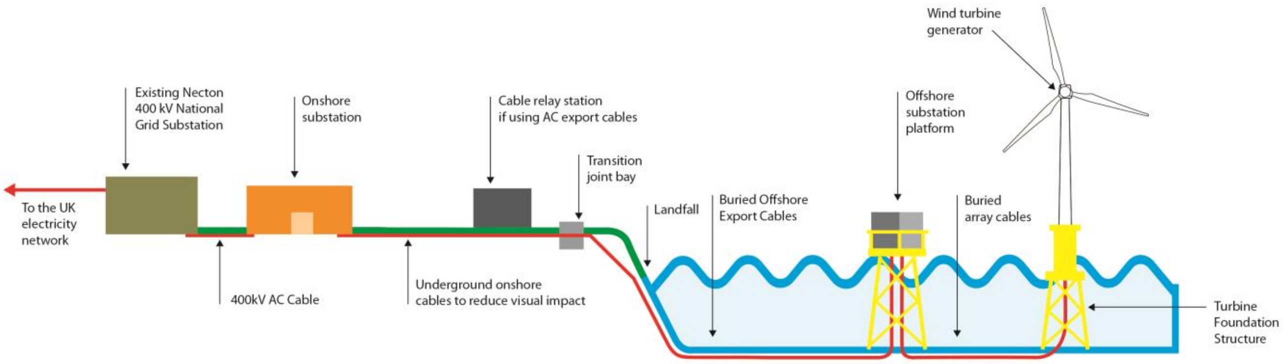


Plate 1.1 Schematic diagram of Norfolk Boreas

3. The project would also require onshore infrastructure in order to connect the offshore wind farm to the National Grid. This is explained in detail in Sections 1.2 and 1.5 and in summary would comprise:

- Landfall (to be sited within one of the three landfall zones shown in Figure 1.3);
- Cable relay station, if required (to be sited within one of the seven cable relay station zones shown in Figure 1.3);
- Underground cables (within the onshore cable corridors shown in Figure 1.2);
- Onshore project substation (likely to be sited within the onshore project substation zone (see paragraph 31) shown in Figure 1.4);

- Underground cables between the onshore project substation and the existing Necton National Grid Substation (to be sited within the onshore cable corridor);
- Extension to the Necton National Grid Substation (within the National Grid substation extension zone shown in Figure 1.4);
- Re-configuration of the overhead lines close to the Necton National Grid Substation (within the overhead line modification zone shown in Figure 1.4).

4. An ‘onshore scoping area’ which is defined in Section 1.1.4, encompasses the areas identified for all onshore infrastructure and which is appropriate for receptor identification and environmental surveys (Figure 1.2).

5. The offshore and onshore electrical infrastructure would be sold to an Offshore Transmission Owner (OFTO), as required by UK regulation. This is expected to be after the project has been built and commissioned.

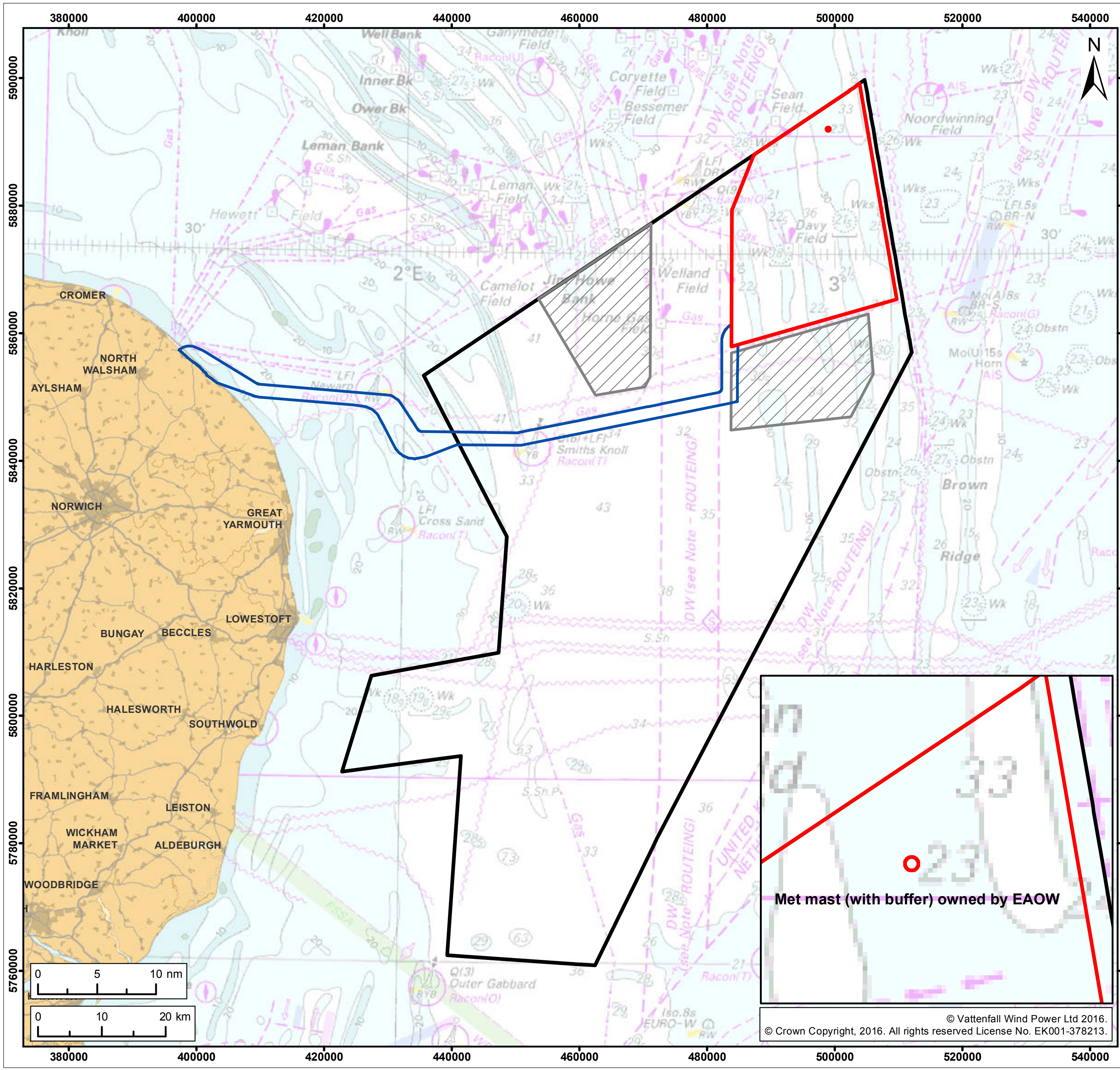
6. Norfolk Boreas is the sister project to the Norfolk Vanguard offshore wind farm which has the same capacity as Norfolk Boreas and is located across two areas of sea. NV East is located directly south and NV West is located to the west of the Norfolk Boreas site (Figure 1.1). Norfolk Vanguard is being developed first and its EIA and project design development are at a more advanced stage than Norfolk Boreas, with a planned DCO application in 2018 and main onshore construction works due to commence in 2022 (enabling works such as such as drainage management or landscape may commence as soon as 2021). Both Norfolk Vanguard and Norfolk Boreas would connect to the National Grid at the existing Necton National Grid Substation.

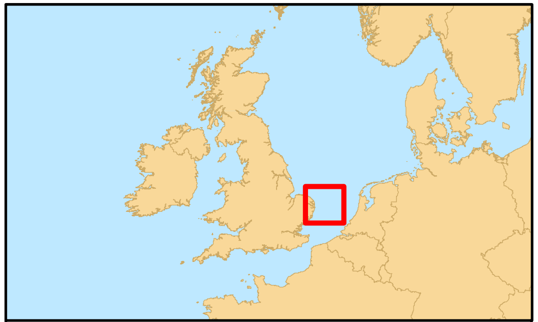
7. There has been a strategic approach to identifying locations for offshore and onshore infrastructure across both projects with the aim of optimising overall design, minimising impacts and reducing the cost of energy where practical. The site selection work considers for example the co-location of infrastructure where practical, the timing of works for both projects, and cumulative impacts. Constraints mapping, stakeholder engagement and site selection work is ongoing to refine the locations of the onshore infrastructure (see Section 1.5) for both Norfolk Vanguard and Norfolk Boreas.

8. Responses to this Scoping Request, as well as feedback during public drop-in exhibitions and the consultation process as a whole, will inform the development of Norfolk Boreas. A full description of the Norfolk Boreas project can be found in Section 1.5.

9. Further detail of the interactions between Norfolk Vanguard and Norfolk Boreas is provided in Sections 1.2 and 1.5.

10. An EIA Scoping Report was produced for Norfolk Vanguard in October 2016 (Royal HaskoningDHV, 2016a), and the subsequent EIA Scoping Opinion has been used to inform this document.





Legend:

- Norfolk Boreas Site
- Norfolk Vanguard Offshore Wind Farm Sites
- Provisional Offshore Cable Corridor
- Former East Anglia Zone
- Met Mast

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Norfolk Boreas Offshore Project Area

Figure: 1.1 Drawing No: PB5640-102-001

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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01	25/01/17	JE	DT	A4	1:850,000

Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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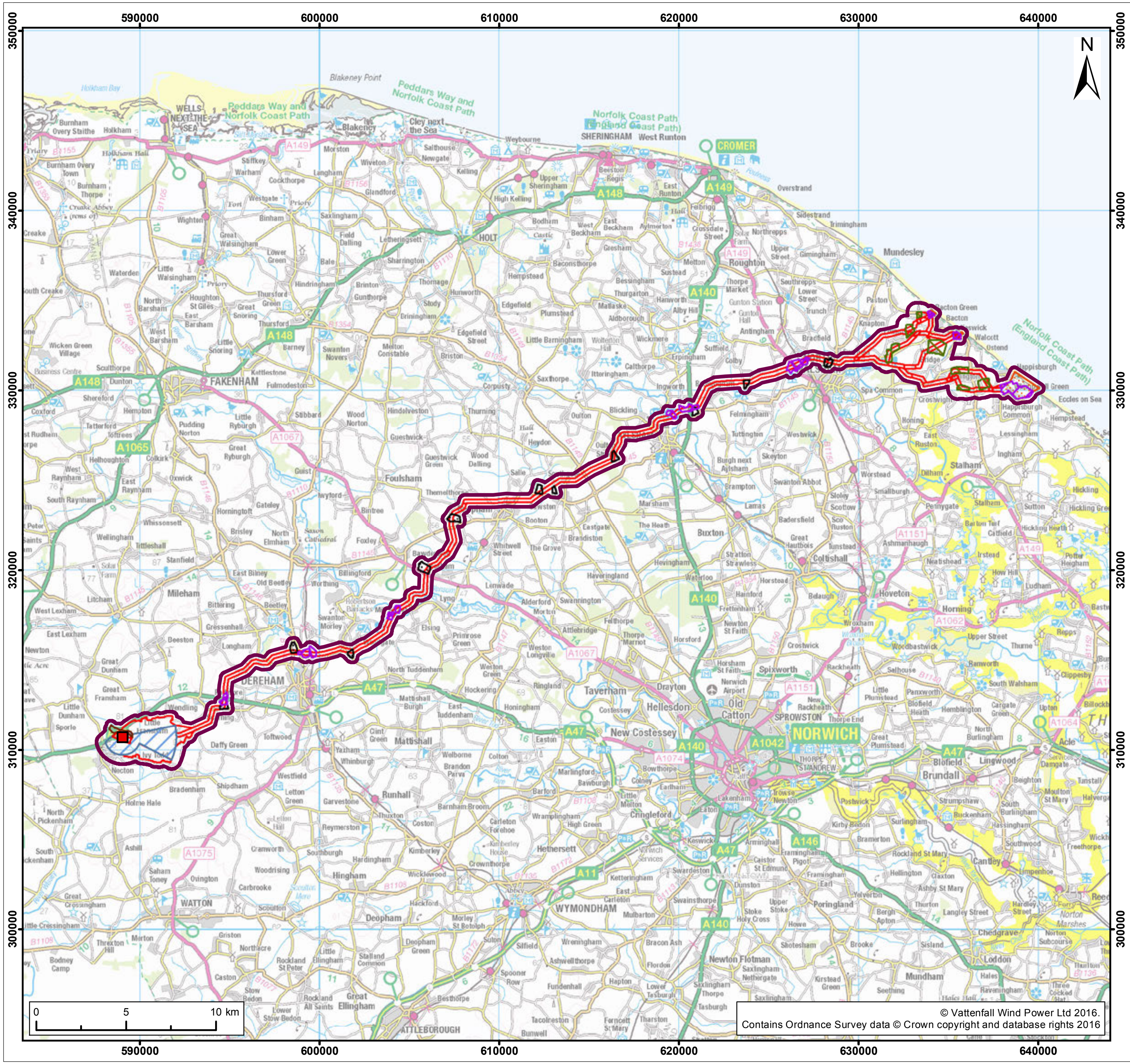

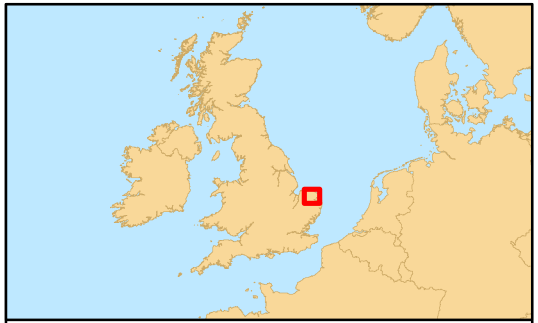

Legend:

- Onshore Scoping Area
- Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
- Cable Relay Station Zone
- Landfall Zone

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Norfolk Boreas Onshore Scoping Area

Figure: 1.2 Drawing No: PB5640-102-002

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	25/01/17	JE	DT	A4	1:300,000

Co-ordinate System: British National Grid **EPSG:** 27700

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1.1.1 The Applicant

11. Vattenfall is a leading European utility and the second largest player in the global offshore sector. Vattenfall has invested over £3bn in the UK, mainly in onshore and offshore wind since 2008 and will have nearly 1GW in operation onshore and offshore by the end of 2017. Vattenfall plans to invest €5bn in Northern European renewables, mainly onshore and offshore wind, by 2020 and Norfolk Boreas along with Norfolk Vanguard represent the next steps in the UK. Vattenfall Wind Power Limited (VWPL) has world leading experience in offshore wind, as owner of the Kentish Flats, Kentish Flats Extension, Ormonde and Thanet offshore wind farms, which are currently operational in the UK.

12. Vattenfall is also constructing the European Offshore Wind Deployment Centre off the Aberdeenshire coast, a test and demonstration facility which will drive continued innovation and cost reduction in the sector. Vattenfall has recently undertaken the world's first decommissioning of an offshore wind farm, Yttre Stengrund in Kalmar Sound, Sweden. Vattenfall will also draw on its highly relevant recent experience of East Anglia ONE and East Anglia THREE.

13. VWPL is undertaking the EIA for Norfolk Boreas (although the project will soon be transferred to a wholly owned subsidiary). The boundary for Norfolk Boreas does not overlap with any other previously defined offshore wind farm areas within the former East Anglia Zone.

14. A wholly owned subsidiary of VWPL, Norfolk Vanguard Limited, also has an Agreement for Lease (AfL) for the Norfolk Vanguard project (Shown in Figure 1.1), which will be the subject of a separate DCO application.

1.1.2 Project background

15. In December 2009 as part of the UK Offshore Wind Round 3 tender process, The Crown Estate awarded the joint venture company, East Anglia Offshore Wind (EAOW) Ltd., the rights to develop Zone 5 (later called the 'East Anglia zone'). These rights were granted through a Zone Development Agreement (ZDA). EAOW Ltd. is a 50:50 joint venture owned by VWPL and Scottish Power Renewables (UK) Limited. Under the ZDA, the joint venture consented East Anglia ONE and commenced the development of East Anglia THREE (prior to the project being taken forward by Scottish Power Renewables (UK) Limited) and the former East Anglia FOUR (up to the submission of a request for Scoping Opinion in 2012).

16. In December 2014, a decision was taken to split the zone, with VWPL retaining development rights within the north of the former East Anglia Zone and Scottish Power Renewables (UK) Limited continuing to develop the southern part. In

agreement with The Crown Estate, the ZDA was effectively dissolved in 2016. New AfLs have been awarded by The Crown Estate within the former East Anglia Zone, separately to VWPL / its affiliate companies and Scottish Power Renewables (UK) Limited / its affiliate companies.

1.1.3 Description of the offshore scoping area

17. The offshore scoping area is defined by the Norfolk Boreas offshore project area which includes the Norfolk Boreas site and the provisional offshore cable corridor (Figure 1.1).

18. Norfolk Boreas comprises a single wind farm site approximately 72km from the coast of Norfolk (at its nearest point). The provisional offshore cable corridor has been designed to accommodate cables from both Norfolk Vanguard and Norfolk Boreas and both projects will include this area in their consent applications. A small area would be required to link the Norfolk Boreas site with the shared offshore cable corridor; this is included within the provisional offshore scoping area (displayed in Figure 1.1).

19. The Norfolk Boreas site includes areas of sand ridges with associated peaks and troughs. Water depths range from 22m to 41m relative to Chart Datum (CD) (Figure 1.1). The site has a maximum tidal range of approximately 1.6m. The physical characteristics of the offshore environment are discussed further in Section 2.2

20. Offshore infrastructure would include wind turbines and foundations, offshore substations, cables which link the wind turbines and offshore substations, and offshore export cables connecting the offshore substations to landfall (discussed further in Section 1.5.2).

21. A meteorological mast (Met Mast) which is owned and operated by EAOW is located in the north-east of the site (Figure 1.1). The Met Mast and an associated 250m buffer are not part of the Norfolk Boreas AfL or offshore scoping area. The mast supports various instruments for measuring meteorological conditions.

1.1.4 Description of the onshore scoping area

22. The Norfolk Boreas onshore scoping area is the result of an ongoing detailed site selection process which has considered both the Norfolk Vanguard and Norfolk Boreas projects (see Section 1.2 for further information). The onshore scoping area, displayed in Figure 1.2, includes the 200m wide cable corridors plus areas suitable for landfall, the cable relay station, the project substation and the National Grid works required. The scoping area includes 250m on either side of the cable corridors and 500m around cable relay station and onshore project substation zone. This

aligns with the environmental survey areas within which data are currently being collected for the EIA of both Norfolk Boreas and Norfolk Vanguard projects.

23. It should be noted that the Norfolk Boreas onshore scoping area is different to the Norfolk Vanguard scoping area; since the publication of the Norfolk Vanguard Scoping Report in October 2016, VWPL has progressed the site selection process (See Section 1.2 for further detail). The resulting Norfolk Boreas onshore scoping area shown in Figure 1.2 is considered to be appropriate for scoping as it is broad enough to identify the potential receptors whilst being focused enough to allow an informed scoping opinion to be made.

1.1.4.1 Landfall

24. The Applicant is currently considering three areas (referred to as landfall zones) where the Norfolk Boreas export cables could make landfall (discussed further in Section 1.2.4). These are:

- Bacton Green;
- Walcott Gap; and
- Happisburgh South.

25. The onshore scoping area (Figure 1.2 and Figure 1.3) includes all three landfall zones.

1.1.4.2 Cable relay station

26. If required (see Section 1.5.4.1) a cable relay station would be located within one of seven cable relay station zones (Figure 1.3). An area (500m around the cable relay station zones) has been added to allow for receptor identification and environmental survey data collection.

1.1.4.3 Onshore cable corridors

27. The onshore cable corridors identified from each of the three landfall locations are shown in Figure 1.3. All onshore cable corridor options from the three landfalls reach a convergence point at a location to the north of North Walsham. From North Walsham the onshore cable corridors head south-west across Norfolk passing to the north of Aylsham and Reepham before crossing the River Wensum (Figure 1.2). From this point the onshore cable corridors pass to the North of Dereham before crossing the A47 and entering the onshore project substation zone near Necton (Figure 1.4).

28. The onshore cable corridors have been defined through a detailed constraints mapping process (See Section 1.2) which was undertaken with the aim of identifying corridors which could accommodate export cables from both the Norfolk Boreas and Norfolk Vanguard projects. The 200m wide corridors (discussed further in Section 1.2.8) allow for a 50m (easement) strip for each project and a further 50m per

project for micro-siting around sensitive features and to accommodate landowner requests where possible. The scoping area also allows for the following along the cable corridor:

- Cable relay stations (see Section 1.1.4.2);
- Areas where trenchless techniques (such as Horizontal Directional Drilling (HDD) or microtunnelling) would be employed to avoid sensitive features (referred to as HDD zones in Figures); and
- Mobilisation areas.

29. The locations of these will be further developed prior to the DCO application being made. An area (250m around all temporary infrastructure) has been added to allow for receptor identification and environmental survey data collection.

1.1.4.4 Onshore project substation

30. Both Norfolk Vanguard and Norfolk Boreas have accepted grid connection offers from National Grid near to the village of Necton. In order to identify onshore project substation locations for both Norfolk Vanguard and Norfolk Boreas, VWPL are undertaking a detailed constraints mapping and site selection exercises around the Necton National Grid Substation.

31. The project substation zone shown in Figure 1.4 is an area of search that was developed in Quarter four of 2016 as part of the site selection process (see Section 1.2.7 for further detail on the site selection process). Further iterations of this search area will be developed during 2017 following review of feedback from public drop-in Exhibitions held in March 2017 (See Section 5.3) and with due regard to input from other stakeholders.

1.1.4.5 Extension to Necton National Grid substation

32. An area around the Necton National Grid Substation has also been included within the onshore scoping area to allow for an extension to the existing 400kV substation required to accommodate the energy produced by the project. This area, which is referred to as the Necton National Grid substation extension zone, is displayed in Figure 1.4. Further detail is included in Section 1.5.4.4.

1.1.4.6 Re-configuration of existing overhead lines

33. An area has been defined to allow for re-configuration of the existing overhead lines close to the Necton National Grid Substation. This area, which is referred to as the overhead line modification zone, is displayed in Figure 1.4 and is included within the onshore scoping area. Further detail is included in Section 1.5.4.5.

1.1.5 Port locations

34. During construction, there will be a requirement for a dockside marshalling facility, where components for the offshore infrastructure will be stored prior to loading onto construction barges or vessels. This facility will be chosen with regard to the location of fabricators and original equipment manufacturers (to minimise transportation requirements) and availability of suitable dockside space.

35. The primary base for the operations and maintenance (O&M) facility for Norfolk Boreas would likely be a suitable port facility on the coast of East Anglia. Options currently under consideration include ports at Great Yarmouth, Lowestoft and Wells-next-the-Sea.

36. Port facilities are outside the Order Limits for the DCO application but will be considered where appropriate, e.g. when assessing impacts on traffic and transport.

1.1.6 The scoping report

37. This Scoping Report supports a request for a formal EIA Scoping Opinion from the Planning Inspectorate. The EIA Scoping Opinion will contain a compilation of responses to this Scoping Report from statutory stakeholders, which will help to guide the Applicant on how to progress the EIA for the project. This Scoping Report presents an initial review of the potential issues associated with the construction, O&M and eventual decommissioning of Norfolk Boreas.

38. This report has been prepared in accordance with Regulation 8 of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 (as amended), which enables an applicant to seek a EIA Scoping Opinion from the Planning Inspectorate on the information to be included in an Environmental Statement (ES).

39. The overall objectives of the EIA for the project are to avoid or minimise potential adverse impacts, identify opportunities for beneficial impacts and to meet the requirements of the Planning Act 2008 and associated EIA Regulations (see Section 1.4). This Scoping Report therefore aims to identify the relevant potential impacts associated with the physical, human and biological environments for the project and set out the proposed approach to addressing those environmental issues through the EIA process. The report provides an overview of all potential issues and makes a case for focusing the EIA on those issues which have the potential to result in significant impacts, reducing the emphasis on those issues which are increasingly shown (from repeated assessment in offshore wind, available data and professional judgement) to be non-significant. The EIA for Norfolk Boreas will take into account the lessons learnt on those offshore wind farm projects that have been through the consenting, construction, O&M and decommissioning processes already. In line with

this approach, this Scoping Report makes robust recommendations, supported by evidence, regarding the issues that the Applicant proposes to exclude (scope out) of the EIA. This allows more effort to be focused on the key issues. Each section of this report summarises potential impacts on a receptor and whether these will be considered further as part of the EIA (scoped in).

40. The outputs of the EIA will be a Preliminary Environmental Information (PEI) Report (PEIR) and the final Environmental Statement (ES) in support of the DCO application. Other documents to support the DCO application are discussed in Section 1.6.6. Ongoing consultation with statutory and non-statutory stakeholders and local communities will inform the process throughout.

1.1.7 Scoping report structure

41. This Scoping Report has the following structure:

- Part 1 – Introductory Section (this section);
    - Introduction – this section introduces the Scoping Report;
    - Site Selection and Outline Assessment of Alternatives – an outline of the site selection process to date and the further assessment that will be undertaken in order to define the final project description for the EIA;
    - Need for the project – a discussion of the key drivers for offshore wind and the project;
    - Policy and legislative context – a high-level overview of where Norfolk Boreas sits within policy and legislative context and how this project aims to fulfil policy needs and meet all environmental requirements;
    - Project Description – a high-level description of the key elements of the project both offshore and onshore through construction, operation and decommissioning phases;
    - EIA Methodology – a description of how the EIA will be undertaken, the philosophy and approach behind the assessment and key areas of consideration;
- Part 2 – Offshore;
    - Offshore Environmental Baseline and Potential Impacts – a discussion of the baseline, potential impacts, approach to the EIA and data sourcing, and approach to mitigation for each relevant receptor, covering the physical, biological and human environment;
    - Summary of offshore designated sites – an overview of the relevant sites designated under the national and international legislation described in Part 1 and referred to in each relevant receptor section;

- Offshore inter-relationships;
- Summary of offshore cumulative and transboundary impacts;

- Part 3 – Onshore;
  - Onshore Environmental Baseline and Potential Impacts – a discussion of the baseline, potential impacts, approach to the EIA and data sourcing, and approach to mitigation for each relevant receptor, covering the physical, biological and human environment;
  - Onshore inter-relationships;
  - Summary of onshore cumulative impacts;
- Part 4 – Wider Scheme Aspects;
  - This section considers aspects that are relevant for both the onshore and offshore assessments;
  - Wider scheme inter-relationships;
  - Summary of wider scheme cumulative impacts;
- Part 5 – Consultation; and
- Part 6 – Summary and Conclusions.

1.1.8 Project programme

42. The following key milestones are planned for the Norfolk Boreas EIA:

- First drop-in exhibitions – March / April 2017 (discussed further in Section 5.3);
- Submission of Scoping Report to the Planning Inspectorate - May 2017;
- Scoping consultation phase – 42 days from submission;
- Further informal engagement and information exchange opportunities through 2017 and 2018;
- PEIR submission – November 2018;
- PEIR formal consultation – November and December 2018 (a minimum of 28 days); and
- DCO application submission – June 2019.

1.2 Site Selection and outline assessment of alternatives

43. This section provides an overview of the main site selection activities which have defined the Norfolk Boreas project thus far and therefore have defined this Scoping Report and scoping areas (both onshore and offshore) described in Section 1.1.3 and 1.1.4.

44. Norfolk Boreas and Norfolk Vanguard are adjacent offshore wind farm sites and will both connect to the National Grid at the Necton National Grid Substation. Therefore, there has been a strategic approach to identifying locations for all

infrastructure with the aim of optimising overall design, minimising impacts and reducing the cost of energy where practicable across both projects. The site selection work considers for example, the co-location of infrastructure where practical, the timing of works for both projects, and cumulative impacts. Constraints mapping and site selection work is ongoing to refine the locations of the onshore infrastructure (see Section 1.4) for both Norfolk Vanguard and Norfolk Boreas.

45. Consent for the projects will be sought separately, however this strategic approach to site selection will allow a more thorough understanding of any cumulative impacts at an early stage, providing transparency to all stakeholders and assisting with the technical aspects of the EIA.

46. Section 1.5 of the Norfolk Vanguard Scoping Report (Royal HaskoningDHV, 2016a) contains an explanation of the key decisions which have been made prior to its publication in October 2016. This section of the Norfolk Boreas Scoping Report summarises those decisions and provides an update on progress that has been made since October 2016.

1.2.1 Site selection process

47. The Norfolk Boreas project has been identified through a detailed site selection process taking account of environmental, physical, technical, commercial and social considerations and opportunities as well as engineering feasibility with the aim of identifying sites that will, in the long term, provide the lowest cost of energy whilst minimising impacts.

48. The site selection process (shown in Plate 1.2) began with the identification of the Offshore Wind Farm location itself, with the onshore scoping area being driven by the grid connection offer from National Grid.

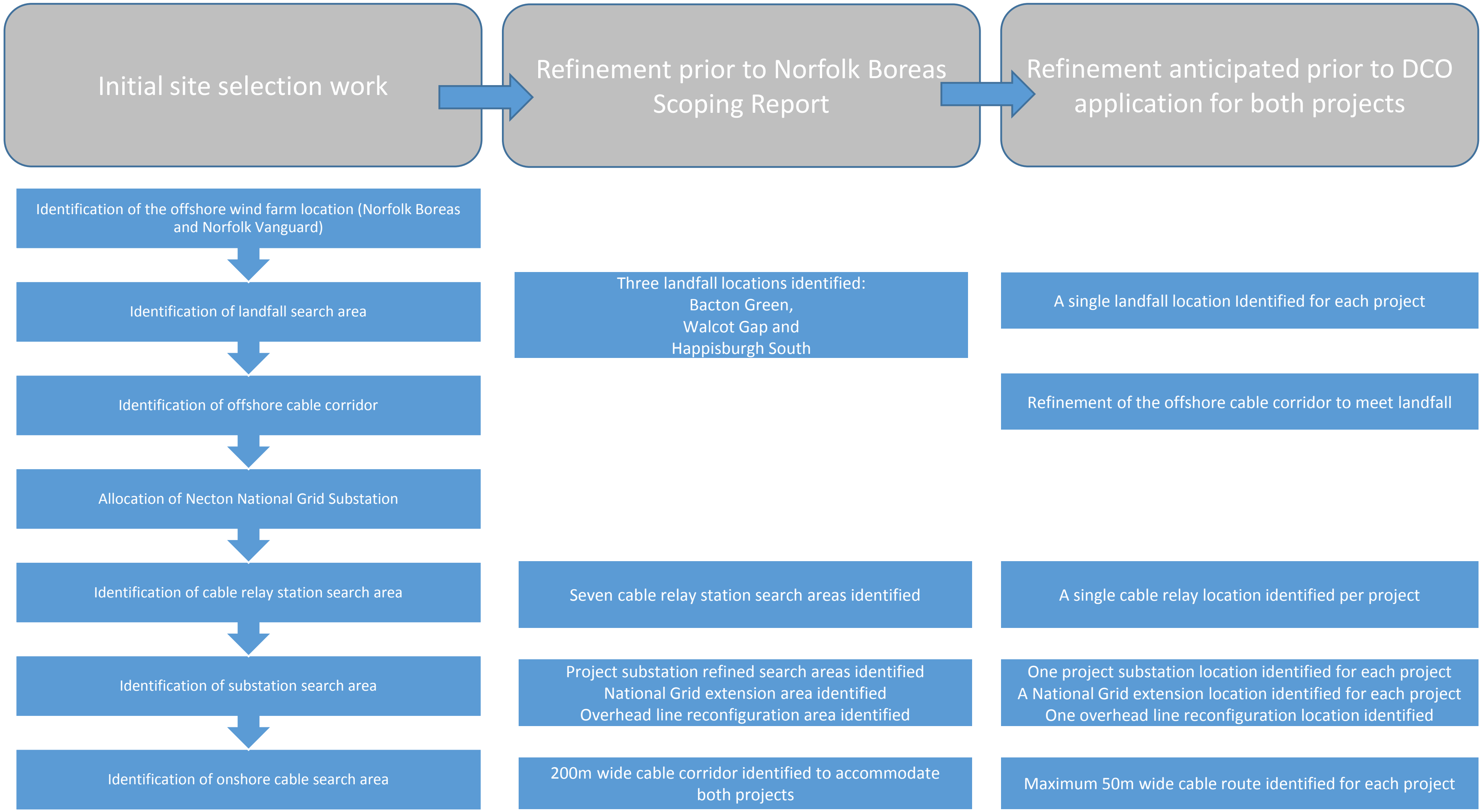

Plate 1.2 Site selection process for Norfolk Boreas scoping area

1.2.2 Zone 5

49. The former Zone 5 (former East Anglia Zone) was originally identified as a suitable area offering 'potential for offshore wind' by The Crown Estate as part of the Round 3 Offshore Wind Zone tendering process in 2008. All the Round 3 Zones were identified using an iterative process that took account of a number of constraints imposed by existing or future use of the sea.

50. The proposed Round 3 zones were the subject of the Offshore Energy Strategic Environmental Assessment (OESEA) which assessed the environmental and other implications of developing within the zones. The results of this strategic level analysis showed that the zones represented suitable 'areas of opportunity' for offshore wind projects, and had the ability to deliver the desired capacity of offshore wind power generation projects within acceptable environmental limits. The zones were subject to an offshore tender round in 2009.

1.2.3 The Norfolk Boreas site

51. Following the offshore tender round in 2009, The Crown Estate awarded EAOW the rights to develop the former East Anglia Zone, which is located off the coast of East Anglia and has a target capacity of 7,200MW.

52. The first projects within the former East Anglia Zone were identified through the Zonal Appraisal and Planning (ZAP) process which was started in 2010 following the award of the Zone. This resulted in the formation of a Zonal Development Plan (ZDP) in 2012 which identified areas with the least environmental and technical constraints.

53. Where potentially significant cumulative and in-combination impacts were identified, further targeted research was initiated to better understand these impacts. This included studies on shipping, birds and marine mammals.

54. As discussed in Section 1.1.2, following the decision to split the former East Anglia Zone, VWPL took control of all development activities for projects in the northern half and Scottish Power Renewables (UK) Limited in the southern half. Commercial agreements to finalise this arrangement were completed in February 2016.

55. During 2015, VWPL revisited the ZDP for the northern half of the former East Anglia Zone. The locations of Norfolk Vanguard and Norfolk Boreas projects were identified using a three-step process:

- Step 1: Potential offshore development areas which had been identified in the ZDP were reviewed through spatial constraints mapping. The key environmental constraints considered were:

- Shipping and navigation;
- Existing infrastructure, including cables and pipelines and oil and gas platforms;
- Aggregate dredging grounds;
- Other wind farms;
- Nature conservation designations;
- Commercial and natural fisheries activity; and
- Civil and military radar coverage and helicopter main routes.

- Step 2. The areas identified were subject to a review of the following technical aspects:
  - Wind resource to provide production estimates;
  - Metocean data to understand weather downtime;
  - Bathymetry and available seismic and borehole data to assess monopile feasibility;
  - Sandwave data in relation to cable burial;
  - Electrical design and grid connection options; and
  - Development of a preliminary O&M strategy.

- Step 3. A cost comparison model was set up for those sites deemed to be technically feasible, to identify which sites would provide the lowest cost of energy and therefore project viability (see Section 1.3.3). This exercise was based on the following indicative parameters (see Section 1.5 for an outline of the likely parameters of Norfolk Boreas that will be considered in the EIA):
  - One 75 x 8MW (600MW) phase of a wind farm;
  - A High Voltage Alternating Current (HVAC) connection;
  - Monopile foundations;
  - 75kV array cables;
  - 220-245kV export cables;
  - Two export cables;
  - One offshore substation; and
  - A connection to the national grid close to the coast.

56. Based on the review of known site characteristics, the parameters which were deemed differentiable between project areas at this early stage of development were wind farm production, offshore operational costs, offshore transmission costs and foundation installation costs. Preliminary results showed that the location of Norfolk Vanguard sites would provide the lowest cost of energy to consumers (in line with Government targets) whilst minimising environmental impacts and that the Norfolk Boreas site would be next most suitable.

57. The main considerations when identifying the location of Norfolk Boreas were:

- Located beyond 12nm from the shore therefore avoiding shore to sea visual amenity impacts and reducing interaction with inshore fisheries interests;
- Outside the International Maritime Organisation (IMO) route and within area of relatively low density shipping in the context of the former Zone;
- Outside any dredging and aggregate extraction areas;
- Outside any known Ministry of Defence (MoD) danger and exercise areas;
- Outside any existing Natura 2000 sites (at that time) and Marine Conservation Zones (MCZs)[2];
- Outside any areas of known significant ornithological activity[3];
- Outside herring spawning areas;
- Located such that it reduces the number of cable and pipeline crossings likely to be required[4].

58. In 2016, an AfL for Norfolk Boreas was awarded to VWPL (and its affiliate companies) from The Crown Estate. This required a rigorous review process to demonstrate that the site did not conflict with any other developments, it represented best and most efficient use of the seabed and that its development was in accordance with relevant legislation.

1.2.4 Landfall and provisional offshore cable corridor

59. Landfall location 'areas of search' were initially identified through constraints mapping and a site walkover by a landscape architect. Details of this exercise are presented in the Norfolk Vanguard EIA Scoping Report (Royal HaskoningDHV, 2016a) and summarised below.

60. The majority of the Norfolk coast is subject to important designations such as:

- North Norfolk Coast Area of Outstanding Natural Beauty (AONB) - from Hunstanton to Mundesley, just north of Bacton;
- Norfolk Broads National Park - from Sea Palling to Lowestoft; and
- Suffolk Coast and Heaths AONB - from Kessingland, south of Lowestoft to Felixstowe.

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[2] A possible Special Area of Conservation (pSAC) for harbour porpoise (see Section 2.15) was under consultation at the time. This has now been submitted to the European Commission (on 30th January 2017) for approval to designate and is now a candidate SAC (cSAC), However as plans currently cover the entire former Zone, the area, if designated, cannot be avoided.

[3] Its distance from the nearest existing SPAs for breeding birds (219km from Flamborough Head and Bempton Cliffs and 113km from the Alde-Ore Estuary) reduces the potential for interaction with breeding and foraging bird species.

[4] Crossing agreements will be required for cables or pipelines that are crossed by the project's export or array cables; proximity agreements may also be required if infrastructure is placed within a set distance from existing cables or pipelines.

61. Therefore the following areas of search were identified:

- Mundesley to Sea Palling (Bacton area);
- Gorleston-on-Sea; or
- Lowestoft to Kessingland (Lowestoft area).

62. In parallel with the landfall assessment, VWPL's in-house mapping team identified options for provisional offshore cable corridors from Norfolk Vanguard and Norfolk Boreas windfarm sites to each of the three landfall areas of search. Offshore constraints included in this exercise were:

- Other wind farms;
- Shipping and navigation;
- Cables;
- Oil and gas infrastructure including platforms and pipelines;
- Military Practice and Exercise Areas (PEXAs);
- Aggregate dredging grounds;
- Nature conservation designations;
- Commercial fishing; and
- Seabed features.

63. The route lengths and cable crossings for the provisional offshore cable corridor options identified are shown in Table 1.1.

Table 1.1 Route lengths and cable crossings for the provisional offshore cable corridor options

Potential landfall areas	Measured route lengths to potential offshore substation locations (km)	No. active cable/pipeline crossings required
Bacton area	132 (max)	3 cables/2 pipelines
Gorleston–on–Sea	120 (max)	2 cable/2 pipelines
Lowestoft area	140 (max)	4 cables/3 pipelines

64. Due to the complex nature of these coastal areas of search, both technically and given the large number of activities and designations, a comprehensive assessment was then undertaken to better understand the risks associated with each option. Two external studies were commissioned:

- Cable constructability assessment (Global Marine Systems (GMSL), 2016). This study assessed geology and seabed topography along offshore cable corridor options to the Bacton area and Gorleston-on-Sea. Cable installation risk and design considerations were also assessed and proposed refinements made to reduce the risks identified.

- HDD feasibility report (Riggall and Associates Ltd, 2016). This provided a subjective ranking of 13 possible landfall sites from Bacton to Lowestoft. This ranking was done on the basis of both offshore and onshore risks, including access, distance from residences, environmental constraints, geology and coastal erosion.

65. The route to a landfall in the Lowestoft area was considerably longer than the other routes as well as being more complex, requiring the highest number of cable crossing agreements (see Table 1.1). For this reason, the Lowestoft to Kessingland area of search was removed from further consideration at an early stage.

66. The conclusion of the GMSL study was that the offshore cable corridor to Gorleston-on-Sea was less favourable than the Bacton area as this option was:

- Within an area of highly mobile sandwaves; and
- Close to aggregate dredging areas.

67. In addition all onshore cable routes from this location would also have to be routed through the Broads National Park. The offshore cable corridor to the Gorleston-on-Sea area of search was therefore discounted and the Mundesley to Sea Palling area of search (Bacton area) was taken forward as the most preferred.

68. The provisional offshore cable corridor with a landfall in the Bacton area was seen as favourable for the following reasons:

- It provides a relatively short route (compared with the Gorleston–on–Sea option) from Norfolk Vanguard and Norfolk Boreas;
- There are minimal cable/pipeline crossings required (up to five active cable crossings (across both projects) and two pipeline crossings);
- Where cable/pipeline crossings are required, routeing at close to 90° is possible which will minimise physical, and in the case of cables, electromagnetic interaction which could affect performance;
- It crosses the shipping deep water route using the shortest distance;
- It avoids the areas of known inshore seabed mobility off Gorleston;
- It is around 6km from the aggregate dredging grounds off Lowestoft thereby reducing any interaction;
- The minimum corridor width of 2km could accommodate cables from both the Norfolk Vanguard and Norfolk Boreas project should this be required; and
- It allows for onshore cable routeing options outside the Broads National Park.

69. The AfL for the Offshore Transmission area was awarded to VWPL (and its affiliate companies) from The Crown Estate in February 2017.

70. Following the responses to the Norfolk Vanguard Scoping Report, the shared site selection work continued; further work on HDD feasibility and feedback from the

first set of Norfolk Vanguard public drop-in exhibitions (held in October 2016) resulted in three landfall zones identified within which suitable landfall locations can be established. These are:

- Bacton Green;
- Walcott Gap; and
- Happisburgh South.

71. The final single landfall location for the Norfolk Boreas export cables will be based on the findings of ongoing consultation (including community drop-in exhibitions held in March/April 2017 see Section 5.3) and further technical studies in relation to coastal erosion, archaeological impacts, visual impacts of the cable relay station and the Cromer Shoals Chalk Bed MCZ.

72. Initial survey and data collection will enable the selection of the landfall location for Norfolk Vanguard and for Norfolk Boreas. Therefore this scoping report will initially consider all zones which will then be refined in the PEIR once a final landfall location is selected.

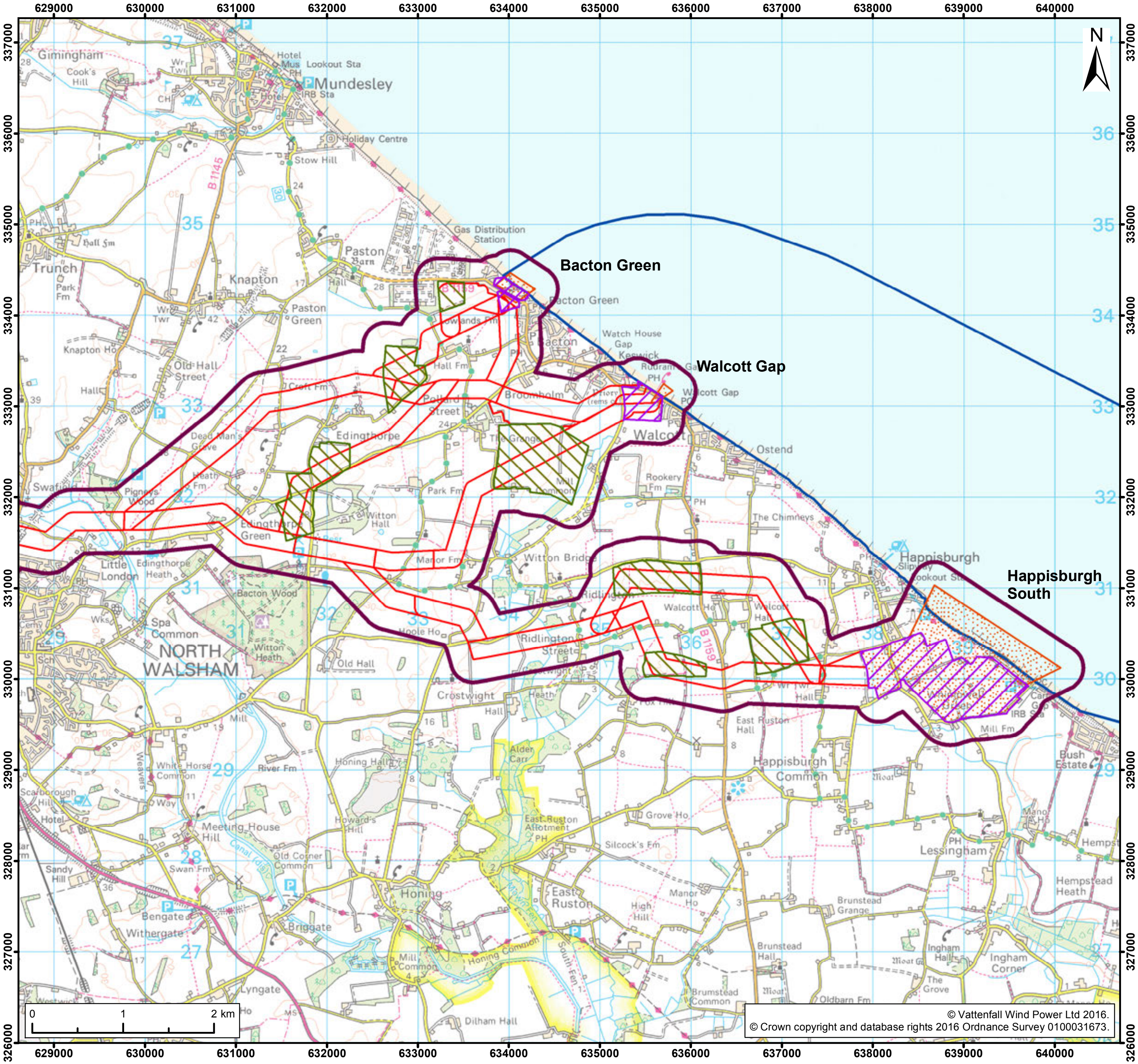
73. The offshore cable corridor (shown in Figure 1.1) will be further refined in the PEIR, specifically in the inshore area to align with the final landfall location once this has been selected from the three options.

1.2.5 Cable relay station

74. During the site selection of the landfall zones regard was also given to potential locations for cable relay stations which may be required under the HVAC solution (Section 1.5.4.1) for both the Norfolk Boreas and Norfolk Vanguard projects.

75. The project team agreed the design assumptions upon which to base the cable relay station locations. These were:

- To align footprints with the identified preferred cable routes to minimise additional cable route length deviations (where possible);
- To provide a required site area of 200m x 120m for each project (which includes an allowance for temporary construction areas);
- Applying general established site selection principles of avoiding designated sites, flood zones, landfill sites etc. where possible;
- To site footprints in close proximity to a road network where possible to aid delivery of materials during construction;
- To utilise orientation requirements for the footprints in relation to cable route as directed by engineering team.



Legend:

- Onshore Scoping Area
- Provisional Offshore Cable Corridor

Norfolk Boreas Onshore Infrastructure

- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Cable Relay Station Zone
- Landfall Zone

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Landfall and Cable Relay Station Zones

Figure: 1.3 Drawing No: PB5640-102-003

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	DT	A4	1:60,000
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Co-ordinate System: British National Grid **EPSG:** 27700

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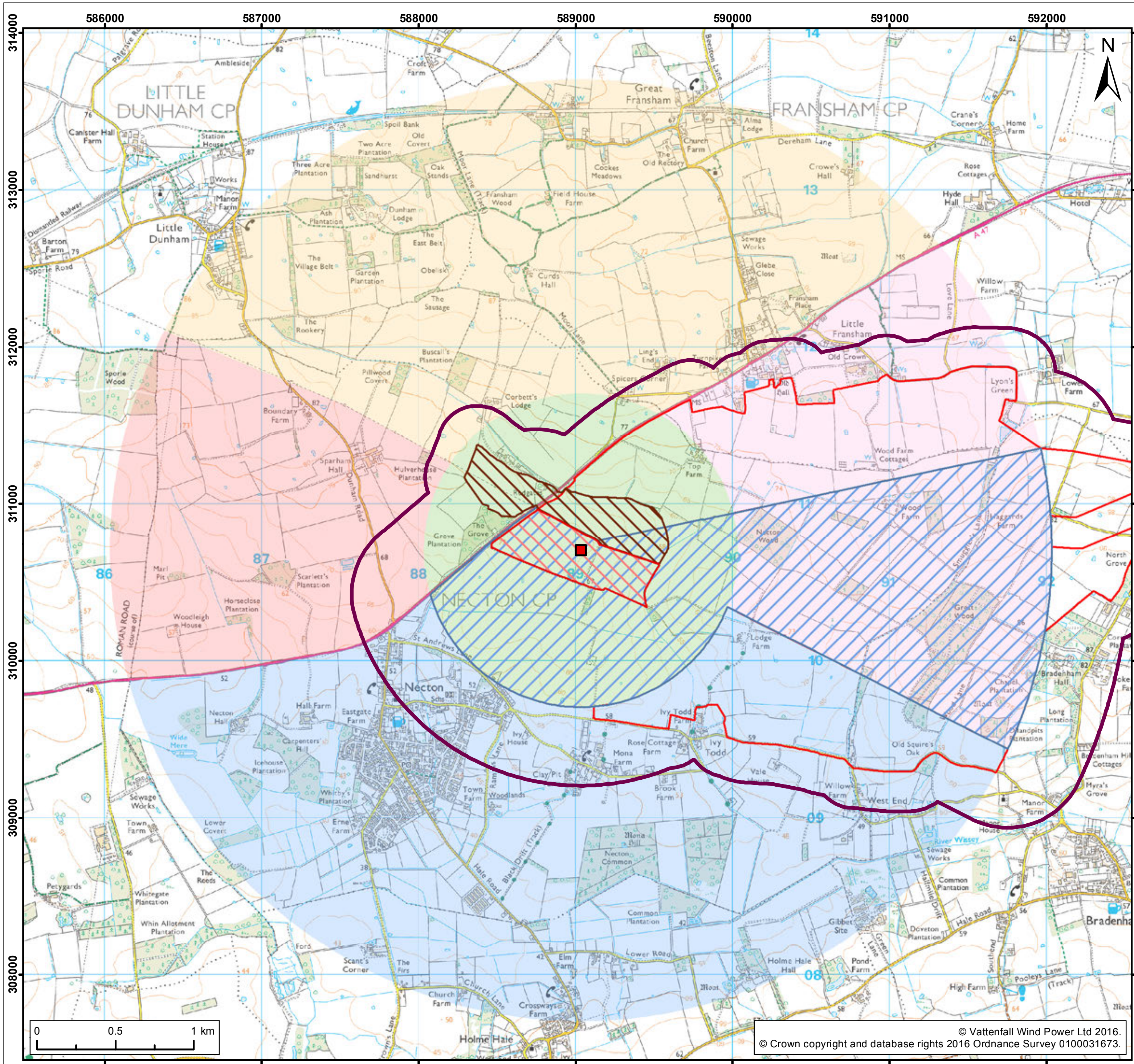

Legend:

- Onshore Scoping Area
- Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone[1]
- Onshore Cable Corridor

Substation Search Area

- Sector 1
- Sector 2
- Sector 3
- Sector 4
- Sector 5

[1] Further iterations of this search area will be developed during 2017, see paragraph 31

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Substation Search Area

Figure: 1.4 | Drawing No: PB5640-102-004

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	17/03/17	JE	DT	A4	1:35,000
01	25/01/17	JE	DT	A4	1:35,000

Co-ordinate System: British National Grid **EPSG:** 27700

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76. The results of this work are the seven cable relay station zones shown in Figure 1.3. These will be reduced to one location following a decision on the final landfall location. It should be noted that the green hatched areas shown in Figure 1.3 represent the area in which the cable relay station could be located and not the actual footprint which would be smaller (150m × 75m) than the areas shown.

1.2.6 Grid connection

77. In May 2010, following the award of rights to develop the former East Anglia Zone, EAOW submitted an application for 7,200MW of generation capacity within the former Zone. In November 2010, National Grid offered connection for this capacity as three separate grid agreements which was then modified in November 2012, to provide six separate agreements for East Anglia ONE to the then East Anglia SIX.

78. The change in operating structure of EAOW, resulted in VWPL and Scottish Power Renewables (UK) Limited each retaining connection agreements for up to 3,600MW, i.e. each now has half of the total capacity of the zone.

79. In July 2016, following a site selection exercise, a modification application for Norfolk Vanguard and Boreas projects was submitted to National Grid to align former agreements to the new development projects. This application included changes to the 'offshore assumptions', notably the potential locations of the offshore substation platforms and the project timelines. The application triggered a detailed review by National Grid and the Applicant to look at the range of connection options and identify the most efficient and economic point to connect to the National Grid network. A grid connection offer for Norfolk Boreas was provided by National Grid in October 2016 based on an onshore connection point at the Necton National Grid Substation. The Applicant accepted this offer in November 2016 and is committed to installing project cables underground which has the benefit of avoiding landscape and visual impacts associated with overhead lines.

80. Confirmation of the connection location at the existing Necton National Grid Substation allowed search areas / zones to be identified for the onshore infrastructure, i.e. the onshore project substation, cable relay station, the current onshore cable corridor and landfall (See Section 1.2.4).

1.2.7 Onshore project substation

81. VWPL has undertaken a detailed constraints analysis to determine possible locations to site the Norfolk Vanguard and Norfolk Boreas onshore project substations. This process is described in detail in the Norfolk Vanguard Scoping Report (Royal HaskoningDHV 2016) but is summarised here.

82. The analysis used National Grid's Guidelines on Substation Siting and Design (The

Horlock Rules).

83. The Horlock Rules state that:

"Consideration must be given to environmental issues from the earliest stage to balance the technical benefits and capital cost requirements for new developments against the consequential environmental effects in order to keep adverse effects to a reasonably practicable minimum."

84. Consideration was given to placing the electrical infrastructure as close as possible to the existing National Grid connection point (where feasible) in order to minimise the landscape and visual effects associated with introducing new electricity infrastructure to the environment. Locating the onshore project substation has taken, and will continue to take into account the following elements:

- Amenity, cultural or scientific value of the sites;
- The local context, planning policy and guidance;
- Existing land use; and
- Feedback from the community and other stakeholder consultation.

85. The following development considerations have influenced, and will continue to influence the final location of the onshore project substation site:

- Community;
    - Proximity to residential properties;
    - Proximity to public rights of way; and
    - Sensitive land uses, e.g. schools, hospitals.
- Archaeology, heritage and ecology;
    - Presence/proximity to Scheduled Monuments and listed buildings;
    - Ecology;
    - Proximity to designated sites; and
    - Presence of protected species.
- Landscape;
    - Proximity to Areas of Great Landscape Value (AGLV);
    - Proximity to other areas of local landscape importance; and
    - Landscapes sensitivity to development.
- Hydrogeology, land quality and flood risk;
    - Proximity to Source Protection Zones (SPZ);
    - Presence of potentially contaminated land; and
    - Flood risk.

- Engineering requirements;
  - Highway access (construction and operation); and
  - Complexity of design required.
- Property;
  - Number of landowners.
- Planning.
  - Other planning applications that may influence future development.

86. The outcome of an initial site selection exercise was the identification of the onshore project substation search area (see Figure 1.4). In accordance with the Horlock Rules, the onshore project substation search area was defined as a maximum 3km radius from the Necton National Grid Substation. In order to understand the constraints and opportunities associated with the onshore project substation, and allow more targeted feedback from consultation, the onshore project substation search area was divided into five sectors (shown in Figure 1.4) using the following approach:

- The main A47 road (divides the search area from south-west to north-east);
- The existing overhead electricity lines (divides the search area from north-west to south-east direction following the same trajectory); and
- A generic 1km radius from the Necton National Grid Substation.

87. Following the production of the Norfolk Vanguard Scoping report in 2016, VWPL held drop-in exhibitions providing an opportunity to consult with public and stakeholders. Feedback from these consultations indicated that Sector 5 (to the south of the Necton National Grid Substation) and Sector 1 (to the east) would be the best Sectors for the siting of onshore project substations.

88. Sectors 2, 3 and 4 were discounted for several reasons including the overall length of cable route, costs, engineering constraints and proximity to the larger residential areas.

89. There are a number of opportunities for minimising local disturbance and environmental impacts associated with siting the onshore project substations within Sector 1. During the public exhibitions in October 2016, comments from local communities also highlighted this Sector as one of the preferred options. Sector 1 has therefore been taken forward as a potential area for siting the onshore project substation, but the Sector has been refined further to take into account the cable corridor search area, and feedback from the local community.

90. There was a strong indication from the local communities during the public exhibitions in 2016 of a preference to keep all project infrastructure as close as

possible to the existing Necton National Grid substation. There is the advantage of existing screening in this area from the Dudgeon Offshore Wind Farm project, an existing access from the A47 and keeping industrial infrastructure together. Sector 5 has therefore been taken forward as a potential area for siting the onshore project substation, but the Sector has been refined further to take into account the engineering requirements in this area and feedback from the local community.

91. The refined onshore project substation zone shown in Figure 1.4 includes the parts of Sectors 1 and 5, south of the A47 and south of the existing overhead line. Further iterations of this search area will be developed during 2017 following review of feedback from public drop-in Exhibitions held in March 2017 (See Section 5.3) and with due regard to input from other stakeholders (see paragraph 31).

92. A search area for underground cables to connect the project substation to the Necton National Grid Substation has also been refined. This is within sector 1 and has been included within the onshore cable corridor shown in Figure 1.4.

93. The onshore project substation zone and onshore cable corridor for Norfolk Boreas will be refined prior to the submission of PEIR and following the results of onshore surveys and further consultation.

1.2.8 Extension to the Existing Necton National Grid substation

94. Since submission of the Norfolk Vanguard Scoping Report (Royal HaskoningDHV, 2016a) a decision has been made by the VWPL to include the required extension works to the Necton National Grid Substation (Section 1.5.4.4) within the EIA and DCO applications for both Norfolk Vanguard and Norfolk Boreas. This is to enable a more transparent impact assessment and allow the development of more effective mitigation across the site.

95. Appropriate search zones (Figure 1.4) for the extension works have been developed in consultation with National Grid, including:

- National Grid Substation Extension Zone - Land adjacent to the existing Necton National Grid substation which could accommodate extension to the existing busbars (Metal bar that conducts electricity within a substation).
- Overhead line modification zone - Land where overhead line realignment works maybe required adjacent to the existing Necton National Grid substation.

96. VWPL will work closely with National Grid to ensure the design of the extension works is appropriate.

1.2.9 Onshore cable corridors

97. The location of the onshore cable corridors was identified as part of a detailed site selection process which examined possible routes to accommodate export cables for both Norfolk Vanguard and Norfolk Boreas. Full details of this process are provided in the Norfolk Vanguard Scoping Report (Royal HaskoningDHV 2016) and are summarised below.

98. The process was largely driven by the location of the landfall search area (Section 1.2.4) and the connection location to National Grid (Section). Detailed feasibility and route selection studies have identified a 200m wide onshore cable corridor using the following key principles:

- Avoid proximity to residential dwellings;
- Avoid proximity to historic buildings;
- Avoid designated sites;
- Minimise impacts to local residents in relation to access to services and road usage, including footpath closures;
- Wherever possible, the onshore cable corridor would seek to utilise open agricultural land;
- Minimise requirement for complex crossing arrangements, e.g. road, river and rail crossings;
- Avoid areas of important habitat, trees, ponds and agricultural ditches;
- Install cables in flat terrain maintaining a straight route where possible for ease of pulling cables through ducts;
- Avoid other services (e.g. gas pipelines) but aim to cross at right angles where crossings are required;
- Minimise the number of hedgerow crossings, utilising existing gaps in field boundaries if possible; and
- Minimise impacts on agricultural practices and access, avoid rendering parcels of agricultural land inaccessible during construction.

99. The result is the onshore cable corridors which are displayed in Figure 1.2. The onshore cable corridors are expected to be refined to a 50m wide cable route prior to PEIR and following the results of onshore surveys and further consultation.

1.3 Need for the project

100. The key drivers underpinning the need for offshore wind power projects are:

- The need to reduce greenhouse gas emissions,
- The need for energy security,
- The need to maximise economic opportunities from energy infrastructure

investment for the UK, and

- The need to produce affordable energy.

101. In a post-Brexit vote speech at the Utility Week Energy Summit in July 2016, Andrea Leadsom, the then UK Energy Minister confirmed the importance of these key drivers to the UK and that offshore wind has strategic importance in achieving these (HM Government, 2016). The UK government has committed to support up to 10GW of new offshore wind projects in the 2020s (HM Government, 2016).

1.3.1 The need to reduce greenhouse gas emissions

102. On current predictions, a continuation of global emission trends, including emissions of greenhouse gases such as carbon dioxide, could lead average global temperatures to rise by up to 6°C by the end of this century (Department of Energy and Climate Change (DECC), 2011a). The potential impacts associated with such a global temperature rise include (DECC, 2014):

- Increased frequency of extreme weather events such as floods and drought;
- Reduced food supplies;
- Impacts on human health;
- Increased poverty; and
- Ecosystem impacts, including species extinction.

103. Commitment was made during the 21st Conference of the Parties (COP) in Paris in 2015 (Section 1.3.1) to pursue efforts to limit the global temperature increase to within 2°C of the pre-industrial average temperature, with an aspiration for an improved limit of 1.5°C. This was ratified by the UK foreign secretary in November 2016.

104. In order to contribute towards these commitments the UK government in its fifth carbon budget (June 2016) committed to a 57% cut in carbon emissions by 2032, on 1990 levels. The fifth carbon budget also states that "*It is important that the low-carbon portfolio includes roll-out in the 2020s of offshore wind*" (Committee on Climate Change, 2015).

105. In order to achieve reductions in carbon production the UK has committed to providing 15% of the UK energy demand from renewable energy sources (DECC, 2011a). The Committee on Climate Change has also recommended that the UK government should support 1-2GW of new offshore wind per year.

1.3.2 The need for energy security

106. Net import of electricity to the UK in the first quarter of 2016 was at a record high of 6.1% of electricity supply (DECC, 2016a). Electricity generated in the UK during this

period fell by 3.4%. With declining fossil fuel reserves and aging nuclear electricity generating infrastructure there is a need for replacement sources. Around a fifth of the energy generation capacity available in 2011 is expected to close by 2020 (DECC, 2012).

107. The UK OESEA (DECC, 2009), identified up to 33GW of offshore wind capacity in UK waters. This formed the basis of The Crown Estate's Round 3 offshore wind programme, which is intended to contribute significantly to meeting the UK's renewable energy target. Nine offshore wind farm zones of varying sizes (including the former East Anglia Zone) were identified within UK waters to deliver the capacity identified in the OESEA. Renewable energy developers were asked to bid for exclusive rights to develop wind farms within the zones which were awarded in 2010.

108. OESEA3 (DECC, 2016b) reflects the potential contribution of renewables, particularly offshore wind, to emissions reductions and also the objectives of the draft plan/programme. In view of the relative maturity of the different technologies covered by the SEA, it is likely that Offshore Wind will make the largest contribution to a reduction in the overall UK energy supply carbon intensity.

1.3.3 The need to maximise economic opportunities and produce affordable energy

109. A key commitment within the UK's Low Carbon Transition Plan was to assist in making the UK a centre of green industry by supporting the development and use of clean technologies (HM Government, 2009).

110. The Centre for Economics and Business Research (CEBR, 2012) estimates that by 2030, offshore wind could increase the Gross Domestic Product (GDP) value by 0.6% and support 173,000 jobs. In contrast, The Stern Report (Stern, 2006) concludes that if no action is taken to prevent climate change, the economic impacts could be equivalent to losing at least 5% of global GDP each year.

111. During Greg Clarke's (Secretary of State for Business, Energy and Industrial Strategy) speech at Energy UK in November 2016[5] he made clear that "*the debate about whether to reduce emissions is over*" and that there is "*huge economic opportunity of climate change action for UK businesses*". He particularly referenced the East Coast as an area where the offshore wind industry is contributing, and will continue to contribute, to the local economy.

112. There has been a rapid reduction in the cost of energy produced by offshore wind over the past decade with a 32% reduction between 2012 and 2016 (ORE Catapult, 2017). This is mainly driven by technology innovation and by the UK government in

[5] https://www.gov.uk/government/speeches/greg-clark-speech-at-energy-uk:

prioritising a competitive UK energy market that benefits all consumers. Further cost reductions will continue as technologies develop further in response to market pressures.

1.4 Policy and legislative context

113. This section presents a summary of the key legislative and policy drivers that underpin and support development of the Norfolk Boreas project. A full explanation of the relevant policy and legislation for the Norfolk Boreas project will be provided in chapter 3 of the ES and specific legislation relevant to different topic areas will be provided in each receptor chapter.

114. UK legislation is underpinned by a number of international (e.g. EU and United Nations (UN)) agreements, which are outlined in this section. Following the triggering of Article 50 of the Treaty on European Union (TEU) on the 29th March 2017 the UK have committed to a withdrawal from the EU, the UK will continue to be committed to all EU treaties until finalisation of the withdrawal agreement and/or until 29th March 2019. At time of writing, the exact nature of amendments to UK legislation which had an origin in EU law is uncertain.

1.4.1 Climate change and renewable energy policy and legislation

115. Climate change policy has been established at global, European and national level key aspects at all levels are presented in Table 1.2.

Table 1.2 Summary of relevant climate change policy

Policy	Key commitments
United Nations Framework Convention on Climate Change (Kyoto Protocol)	• Limit global temperature increase to below 2oC, while pursuing efforts to limit the increase to 1.5°C; • Commitments by all Parties to prepare, communicate and maintain a Nationally Determined Contribution (NDC); • In 2023 and every 5 years thereafter, a global stocktake will assess collective progress toward meeting the purpose of the Agreement.
European Union Renewables Directive/Renewable Energy Directive	• A reduction of 20% in greenhouse gases by 2020 (below 1990 levels); and • 20% of the total EU energy (electricity, heat and fuel) consumption to come from renewable sources by 2020.
The UK Climate Change Act (2008)	• A reduction of 34% in greenhouse gases by 2020 (below 1990 levels); and • A reduction of 80% in greenhouse gases by 2050
The UK Energy Act (2013)	• Introduction of the Contracts for Difference (CfDs) support mechanism

1.4.2 Planning legislation

116. The Planning Act 2008 (as amended by the Marine and Coastal Access Act (MCAA) 2009, the Localism Act 2011, the Growth and Infrastructure Act 2013, and the

Infrastructure Act 2015) is the primary legislation that established the legal framework for applying for, examining and determining applications for NSIPs taking into account the guidance in National Policy Statements (NPSs).

117. NSIPs require permission to construct and operate known as a DCO, under procedures governed by the Planning Act 2008. Norfolk Boreas is over the 100MW threshold set by the 2008 Act, and therefore is classed as an NSIP and will require a DCO application, supported by an ES.

118. As part of its application for a DCO, the Applicant will seek other relevant permissions, consents and licences which may include:

- Powers to compulsorily acquire land or rights
- Marine works under a deemed marine licence; and
- Powers to divert or stop public rights of way.

119. Secondary legislation and guidance relevant to DCO applications have also been taken into account in planning the approach to the Norfolk Boreas EIA. A full list of these can be found on the Planning Inspectorate website[6].

1.4.2.1 National Policy Statements

120. NPSs are produced by the UK Government and set out national policy against which proposals for major infrastructure projects will be assessed and decided on by the Planning Inspectorate. NPSs include the Government's objectives for the development of nationally significant infrastructure. There are twelve NPS in total, of which six are relevant to energy. The three NPS of relevance to Norfolk Boreas are:

- EN-1 Overarching Energy;
- EN-3 Renewable Energy Infrastructure, which identifies the construction of offshore generating stations in excess of 100MW as NSIPs; and
- EN-5 Electricity Networks, which covers the electrical infrastructure in conjunction with EN-1.

1.4.2.2 Requirement for EIA and the EIA process

121. EIA was introduced under the European Union (EU) EIA Directive 85/337/EEC (as amended by Directives 97/11/EC, 2003/35/EC and 2009/31/EC). The EIA Directive is transposed into English law for NSIPs by the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 (the EIA Regulations). In 2011, the original EIA Directive and amendments were translated into EIA Directive 2011/92/EU (as amended by Directive 2014/52/EU).

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[6] http://infrastructure.planningportal.gov.uk/legislation-and-advice/legislation/

122. The amendments made by EIA Directive 2014/52/EU are due to be transposed into UK legislation in May 2017, after the submission of this scoping report. Key features of the forthcoming amendment to the EIA Regulations will relate to:

- Requirement to provide an assessment of how climate change, human health and natural resources will be affected by the development;
- An enhanced screening and scoping process to ensure EIAs are focused on developments that are likely to cause significant effects and that the EIA is targeted on those potentially significant effects;
- Ensuring EIA quality by requiring that those who undertake the work have competent expertise to do so;
- More detailed demonstration of the consideration of alternatives to the proposed project;
- Further consideration of how to avoid, prevent, reduce and/or off-set significant adverse effects where possible and develop monitoring strategies; and
- The ES will be re-named the EIA report.

123. Projects which enter the planning system (e.g. submit a request for EIA screening or a EIA Scoping Opinion) prior to the 2017 amendment are not required to follow the new EIA Regulations. However, as best practice, the Norfolk Boreas EIA will aim to align and comply with the amended Regulations where practical. The report of the Norfolk Boreas EIA will continue to be called the ES at this stage.

124. The EIA process will take account of guidance provided by the Planning Inspectorate. Of particular interest for the current process are the following Advice Notes:

- Advice Note Three: EIA consultation and notification (the Planning Inspectorate, 2015a);
- Advice Note Seven: Environmental Impact Assessment, Preliminary Environmental Information, Screening and Scoping (the Planning Inspectorate, 2015b);
- Advice Note Nine: Rochdale Envelope (the Planning Inspectorate, 2012a);
- Advice Note Ten: Habitat Regulations Assessment (the Planning Inspectorate, 2016a); and
- Advice Note Twelve: Transboundary Impacts (the Planning Inspectorate, 2015c)
- Advice Note Seventeen: Cumulative effects assessment relevant to nationally significant infrastructure projects (the Planning Inspectorate, 2015d)

1.4.2.3 The project design envelope principle

125. The Norfolk Boreas EIA will be based on a 'Rochdale Envelope' approach. The Planning Inspectorate Advice Note Nine (the Planning Inspectorate, 2012a) recognises that, at the time of submitting an application, offshore wind developers may not know the precise nature and arrangement of infrastructure and associated

infrastructure that make up the proposed project. Where necessary, a range of parameters for each aspect of the project will be defined in the ES and the worst case scenario will be used in each impact assessment. The project design envelope therefore provides the maximum extent of the consent sought. The detailed design of the project can then be developed, refined and procured within this consented 'envelope' prior to construction.

126. The Applicant recognises that maintaining a broad project envelope could lead to uncertainty in stakeholder's minds as to exactly what the proposals are and whether they will be affected by the proposed project. Therefore the applicant will define the project as far as possible before the application is submitted. This will be especially applicable to the onshore elements of the project where local stakeholders will require a greater level of detail to formulate an opinion on the project than those offshore.

1.4.2.4 Transboundary considerations

127. The United Nations Economic Commission for Europe (UNECE) convention (the 'Espoo Convention') sets out the obligations of States to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental effect across international boundaries (transboundary effects). The Planning Inspectorate published Advice Note Twelve: Development with significant transboundary impacts consultation (Planning Inspectorate, 2015c), setting out the procedures for consultation in association with an application for a DCO to the Planning Inspectorate, where such development may have significant transboundary impacts. The Guidance provided in Advice Note Twelve will be followed by the Norfolk Boreas project (Planning Inspectorate, 2015c).

1.4.3 Environmental legislation

128. There are a great many pieces of legislation at international, European and National level that will apply to the Norfolk Boreas project. These will be described within Chapter 3 of the ES and are summarised in Table 1.3.

Table 1.3 Summary of relevant environmental legislation

Level	Legislation	Key aspects/ aims
International	The OSPAR Convention	• Establish a network of Marine Protected Areas (MPAs)
	The Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)	• Establish Ramsar sites to protect important areas for waterfowl
	The Convention on Biological Diversity	• The conservation of biological diversity; • The sustainable use of the components of biological

Level	Legislation	Key aspects/ aims
		diversity; and • The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources.
European	Water Framework Directive (WFD) (2000/60/EEC)	• Ensure a 'good ecological status' of inland, estuarine and groundwater bodies including coastal surface waters up to an offshore limit of one nautical mile.
	Marine Strategy Framework Directive (MSFD) (2008/56/EC)	• Establish a framework within which Member States will take measures to maintain or achieve 'good environmental status' (GES) in the marine environment by 2020
	Habitats Directive 92/43/EEC	• Implements the Bern[7] and Bonn[8] conventions • Aims to conserve natural habitats of wild fauna and flora and is intended to protect biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species, including protection for specific habitats listed in Annex I and species listed in Annex II of the Directive. • Establishment under Article 3 of the Directive of a European wide network of protected sites, known as Special Areas of Conservation (SACs).
	Birds Directive (2009/147/EC)	• Provides a framework for the conservation and management of wild birds in Europe. • Establishment under Article 4 of the Directive a network of Special Protection Areas (SPAs) for rare or vulnerable species listed in Annex I of the Directive
UK Legislation	Marine Coastal and Access Act 2009	• Enables the designation of MCZs in England, Wales and UK offshore waters • provisions for the coastal environment including improving access to the coast and undertaking Integrated Coastal Zone Management (ICZM),
	The Wildlife and Countryside Act 1981	• Enables the designation of SSSI to provide statutory protection to the best examples of flora, fauna, geological and physio-geological features. • Enables Statutory Nature Conservation Bodies to declare sites which are considered to be of national importance as National Nature Reserves (NNRs) • Makes it an offence to intentionally: kill, injure, or take wild birds and to take, damage or destroy the nest of any wild bird while that nest is in use or being built. • Makes it an offence to intentionally kill, injure or take any animal listed in Schedule 5 of the Act and protects occupied and unoccupied places used for

[7] Convention on the Conservation of European Wildlife and Natural Habitats
[8] The Convention on the Conservation of Migratory Species of Wild Animals

Level	Legislation	Key aspects/ aims
		shelter or protection • Makes it an offence to intentionally pick, uproot or destroy any wild plant listed in Schedule 8 and to plant or otherwise cause to grow any non-native, invasive species listed under Schedule 9 of the Act.
	Conservation of Habitats and Species Regulations 2010 (the 'Habitats Regulations')	• Transposes the requirements of Habitats directive (see line 6 above) into UK law within 12 nautical miles • Makes it an offence to kill, injure, capture or disturb European protected species (EPS)
	Offshore Marine Conservation (Natural Habitats & c.) Regulations 2007	• Transposes the requirements of Habitats directive (see line 6 above) into UK law outside of 12 nautical miles • Makes it an offence to kill, injure, capture or disturb European protected species (EPS)
	Countryside and Rights of Way Act 2000	• Gives Natural England the power to designate AONBs
	The Protection of Badgers Act 1992	• Makes it an offence to wilfully kill, injure or take, or attempt to kill, injure or take a badger; and to cruelly ill-treat a badger. • Makes it an offence to intentionally or recklessly damage, destroy or obstruct a badger sett, or to disturb a badger whilst in a sett.
	Natural Environment and Rural Communities Act 2006 (NERC)	• requires the relevant Secretary of State to compile a list of habitats and species of principal importance for the conservation of biodiversity
	The Hedgerow Regulations 1997	• Make it an offence to remove or destroy certain hedgerows without permission from the local planning authority and the local planning authority is the enforcement body for such offences.
	The Commons Act 2006	• The Act aims to protect areas of common land, in a sustainable manner delivering benefits for farming, public access and biodiversity.

1.4.4 Habitat Regulations Assessment

129. Under the Habitats and Species Regulations (2010), the relevant Secretary of State must consider whether a plan or project has the potential to have an adverse effect on the integrity and features of a Natura 2000 site. This process is known as Habitat Regulations Assessment (HRA). Under Regulation 61 of the Habitats and Species Regulations, appropriate assessment is required for a plan or project, which either alone or in combination with other plans or projects, is likely to have a significant effect on a Natura 2000 site and is not directly connected with or necessary for the management of the site.

130. HRA for Norfolk Boreas will follow the four stage process defined by The Planning Inspectorate (2012b):

- Stage 1: Screening is the process which initially identifies the likely impacts upon a Natura 2000 site of a project or plan, either alone or in combination with other projects or plans, and considers whether these impacts may be significant. It is important to note that the burden of evidence is to show, on the basis of objective information, that there will be no significant effect; if the effect may be significant, or is not known, that would trigger the need for an appropriate assessment;
- Stage 2: Appropriate assessment is the detailed consideration of the impact on the integrity of the Natura 2000 site of the project or plan, either alone or in combination with other projects or plans, with respect to the site's conservation objectives and its structure and function. This is to determine whether there is objective evidence that adverse effects on the integrity of the site can be excluded. This stage also includes the development of mitigation measures to avoid or reduce any possible impacts;
- Stage 3: Assessment of alternative solutions is the process which examines alternative ways of achieving the objectives of the project or plan that would avoid adverse impacts on the integrity of the Natura 2000 site, should avoidance or mitigation measures be unable to prevent adverse effects; and
- Stage 4: Assessment where no alternative solutions exist and where adverse impacts remain. At Stage 4 an assessment is made as to whether or not the development is necessary for imperative reasons of overriding public interest and, if so, of the compensatory measures needed to maintain the overall coherence of the Natura 2000 network.

131. The requirement for an appropriate assessment will be determined by the competent authority following consideration of the information presented in the ES and the information to support an appropriate assessment report. The information to support an appropriate assessment report will also contain sufficient information to enable the competent authority to carry out an appropriate assessment should it determine that one is required.

1.5 Project description

132. This section provides an overview of the likely key parameters and descriptions of:

- The project design (Sections 1.5.1 to 1.5.4);
- Different construction scenarios (Section 1.5.4);
- Indicative construction sequencing (Section 1.5.5);
- The possible construction methodologies (Section 1.5.6);
- The operations and maintenance (Section 1.5.7); and

- The decommissioning options (Section 1.5.8).

133. The parameters provided are indicative in order to inform the scoping process and will be further detailed in the PEIR and ES to provide the design envelope (see Section 1.4.2.3) for the DCO application. The key offshore components of the wind farm are likely to comprise the following:

- Wind turbine generators and their associated foundations;
- Offshore substation platforms;
- Offshore accommodation platforms (if required) or offshore accommodation vessels;
- Array cables between the wind turbine generators and the offshore substation platforms;
- Interconnector cables between offshore substation platforms (if required);
- Subsea export cables between the offshore substation platforms and the shore; and
- Scour protection around foundations and on array and export cables as required.

134. The key onshore components of the wind farm are likely to comprise the following:

- Landfall site with an associated transition pit to connect the offshore and onshore cables;
- Cable relay station (if required);
- Onshore underground cables with associated link boxes (if required) and Jointing pits;
- Temporary construction areas and access roads;
- Onshore project substation in proximity to the grid connection location at the existing Necton National Grid Substation;
- Underground cables connecting the onshore project substation with the Necton National Grid Substation;
- Extensions to the existing Necton National Grid substation; and
- Modification of the National Grid overhead lines and supporting structures close to the Necton substation.

135. Equipment (e.g. Light Detection and Ranging (LIDAR)) for monitoring weather and ocean conditions on site may be required during pre-construction, construction and operation.

136. Table 1.4 provides an overview of the indicative project parameters.

Table 1.4 Indicative project characteristics (likely maximum values provided unless otherwise stated).

Feature	Indicative Parameters
Offshore	
Capacity	1,800MW
Lease period	50 years
Estimated initial operational life	25 Years
Number of wind turbines	90-257
Norfolk Boreas site area	725km^2
Distance from Norfolk Boreas site to shore (closest distance)	72km
Approximate provisional offshore cable corridor length to shore	95km
Maximum number of offshore export cables	6 (3 core)
Maximum number of offshore fibre optic cables	6 (integrated in export cables)
Target offshore export cable burial depth	Range of 1 - 3m below seabed
Wind turbine generators capacity	7 -20MW
Maximum wind turbine generators rotor diameter	303m
Indicative hub height	90 to 200m
Indicative wind turbine generators tip height	325m
Minimum rotor clearance above Mean High Water Springs (MHWS)	22m
Indicative minimum separation between wind turbine generators	Four times the rotor diameter
Water depth over the Norfolk Boreas site	25-45m
Offshore substation platforms	Up to 6
Offshore accommodation platform or vessel (if required)	1
Maximum array cable length and type	650km (66kV)
Maximum interconnector number and length	3 × 40km
Landfall	
Location	Within one of three zones: Bacton Green, Walcott Gap or Happisburgh South
Number of cables	Up to 6
Number of transition pits	Up to 6
Transition pit size (buried once constructed)	10m x 15m (5m deep)
Number of HDD exit pits (buried once constructed)	Up to 6
Footprint of HDD exit pit	5m x 3m (2m deep)
Onshore	
Grid connection location	At the existing Necton 400kV National Grid Substation
Number of onshore cables	Up to 18 cables (6 trenches, each with 3 cables in 3 separate ducts)
Number of onshore fibre optic cables	Up to 6 in separate ducts (1 per onshore trench)
Approximate onshore cable corridor length	63km
Number of interface cables (between the project onshore substation and the Existing Necton National Grid Substation and the	Up to 12

Feature	Indicative Parameters
Onshore cable corridor width	200m
Working width for cable installation (cable route)	50m
Cable relay station location (if required)	Would be located in one of the seven cable relay station zones (Figure 1.3).
Cable relay station footprint (if required)	150m x 75m
Cable relay station height (if required)	8m
Jointing pit footprint	15m x 6m (2m deep)
Number of jointing pits	At regular intervals along cable route (500m to 1,000m), up to 6 at each location
Onshore project substation footprint	300m x 250m
Maximum Onshore substation buildings height	25m
Necton National Grid Substation extension footprint	100m x 450m
Maximum Necton National Grid Substation extension building height	15m
Overhead line additional tower height	67m
Overhead line additional tower Footprint	20m × 20m (from outer most edge of feet)

1.5.1 Electrical connection options

137. Two different electrical solutions will be included within the consent application for Norfolk Boreas; high voltage alternating current (HVAC) and high voltage direct current (HVDC). The decision as to which electrical solution will be used for the project will be agreed post consent and will depend on availability of technology, technical considerations, supply chain and cost. HVDC is still a relatively new technology; to date, all offshore wind farms in the UK have used HVAC. The HVAC option will require a cable relay station close to the coast. This option will also require a greater number of cables. Both options avoid the need for overhead lines.

1.5.2 Offshore

1.5.2.1 Wind turbine generators

138. Currently available wind turbine generators include, for example Siemens SWT-154-7.0 (Seimens, 2017) and Vestas V164 (Vestas, 2017), which have ratings of 7MW and 8MW, respectively. Wind turbine generator development between the time of scoping and construction (see Section 1.5.5) is unknown; however it is anticipated, based on industry research, that ratings of up to 20MW may become available prior to construction of Norfolk Boreas. The application and EIA will therefore include a range of rated capacities (e.g. 7MW to 20MW) in order to allow Norfolk Boreas to make use of anticipated industry advances.

139. Based on this wind turbine generator capacity range and the total site capacity of 1,800MW, Norfolk Boreas is likely to consist of a maximum of 257 wind turbine

generators but could comprise as few as 90 and still achieve maximum capacity for the site. It is possible that more than one wind turbine generator model would be used across the site and that the full capacity may not be reached.

140. It is estimated that the maximum wind turbine generator hub height used would be 200m with maximum rotor diameter likely to be 303m. The blades (regardless of wind turbine generator model or size) would maintain a minimum 22m draught height between the lowest point and sea level at highest astronomical tide. The maximum tip height is currently anticipated to be 325m.

141. The wind turbine generators will incorporate tapered tubular towers and blades attached to a nacelle housing the electrical generating equipment.

142. The division of wind turbine generators across Norfolk Boreas will be informed by site investigation works post consent. However it is anticipated that the layout of wind turbine generators would be regular in plan (i.e. wind turbine generators will be set out in rows).

1.5.2.2 Foundations

143. The design of foundations for the wind turbine generators and offshore substation platforms would be informed by site investigation and procurement, post consent. A number of factors would influence the choice of foundation and the parameters of each foundation option (e.g. the type and size of wind turbine generator selected, the nature of the ground conditions, the water depth, metocean characteristics and supply chain constraints). It is possible that more than one type of foundation will be used across the project area. The following foundation design options are currently being considered:

- Monopiles;
- Jackets on pin piles (on 3 or 4 legs);
- Jackets on suction caissons (on 3 or 4 legs);
- Gravity base structures (GBS); and
- Floating.

144. The design options will be defined for the EIA based on initial geophysical and geotechnical survey results and ongoing engineering feasibility studies. Indicative dimensions and construction materials are outlined in Table 1.5 below.

Table 1.5 Foundation descriptions

Foundation type	Description
Monopile	Cylindrical steel pile with conical transitions - up to 20m diameter. Penetration could be 30 to 60m depth below seabed level
Jackets on pin	Steel pin piles - diameter approximately 3m. Seabed penetration of up to 60m. Spacing

Foundation type	Description
piles (3 or 4 legs)	between legs is a maximum of approximately 60m
Jackets on suction caisson (3 or 4 legs)	Steel suction caisson – diameter is approximately 10m -15m each. Penetration of approximately 10-20m. Spacing between legs is a maximum of approximately 60m
Gravity Base Structures (GBS)	A number of design variants will be considered: • Reinforced or pre-stressed concrete shell with sand ballast fill • Typically conical shape • Up to 60m diameter footprint at base • Minimal penetration
Floating	A number of design variants will be considered including: • Mooring line stabilised (tension leg platform with suction pile anchors) • Buoyancy stabilised (Barge with catenary mooring lines)

145. A number of options will be considered (and detailed within the ES) to protect the foundations from scour if required, including rock dumping, frond mats and mattressing. If monopile foundations are selected the area required for scour protection is likely to be five times the diameter (i.e. 10m monopile may require 100m diameter scour protection). Alternative foundation options are likely to require smaller areas of scour protection.

1.5.2.3 Offshore electrical infrastructure

146. Offshore electrical infrastructure would include the following components:

- Array cabling;
- Offshore substation platform;
- Interconnectors (between offshore substation platforms); and
- Export cabling to bring the electricity from the wind farm sites to landfall.

147. 66kV (or higher) array cables would be used to connect the wind turbine generators to the offshore substation platform. Array cables will be 3-core HVAC cables with a diameter of approximately 160mm. The maximum length of array cabling for Norfolk Boreas would be 650km, with a more realistic total length estimated to be 500km. The location of the array cabling will be determined post consent, subject to the final layout design of the wind turbine generators.

148. If HVAC is selected, the 'base case' design would include three 600MW offshore substation platforms, however alternatively, six 300MW offshore substation platforms could be used. The HVDC solution is likely to comprise two 900MW converter platforms. This would provide a combined capacity of 1,800MW for either option.

149. Under either electrical solution up to three interconnector cables (up to 40km in length) may be installed between the offshore substation platforms.

150. The export cables would be either:

- Up to six 3-core HVAC cables operating at 220kV, with a diameter of approximately 250mm; or
- Up to four single core HVDC cables operating at 320kV, with a diameter of approximately 150mm.

151. Fibre optic communications cables (either inside the electrical transmission cables or laid alongside) would be required to allow for System Control and Data Acquisition (SCADA).

1.5.3 Landfall

152. Cable landfall, where the export cables will be brought onshore, would be achieved by a HDD from the land above the seacliffs to the intertidal zone (known as short HDD) or into the subtidal zone (long HDD) (see Section 1.5.6.4). The HDD process would install buried cable ducts. Temporary HDD compounds will be required and will be removed, with the land restored once the ducts are in place.

153. A transition pit will be located at the landward end of the HDD. Transition pits are below-ground structures that house the joints between the offshore export cables and the onshore cables. There would be up to six transition pits located at the landfall site. Typical dimensions for each pit would be approximately 10m wide, 15m long and 5m deep. Each transition pit would comprise a buried concrete structure. The whole structure, including access covers, would be covered with earth and reinstated. These transition pits may also house the required SCADA equipment or alternatively a second set of smaller jointing pits would be installed.

1.5.4 Onshore

154. The EIA will be undertaken using the following scenarios which will be explicitly defined within each onshore technical chapter of the ES:

- Scenario 1: Norfolk Vanguard consents and constructs transmission infrastructure which would be used by Norfolk Boreas. This includes, cable ducts (further information provided below 1.5.4.2) access routes to jointing pit locations, extension of the Necton National Grid substation (further information provided in Section 1.5.4.4), overhead line modification at the Necton National Grid substation (Further information provided in 1.5.4.5) and any landscaping and planting schemes around co-located infrastructure (see Sections 1.5.4.1 and 1.5.4.3 for further detail).

- Scenario 2: Norfolk Vanguard is not constructed and therefore Norfolk Boreas consents and constructs all required project infrastructure including cable ducts, extension to the Necton National Grid Substation, overhead line modification and any landscape and planting schemes.

1.5.4.1 Cable relay station

155. If HVAC electrical solution is selected, a cable relay station would be required in order to condition the electricity for onward transmission to the grid. VWPL are currently investigating the suitability of siting this in one of seven cable relay station zones (Section 1.1.4.2) which are displayed in Figure 1.3. It is envisaged that the cable relay station for Norfolk Boreas would be located in one of these zones, possibly co-located with the cable relay station for Norfolk Vanguard. If it were to be co-located the Applicant's preferred option would be to consent and develop landscaping and planting schemes common to both projects under the Norfolk Vanguard project (Scenario 1) to allow planting to mature as soon as possible prior to construction. To permit for the situation where Norfolk Vanguard is not built, the Norfolk Boreas DCO application will also contain permissions to develop these landscape and planting schemes.

156. The cable relay station would primarily comprise an outdoor compound of up to 150m by 75m (overall area up to 10,500m^2) encompassing reactors (also called inductors, or coils) which absorb unwanted charging currents, which in turn reduces electrical losses in the cables.

157. The likely maximum height of any of the equipment within the cable relay station would be 8m. An indicative visualisation of a cable relay station is provided in Plate 1.3.

Plate 1.3 3D visualisation of cable relay station

1.5.4.2 Onshore cable corridors

Cable installation scenarios

158. To minimise disruption to local communities and disturbance to the environment VWPL hope to install additional ducting (to that required for the Norfolk Vanguard project) within the onshore cable corridors during the first phase of Norfolk Vanguard construction (Scenario 1). The additional ducting would then be used to accommodate onshore cables for the Norfolk Boreas project. However, this is subject to consent for "associated development" being permitted under the Norfolk Vanguard DCO and Norfolk Vanguard construction being completed prior to the start of construction of Norfolk Boreas. Therefore, the Norfolk Boreas DCO application will need to provide the necessary permissions to build a complete, self-sufficient project including duct and cable installation (Scenario 2).

Scenario 1

159. Under Scenario 1 it is assumed that ducts would be installed for the Norfolk Boreas export cables during construction of Norfolk Vanguard. These would be installed along the entire length of the onshore cable route and all required trenchless cable installation operations (apart from those at cable landfall) would be undertaken as part of the Norfolk Vanguard construction. New access routes to jointing pit locations would not be required as these would have already been established by Norfolk Vanguard. Depending on the final timescales of both projects these access routes may need to be reinstated for Norfolk Boreas.

Scenario 2

160. Under Scenario 2 there would be no pre-installed ducts and Norfolk Boreas would have to install the ducts along the entirety of the onshore cable route by open cut trenching and trenchless techniques where required.

161. Under this scenario, Norfolk Boreas would also need to install temporary haul road along the onshore cable corridor, which would be removed and reinstated on completion of the construction works. Access to jointing pits would also need to be established for cable pull through during Phases 2 and 3 (see Section 1.5.5.1).

162. Ducts would be approximately 300mm in diameter and would be made of High Density Polyethylene (HDPE). Onshore cables would be pulled through the ducts (see Section 1.5.6.5).

163. All identified onshore impacts will be assessed against both scenarios within the ES.

Onshore Cables

164. The HVAC option would require up to 18 onshore cables, each in separate ducts. Ducts would be placed in up to six trenches (each trench is approximately 1.5m deep and 1m wide containing up to three ducts) (Plate 1.4). Up to six fibre optic cables would be required, each in separate ducts with one laid in each trench.

165. The HVDC solution would require up to four onshore cables, each in separate ducts. Cables would be laid in up to two trenches, each with two cables (Plate 1.4). Up to two fibre optic cables would be required, each in separate ducts with one laid in each trench. Onshore SCADA infrastructure will be considered as part of the EIA.

166. The following onshore cable options are anticipated:

- HVAC - 220kV, cable diameter approximately 125mm; or
- HVDC - 320kV, cable diameter approximately 150mm.

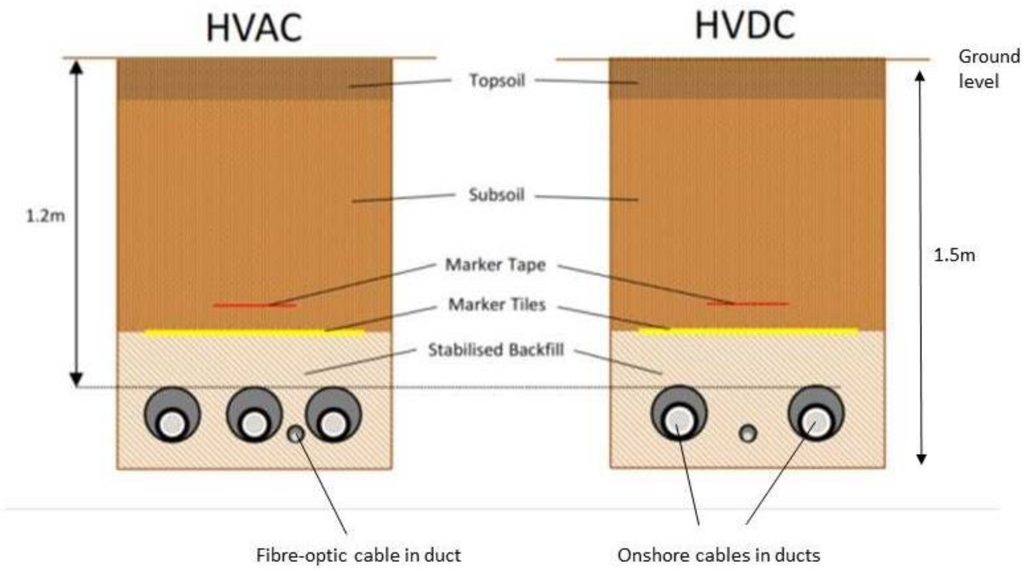

Plate 1.4 Indicative cable trench sections for HVAC (up to 6 trenches required) and HVDC (up to 2 trenches required) options

167. Under Scenario 2 a temporary strip along the entire route would be required during the construction phase (see Section 1.5.6.5) which would provide an area for storage of excavated substrate and a haul road alongside the trench. Under Scenario 1 this would not be required.

168. Plate 1.5 and Plate 1.6 provide an indication of the areas required for the HVDC and HVAC options, showing the maximum cable route width which would be 50m, except for short sections at major crossings and constrained areas where it may be wider.

169. No trenching work will be required under Scenario 1 as ducts will already be installed by Norfolk Vanguard.

170. Under both scenarios the cable would be transported to the site on cable drums in sections and joined together in jointing pits. The length of each section (and therefore the size of the drum) will be subject to constraints, such as available access and procurement but will be a maximum of 1km section lengths.

171. The jointing pits would be underground concrete structures of approximately 10m (length) x 3m (width) x 2m (depth). The jointing pits would be constructed at regular intervals along the cable route (likely to be between 500m - 1000m between jointing pits) to facilitate installation of the cables into the buried ducts (see Section 1.5.6.5), with up to six pits at each location, one for each cable trench. The precise location of the jointing pits will be determined during detailed design, however wherever possible the jointing pits would be located at the edge of field boundaries or roads to facilitate future access and minimise any potential impacts.

172. Link boxes which are a type of jointing bay would be required at a number of joint pit locations (although not all) within the cable corridor for the HVAC solution to maintain power rating. Link boxes are underground structures made of concrete or a composite material with access covers to allow for routine maintenance. There would be small markers at each link box. The other jointing pits will not require access.

173. Temporary mobilisation areas would be required for welfare, parking and storage. Additional working areas will be required at crossing sites. Indicative search areas in which these could be located are displayed in Figure 1.2 (labelled as Mobilisation Zones) and the location and size of all areas required for construction will be further defined in the EIA based on further consultation and constraints identification. The number required and the size may vary depending on whether Scenario 1 or 2 is chosen (both will be defined within the ES).

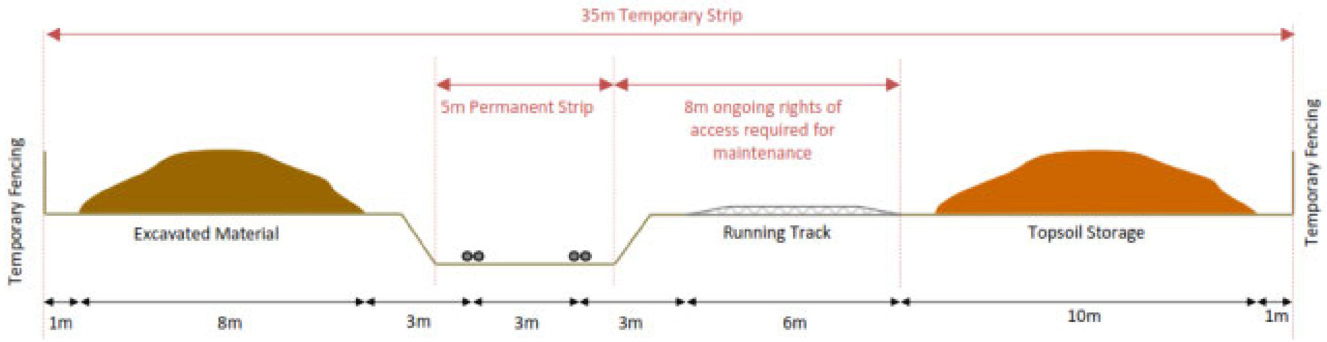

Plate 1.5 Indicative HVDC onshore cable route

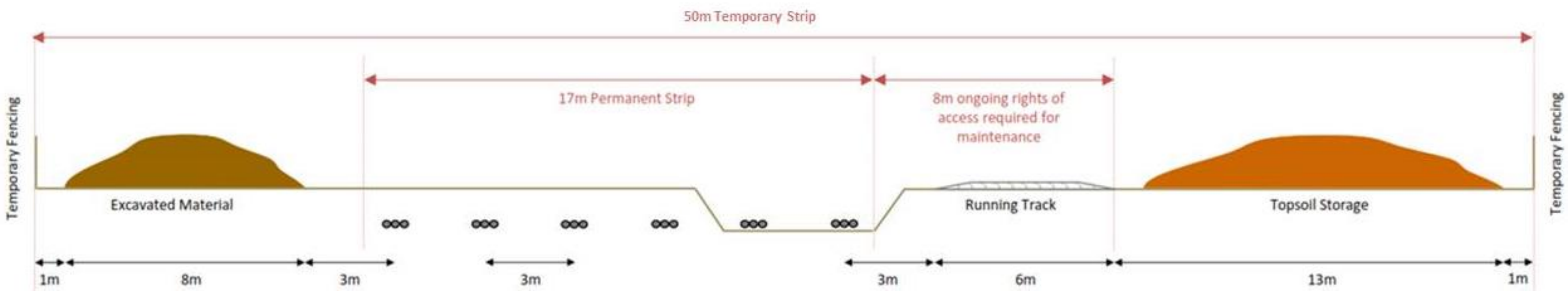

Plate 1.6 Indicative HVAC onshore cable route

1.5.4.3 Onshore project substation

174. An onshore project substation would be required for the Norfolk Boreas project. In an HVAC system the onshore project substation would convert the exported power from 220kV (export cable voltage) to 400kV (grid voltage). For an HVDC system this would convert the exported power from HVDC to HVAC, with a step up to 400kV (grid voltage). For both electrical solutions this also contains equipment to help maintain stable grid voltage.

175. The location of the onshore project substation is yet to be determined, however it is likely to be located within the onshore project substation zone shown in Figure 1.4 (see paragraph 31) with the potential to be co-located with the Norfolk Vanguard project substation. The process by which the area of zone has been identified is described in Section 1.2.7.

176. The onshore project substation would be a fenced compound encompassing buildings and outdoor equipment. The area of the compound would be approximately 300m x 250m, based on the maximum parameters of an HVDC substation. The maximum height of the buildings would be approximately 25m.

177. The appearance of the onshore project substation will depend on whether the HVAC or HVDC technology is utilised. If it were to be co-located with Norfolk Vanguard's substation the Applicants preferred option would be to consent and develop joint landscaping and planting schemes under the Norfolk Vanguard project (Scenario 1) to allow them to mature as soon as possible. To permit for the situation where Norfolk Vanguard is not built the Norfolk Boreas DCO application will also contain permissions to develop its own landscaping and planting schemes.

178. In the case of HVAC, most of the onshore project substation compound would consist of outdoor electrical plant such as transformers, reactors and capacitor banks. The majority of this equipment would be 6m or less in height, but some items would be up to 10m. Infrastructure would include phase reactors, transformers, harmonic filters, STATCOMs (Static compensator), SVC (Static Var Compensator) or equivalent and control buildings all set out in the open. The transformers would be the largest component at a maximum height of 10.1m, with the other components not exceeding 6m; there may also be a number of smaller buildings (indicative height 4m).

179. In the case of HVDC option, the onshore project substation would comprise two identical HVDC converter stations; each converter station would contain a high-voltage AC switchyard area and a large warehouse-style building. The AC switchyard would contain transformers, reactors, capacitor banks and other outdoor equipment. The height of this equipment would generally be 10m or less, but some

items could be up to 15m. The large building would be up to 110m long by 70m wide and would house the DC converter equipment. It would likely be a steel framed structure with cladding panels.

180. An additional mobilisation area of 200 x 100m would be required for both options (HVAC or HVDC) to accommodate offices, welfare facilities, workshops, storage areas and parking. This would be located within the onshore project substation zone (paragraph 31) and adjacent to the onshore project substation. Therefore the total construction area would be approximately 400m by 400m in size.

181. The connection between the Norfolk Boreas onshore substation and the Necton National Grid Substation would require interface cables, comprising up to twelve 400kV underground cables. The interface cables would be buried to a depth of approximately 1m, with protective tiles and warning tape laid above them. This arrangement allows the land to be returned to normal agricultural use, following installation.

182. Indicative onshore project substation visualisations are provided in Plate 1.7. The visualisations include both Norfolk Vanguard and Norfolk Boreas substations in a co-located situation.

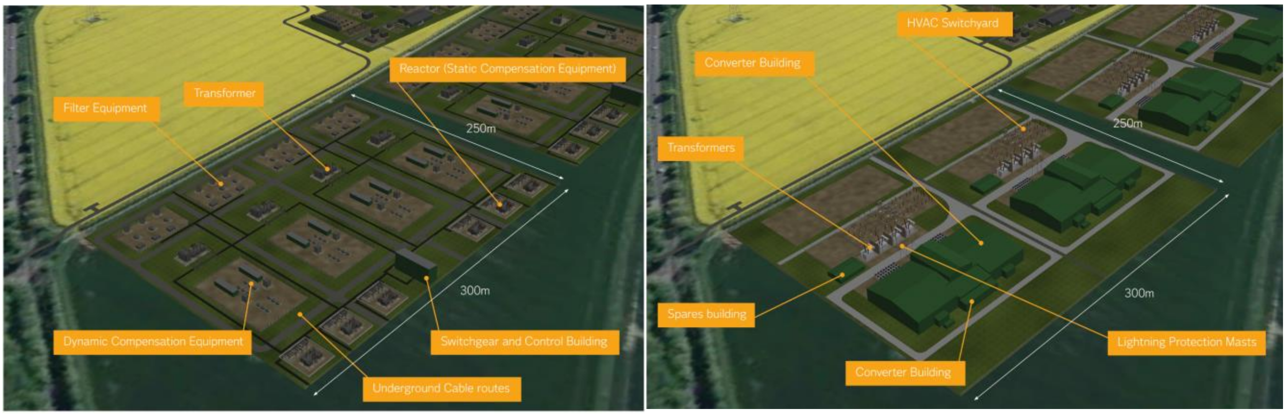

Plate 1.7 3D visualisation of HVDC and HVAC onshore project substations

1.5.4.4 Works at the Necton National Grid substation

183. An extension to the Necton National Grid substation would be required regardless of whether the HVAC or HVDC electrical solution is selected.

184. The extension would also be required for Norfolk Vanguard and it is the preference of National Grid that extensions for both projects are completed at the same time. Therefore Norfolk Vanguard will include within its DCO application permissions to carry out works to extend the Necton National Grid Substation to be able to accommodate both projects. This will include construction of access road, earthworks, foundations, buildings, civil works and Busbar extensions. This will be

considered in Scenario 1. Under this scenario however Norfolk Boreas would still need to install the 400kV switchgear in 'customer bays' provided by National Grid for this purpose.

185. To ensure that the Norfolk Boreas consent is completely independent, the necessary requirements to extend the Necton National Grid substation will also be included in the Norfolk Boreas consent application (Scenario 2).

186. The Necton National Grid substation would need to be extended by a maximum of 12 additional Air Insulation Switchgear (AIS) bays to accommodate both projects. The extension would be in an east west direction with the National Grid substation extension zone shown in Figure 1.4.

1.5.4.5 Overhead line modification

187. Re-configuration of the 400kV overhead lines which export the electricity from the Necton National Grid substation would also be required. This is likely to involve the construction of two new overhead line towers in close proximity to the Necton National Grid substation. These towers would have a footprint of up to 20m × 20m, and a maximum height of 67m and would be constructed in close proximity to an existing tower (located to the north-east of the Necton National Grid substation). The towers would be located within the overhead line modification zone shown in Figure 1.4. The existing tower (which is of similar dimensions to the proposed new tower) would be demolished such that the number of towers increases by one. Alternatively, the existing tower could be modified and one new terminal tower constructed in close proximity. The design and approach to construction will be confirmed at detailed design phase, but construction is not anticipated to require any abnormal loads (large vehicles).

188. This will be applied for as part of the Norfolk Vanguard DCO application (under Scenario 1), however, to account for the situation where Norfolk Vanguard does not get built, Norfolk Boreas will also need to seek permissions to carry out this work (Scenario 2). These works would occur within the overhead line modification zone displayed in Figure 1.4.

189. During the extension of the Necton National Grid substation, perimeter and site lighting would be used during winter months to enable construction activities during the day. Lower levels of light may be used overnight for security purposes only.

190. The Applicant is committed to working closely with National Grid to ensure that any works required are considered as part of the overall project.

1.5.5 Construction sequencing

1.5.5.1 Offshore

191. It is envisaged that Norfolk Boreas would be built out in either two phases of 900MW (HVDC option) or three phases of 600MW (HVAC option). The location of each phase across the wind farm site will be determined based on constraint identification throughout the EIA process as well as post consent site investigations. The EIA will therefore assess up to the capacity of 1,800MW.

192. Norfolk Boreas construction is likely to be staggered with temporal overlap between phases. The objective is to ensure each phase is complete and generating electricity in as short a time as possible. A three phase project may have the following indicative construction programme:

- Phase 1 - Construction 2025 to 2026, commissioning 2027;
- Phase 2 - Construction 2026 to 2027, commissioning 2028; and
- Phase 3 - Construction 2027 to 2028, commissioning 2029.

1.5.5.2 Landfall

193. Installation of the landfall ducts is expected to be from 2024 to 2025.

1.5.5.3 Onshore

194. Onshore project substation infrastructure (groundworks, roads and services, some plant and buildings) and ducting for the onshore cables would be established prior to commissioning the first phase of the wind farm. Installation of cables and onshore project substation plant would then be carried out in sequence with the phases of the wind farm. For the indicative three phase project described above, an indicative programme of onshore activities is provided below:

- Onshore enabling works - 2024 onwards;
- Main works for onshore project substation infrastructure and cable ducting - 2025 to 2026;
- Installation of cables and onshore project substation plant for phase 1 – 2025;
- Installation of cables and onshore project substation plant for phase 2 – 2026; and
- Installation of cables and onshore project substation plant for phase 3 – 2027.

195. It is likely that the early onshore construction activities for Norfolk Boreas will overlap with the later construction phases of Norfolk Vanguard.

196. It is currently anticipated that should Norfolk Boreas be required to proceed with Scenario 2 (see Section 1.5.4), ducts to accommodate all phases of the project would be installed during construction of the first phase.

1.5.6 Construction methods

1.5.6.1 Wind turbine generator and offshore platform installation

197. The wind turbine generators (including foundations, nacelles and blades) and offshore substations are likely to be installed using specialist installation vessels (e.g. jack-up or dynamic positioning (DP) technology).

198. Different methods would be required for installation of foundations dependent upon the type(s) chosen. Some of these methods may first require seabed preparation (e.g. dredging) to level the area, before placement of foundations or grouting and ballasting post-placement. An overview of the installation sequence for each foundation type is provided in Table 1.6.

Table 1.6 Foundation and Wind turbine generator installation overview

Foundation type	Description
Monopile	• Seabed preparation (dredging) as necessary • Piles and transition pieces transported to site • Piles sequentially up-ended and lowered to sea bed • Piles sequentially driven • Transition pieces sequentially installed • Scour protection (if required) • Towers and nacelles pre-erected or erected individually at site using suitable installation vessel • Blades fitted to the tower/nacelle structure as individual components or in a part assembled state.
Jacket on pin piles	• Seabed preparation (dredging) as necessary • Tripods and piles transported to site • Installation template set down on seabed • Piles stabbed and driven • Tripods lifted and set down on piles • Tripods levelled and pile connections grouted • Scour protection (if required) • Towers and nacelles pre-erected or erected individually at site using suitable installation vessel • Blades fitted to the tower/nacelle structure as individual components or in a part assembled state.
Jacket on suction caisson	• Seabed preparation (dredging) as necessary • Tripods and caissons transported to site • Installation template set down on seabed • suction caissons sunk • Tripods lifted and set down on caissons • Connection of caissons • Scour protection (if required) • Towers and nacelles pre-erected or erected individually at site using suitable installation vessel • Blades fitted to the tower/nacelle structure as individual components or in a part assembled state.
GBS	• Seabed preparation (dredging) as necessary • GBS transported to site by vessel (or floated)

Foundation type	Description
	• GBS lowered to seabed • Levelling and underbase grouting • Ballasting of foundation and further levelling as necessary • Scour protection (if required) • Towers and nacelles pre-erected or erected individually at site using suitable installation vessel • Blades fitted to the tower/nacelle structure as individual components or in a part assembled state.
Floating (variety of installation methods available, this is indicative)	• Anchors installed in seabed • mooring line laid and lowered to the seabed with a subsea retrieval system • Floating Foundation and wind turbine generator Unit arrival at site together as one pre-assembled unit • Retrieve the pre-laid mooring line from the seabed using an ROV • Connection made on the deck of the installation vessel • Installation vessel will heave the winch wire until the chain is connected and tensioned to design pretension

199. A number of options will be considered to protect the foundations from scour if required, including rock dumping and mattressing. If monopile foundations are selected the area required for scour protection is likely to be five times the diameter (i.e. a 10m monopile may require 50m diameter scour protection). Alternative foundation options are likely to require smaller areas of scour protection.

1.5.6.2 Offshore cable installation

200. Array and interconnector cables are likely to be installed using either a water jetting or ploughing technique. Water jetting, ploughing, trenching and/or cable injector may all be used for the export cable installation.

201. Burial depth for the offshore export cables would be subject to a detailed burial risk assessment but is likely to be in the range of 1-3m below seabed. Burial provides protection to the cables, however additional protection (rock dumping, frond mats or grout bags) would be required at key locations (e.g. where cable ends enter WTG or platform foundations and when ground conditions or crossings result in the cable being laid near to or on the seabed surface).

202. Where cable or pipeline crossings are required, the design of these crossings would be agreed with the owner/operator to ensure that integrity of all the assets is maintained.

1.5.6.3 Offshore safety zones

203. During offshore construction activities, the Applicant will apply for safety zones[9] around wind turbine generator, platforms and installation vessels as appropriate. These safety zones would be based on an appropriate navigation risk assessment and applied for to the relevant authorities and in consultation with relevant consultees.

1.5.6.4 Landfall

204. HDD methods would be used to install ducts through which the offshore cables would be brought ashore. A fenced working area would be established at a suitable distance from the edge of the coast from which the borehole would be drilled.

205. The short HDD option (discussed in Section 1.5.3) would result in the exit points at just below Mean Low Water Springs so that the drill would emerge at a point that would normally be covered by the tide. The long HDD option could result in the exit points taken up to 1,000m offshore.

206. The factors influencing the choice of HDD (long or short) are complex. Detailed engineering design will need to consider the ground conditions on and offshore to determine whether the length and profile of the HDD route may be constrained by equipment limitations and/or ground conditions. The type and specification of the submarine cable to be used will also factor into the longest distance over which the cable can be safely pulled into the HDD duct and this combined with any restrictions on the HDD technique would determine the maximum length of the long option HDD.

207. Shorter HDD may be constrained by the ability of cable installation and burial equipment to access shallow water to safely land the cable through the HDD and as such the optimum solution and hence exit point locations would most likely fall between the two extremes quoted above, being a factor of all the issues.

208. At the point at which the HDD punches out from the ground, be that a short or long option, a pit would be excavated on the seabed. The pit is designed to protect the installed duct from natural erosion and physical damage from other seabed users (e.g. anchoring or mobile fishing gear). The depth of the exit pit below seabed level would be designed to take into consideration the nature of the seabed and coastal processes that may change the depth of covering substrate over time. Depending on the location of the exit point the pit may be excavated by a land or marine based excavator. The exact dimensions of the exit pit would be a function of the stability of

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[9] Safety Zones are set out in the Energy Act 2004 and the Electricity (Offshore Generating Stations) (Safety Zones) (Applications Procedures and Control of Access) Regulations 2007)

the seabed sediments and the coastal processes that operate at that location but similar projects have required pits that are approximately 5m long, 3m wide and 2m deep.

209. The exact location and design of the HDD pit would be carefully considered during the detailed engineering phase to minimise any impact on coastal processes which may have a long-lasting detrimental effect on the seabed at this or adjacent locations.

210. It is anticipated that the majority of construction work at the landfall would be undertaken in daytime working hours of 7am and 7pm, however during the drilling itself the work may be required to be undertaken outside of these hours.

1.5.6.5 Onshore construction

Pre-construction Work

211. Onshore pre-construction activities may include, but are not limited to, topographic surveys, ecological pre-construction work, archaeological pre-construction work, drainage surveys, geotechnical, ground stability surveys and modifications to field drains (as required).

Construction of the Cable Relay Station

212. This would start with construction of any access roads to the cable relay station, followed by grading, earthworks and drainage of the site.

213. The foundations would be either ground-bearing or piled based on the prevailing ground conditions.

214. The main part of the cable relay station construction would then be the installation of the reactors. Due to their size and weight they would be delivered to the site using multi-axle vehicles which would be subject to the abnormal loads controls.

215. Working hours would normally be 7am to 7pm, however there may be certain exceptions which would be discussed with the local authority and other relevant regulators (for example, larger components may be best delivered outside these hours to avoid traffic impacts). Lighting may be required during construction of the cable relay station to allow for work to continue during the winter. Reduced lighting may be required between 7pm and 7am for security purposes.

Installation of the Onshore Cables

216. The methodology used to install onshore cables will be determined by whether Scenario 1 or 2 as discussed in Section 1.5.4 is implemented.

Scenario 1

217. Under Scenario 1 temporary access points from local roads to the jointing pit locations would need to be established. These would have been established through the Norfolk Vanguard construction however they could require some reinstatement or restoration depending on their condition.

218. Jointing compounds would then be established at regular intervals along the onshore cable route. These would consist of fenced area within which a jointing pit would be excavated to unearth the preinstalled ducts. The jointing pits would then be created within the jointing compound by the placement of precast components or construction of reinforced concrete base slab, walls and cover *in situ.*

219. Each section of cable installed between jointing pits would be delivered to the Jointing pit site on a cable drum, transported to the site by low loader or cable trailer along public highway to nearest access point, then, where necessary, across agricultural land to the jointing pits. The particular low loader dimensions would depend on the cable length on the drum and thus the drum size.

220. A cable pulling system would then be installed into the trench. As with the direct lay (Scenario 2) the cable will be pulled into the duct using a pull-wire and winch.

221. Once on site, the cable drum would be raised off the ground on hydraulic jacks to enable it to spin freely when pulled. The cable would then be pulled from the drum into the duct using a pull wire and winch, with sufficient cable pulled through to the far jointing pit to allow for jointing onto the next section. The process would be repeated for the second cable to be installed in the duct.

222. Once the joint has been made the jointing pit would be buried by backfilling the material which had been excavated from the jointing pit. At the Link Box locations access points would be constructed and link box markers would be installed. Reinstatement would then follow at either jointing pit or link box location.

Scenario 2

223. Under scenario 2 temporary fencing would be installed around the onshore cable route. The working width would then be cleared of vegetation, and the topsoil stripped and stored locally (on mats to the side of the cable trench).

224. Temporary haul roads would then be installed to provide access points from local roads, where necessary and a running track would be installed along the onshore cable route.

225. Each cable trench would be excavated and the material stored locally before

installing the ducts and infilling the trench.

226. HDD or other trenchless techniques such as micro-tunnelling, would be required at certain crossing locations: potential locations have been identified in Figure 1.2 (HDD zones).

227. Following installation of the ducts, the onshore cable route would be reinstated including removal and appropriate disposal of excess material; removal of haul road/running track materials and mats where appropriate; replacement of topsoil and re-seeded if required; and removal of fencing.

228. As with Scenario 1 the installation of the transition pits and jointing pits would require:

- Mechanical excavation to the required depth;
- Placement of precast components or construction of reinforced concrete base slab, walls and cover *in situ*; and
- Backfilling and reinstatement.

229. As with Scenario 1 the cables would then be delivered on drums. Cables would be installed into the ducts by aligning the cable drums with pulling wires at each joint pit, then mechanically pulling the cables into the ducts and making the cable joints. The jointing pits would then be closed up and covered over.

230. It is anticipated that under both scenarios working would be undertaken from 7am to 7pm. However during the drilling of the HDDs (under Scenario 2) 24 hour working may be required.

231. Under Scenario 2 all of the above works would be completed during Phase 1 of the project and Phases 2 and 3 would then only require jointing pit construction and cable pull (as described under Scenario 1).

Construction of the Onshore Project Substation

232. Construction of access roads to the onshore project substation would be undertaken, followed by grading, earthworks and drainage of the onshore project substation site.

233. The foundations would be either concrete foundation plinths or piled for heavy items (such as transformers) subject to the prevailing ground conditions.

234. Once the foundation works are complete, the electrical plant would be delivered and installed, and buildings will be erected. Heavy items such as transformers would be delivered to site using multi-axle vehicles, and off-loaded with the use of a mobile crane. The majority of the remaining HVDC or HVAC equipment would be erected

with the use of small mobile plant and lifting equipment.

235. The proposed building structures would typically be composed of a steel framework and lightweight cladding materials. The structural steelwork would be fabricated and prepared off site and delivered to site for erection activities. The steelwork would be erected with the use of cranes. Cladding panels (typically composite) would also be delivered to site ready to erect and be fixed to the steelwork.

236. For the HVAC option, most of the electrical plant would be located outdoors. There would be a single steel-frame building housing high-voltage switchgear and control equipment.

237. For the HVDC option, the converter valves would be housed in large steel-frame buildings built up from a concrete foundation plinth. The converter station would also include an outdoor AC switchyard with transformers and overhead gantries.

238. As with the cable relay station construction, working hours would normally be 7am to 7pm, however there may be certain exceptions, which would be discussed with relevant stakeholders.

Construction of the Necton National Grid Substation

239. The construction methods used to extend the Necton National Grid Substation and modify the overhead lines have not yet been developed. VWPL will work closely with National Grid to ensure that a design of the extension is appropriate and will be available for the EIA. Under Scenario 1 (Section 1.5.4) the majority of the works will already have been completed during the Norfolk Vanguard construction and under Scenario 2 all works will be completed as part of the Norfolk Boreas construction.

1.5.7 Operations and maintenance strategy

1.5.7.1 Offshore

240. All offshore infrastructure, including wind turbine generators, foundations, cables and offshore substations would be monitored and maintained during their operational life.

241. The operation and control of the wind farm would be managed by a SCADA system, connecting each wind turbine generator to one or more off-site control rooms. These would be located at the project onshore operations base, likely to be within a local port, as well as at the wind turbine generator manufacturer’s base and the Applicant’s centralised control centre based in Esbjerg, Denmark. The SCADA system would enable remote control of the wind farm (e.g. shutdown/start-up of individual wind turbine generators and information management).

242. There are a number of potential maintenance strategies for the wind farm including:

- Onshore strategy - using various O&M vessels (e.g. crew transfer vessels, supply vessels) and/or helicopters to transfer from shore direct to the wind farm;
- Offshore strategy - the wind farm could be maintained primarily from an offshore accommodation vessel or a fixed offshore platform (possibly shared with other infrastructure such as an offshore substation platform or a standalone accommodation and O&M platform) within the project boundary. Transfer vessels or helicopters would be used to transfer personnel to or from the mother ship or platform; or
- A combination of onshore and offshore strategies.

243. A number of vessel and / or helicopter visits to each wind turbine generator would be required each year to allow for scheduled and unscheduled maintenance. If the onshore maintenance strategy is chosen, this would mean small crew vessels sailing to and from the wind farm on a daily basis from the shore, possibly supported by helicopters. If the offshore maintenance option is preferred, the majority of small crew vessels would be operated on a daily basis from the offshore accommodation vessel or accommodation platform, although further support vessels are also still likely to transit to and from shore each day and helicopter operations may still be utilised. The O&M fleet may comprise one or two offshore accommodation vessels and up to eight crew transit vessels (CTVs). The offshore accommodation vessels would be deployed offshore on a year-round basis, returning to port approximately every 2 weeks for crew changes.

244. Although it is not anticipated that large components (e.g. wind turbine generator blades or offshore substation transformers) would require replacement during the operational phase, it is a possibility. Should this be required large jack-up or heavy lift vessels may need to operate continuously for significant periods to carry out these major maintenance activities. The anticipated requirements for replacement of large components will be further developed in the PEIR stage.

245. During the operational phase of the project there would be no planned maintenance or replacement of the subsea cables, however repairs could be required should the cable fail or be damaged. All required consents would be obtained prior to any works. Periodic surveys would be required to ensure the cables remain buried and if they do become exposed, re-burial works or additional cable protection would be undertaken.

246. During O&M activities, the Applicant will seek to establish safety zones around wind turbine generators and work areas where appropriate. These safety zones would be based on an appropriate safety assessment and applied for to the relevant authorities and in consultation with relevant consultees.

1.5.7.2 Landfall

247. Once the ducting and cables are in place, no routine maintenance at the landfall is expected, however access is required to allow for any unplanned works.

1.5.7.3 Onshore

248. The onshore project substation and cable relay station would not be permanently manned. O&M staff would visit on a regular basis (e.g. monthly) to carry out routine checks and maintenance. Key maintenance campaigns will take place every summer, during which time there would be teams working 24/7 in order to complete the tasks quickly and return any affected equipment to service. Most annual maintenance campaigns would be short (approximately 1 week), but if required some campaigns may be longer (e.g. 1-2 months).

249. Security at the cable relay station and onshore project substation would be provided using perimeter fencing and gates, plus intruder detection and closed-circuit television (CCTV) systems.

250. Occasional access would be required at those joint pits with link boxes; access would be via the link box access hatch. In the unlikely event of an onshore cable failure, more invasive works would be needed in order to repair or replace the faulty cable.

251. The ES will need to identify and describe the control processes and mitigation procedures for storing and transporting waste off site. All waste types will be quantified and classified as far as possible.

1.5.8 Decommissioning

252. At the end of the offshore wind farm's operational life, it is a statutory requirement (through the provisions of the Energy Act 2004 (as amended)) that Norfolk Boreas is decommissioned. As an alternative to decommissioning, the Applicant may wish to consider re-powering the wind farm, however this would be subject to a new consent application.

253. The Applicant has first-hand experience of decommissioning offshore wind farms; Yttre Stengrund has been operational since 2001 and owned by Vattenfall since 2006. The five wind turbine generator offshore wind farm was decommissioned in 2015/2016. The rotor blades and nacelles were removed, the towers dismantled and the foundations cut at the level of the seabed. Underwater cables were removed in summer 2016.

254. Offshore decommissioning may include the removal of all of the wind turbine generator components, part of the foundations (those above seabed level), the array

cables, and the export cables subject to agreement with the regulator.

255. The onshore project substation and cable relay station equipment would likely be removed and reused or recycled. The building may be reused for a future development or demolished. If removing the building, the foundations would be removed to below ground level and the ground covered in topsoil and re-vegetated to return the site to its initial state. The jointing pits and transition pits would also be reinstated to ground level. Any access tracks would be reinstated if required. It is expected that the onshore cables would be removed from ducts and recycled, with the transition pits and ducts left *in situ*.

256. The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator.

257. Under the statutory process, the Applicant is required to prepare a decommissioning plan at the request of the relevant Secretary of State and, prior to construction, funds must be set aside for the purposes of decommissioning.

1.6 EIA Methodology

1.6.1 Introduction

258. The EIA will consider all relevant topics covered under the three general areas of physical environment, biological environment and human environment.

259. The EIA will be carried out in accordance with the Planning Act 2008 and the EIA regulations (see Section 1.4.2). Furthermore, the approach to the EIA and the production of the resulting ES document will closely follow relevant guidance including:

- National Infrastructure Advice Notes in relation to the Planning Act 2008 process (as amended);
- Assessment of the environmental impact of offshore wind-farms (OSPAR Commission, 2008)
- Planning Inspectorate Advice Notes (the Planning Inspectorate, 2012a; 2015a; 2015b; 2015c; 2016a)
- Overarching National Policy Statements for Energy EN-1, Renewable Energy Infrastructure EN-3, and Electricity Networks Infrastructure EN-5 (DECC, 2011b);
- Relevant guidance issued by other government and non-governmental organisations; and
- Receptor specific guidance documents.

260. It will also give due regard to the requirements of the Habitats and Species

Regulations 2010, The Offshore Marine Conservation (Natural Habitats, &c.) (Amendment) Regulations 2010 and the Marine and Coastal Access Act 2009.

1.6.2 Stakeholder consultation

261. An Evidence Plan Process (EPP) will be undertaken during the EIA to structure technical stakeholder consultation. This will commence following the production of this Scoping report.

262. The EPP is a voluntary mechanism to help agree the information required by the Planning Inspectorate as part of a DCO application to help to ensure compliance with the EIA Regulations and Habitat Regulations. The EPP aims to give greater certainty to all parties on the amount and range of evidence the Applicant should collect and present to support the DCO application.

263. The EPP will include expert topic group meetings that provide a platform to debate advice on each topic between multiple agencies. The process will be monitored by a steering group chaired by the Planning Inspectorate, and will be formulated to meet the requirements of the Planning Act 2008 and DCO application process.

264. Ongoing discussions will be minuted to log areas of agreement/disagreement on key aspects of the EIA, such as data acquisition, survey methodologies and approach to assessment, data analysis results and impact assessment outcomes to ensure the EIA is as robust as possible. The approach provides increased certainty to key stakeholders on the amount and range of evidence to be presented within the application, as well as enabling the Applicant to address issues early in the pre-application stage.

265. The development of the project design and the EIA also takes account of the views and opinions expressed through the community consultation and events which are underway and will continue throughout the Norfolk Boreas EIA and DCO application process. Details of the consultation and how the views will be included are provided in Section 5 of this report.

1.6.3 Characterisation of the existing environment

266. The characterisation (description) of the existing environment will be undertaken in order to determine the baseline conditions in the area covered by Norfolk Boreas and relevant surrounding study areas. This will require the following steps:

- Study areas will be defined for each receptor based on the relevant characteristics of the receptor (e.g. mobility/range);
- Review of available information;

- Review the likely or potential impacts that might be expected to arise from the development;
- Determine if sufficient data to make the EIA judgements with sufficient confidence;
- If further data required, ensure that data gathered are targeted and directed at answering the key question and filling key data gaps; and
- Review the information gathered to ensure the environment can be sufficiently characterised in sufficient detail.

267. The Applicant has collated a significant amount of existing data from a number of sources including:

- Data acquisition and subsequent Zone Environmental Appraisal (ZEA) process undertaken for the former East Anglia Zone;
- Data acquisition and the subsequent EIA documents undertaken for the EAOW consortium projects, East Anglia ONE and East Anglia THREE; and
- On-going data acquisition for the Norfolk Boreas and Norfolk Vanguard projects.

268. Consideration will also be given to the evolution of the baseline in the absence of the project; this will take account of current trends such as climate change and biodiversity loss.

269. The specific approach to establishing a robust baseline (upon which impacts can be assessed) is set out under each parameter within this Scoping Report (Sections 2 to 4). It is envisaged that this approach will be subject to review following the receipt of the Scoping Opinion from the Planning Inspectorate and subsequent consultation with statutory bodies. It is also recognised that this approach may evolve over time with the collection of new data from the study area and as the design of the project advances.

1.6.4 Assessment of impacts

270. The approach the EIA team will take to making balanced assessments will be guided by both EIA specialists and technical specialists using available data, new data, experience and expert judgement. In order to provide a consistent framework and system of common tools and terms, where appropriate, a matrix approach will be used to frame and present the judgements made. However, it should be noted that for each topic of the EIA, the latest guidance or best practice will be used and therefore definitions of sensitivity and magnitude of impact will be tailored to each receptor. The impact assessment will consider the potential for impacts during the construction, operation and decommissioning of Norfolk Boreas.

1.6.4.1 Determining receptor sensitivity and value

271. The characterisation of the existing environment will help to determine the receptor

sensitivity in order to assess the potential impacts upon it.

272. Receptor value considers whether, for example, the receptor is rare, has protected or threatened status, importance at local, regional, national or international scale, and in the case of biological receptors whether the receptor has a key role in the ecosystem function. These considerations are balanced against the properties of the receptor under consideration.

273. The ability of a receptor to adapt to change, tolerate, and/or recover from potential impacts will be key in assessing its sensitivity to the impact under consideration. For ecological receptors tolerance could relate to short term changes in the physical environment, for human environment receptors tolerance could relate to displacement effects and therefore impacts upon economics or safety. It also follows that the times required for recovery will be key considerations in determining receptor sensitivity.

274. The overall receptor sensitivity is determined therefore by considering a combination of value, adaptability, tolerance and recoverability and applying professional judgement and / or past experience.

275. Expert judgement is particularly important when determining the sensitivity of receptors. For instance, an Annex II species (under the Habitats Directive) would have a high value, but if it was highly tolerant of an impact or had high recoverability it would follow that the sensitivity in this instance should reflect the ecology rather than default to protected status taking precedence.

1.6.4.2 Predicting the magnitude of impacts

276. In order to predict the significance of an impact it is fundamental to establish the magnitude and probability of impact occurring through a consideration of:

- Scale or spatial extent (small scale to large scale or most of the population or a few individuals);
- Duration (short term to long term);
- Frequency; and
- Nature of change relative to the baseline.

1.6.4.3 Evaluation of significance

277. Subsequent to establishing the sensitivity and magnitude, the impact significance will be predicted by using quantitative or qualitative criteria, as appropriate to ensure a robust assessment. Where possible a matrix such as the one presented in Table 1.7 will be used to aid assessment of impact significance based on expert judgement. For each section of the ES, the best methodology (based on the latest

available guidance) will be followed and, when more appropriate, another approach than the matrix may be used.

278. Table 1.8 provides an indication of the significance definitions that the Applicant proposes to use in the assessment process for the majority of parameters.

279. A description of the approach to impact assessment and the interpretation of significance levels will be provided within each section of the ES. This approach will ensure that the definition of impacts is transparent and relevant to each topic under consideration.

Table 1.7 Significance of an impact resulting from each combination of receptor sensitivity and the magnitude of the effect upon it

		Negative Magnitude				Beneficial Magnitude			
		High	Medium	Low	Negligible	Negligible	Low	Medium	High
Sensitivity	High	*Major*	*Major*	*Moderate*	*Minor*	*Minor*	*Moderate*	*Major*	*Major*
	Medium	*Major*	*Moderate*	*Minor*	*Minor*	*Minor*	*Minor*	*Moderate*	*Major*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*	*Negligible*	*Minor*	*Minor*	*Moderate*
	Negligible	*Minor*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Negligible*	*Minor*

Table 1.8 Impact significance definitions

Impact Significance	Definition
Major adverse	Very large or large change in receptor condition, both adverse or beneficial, which are likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or, could result in exceedance of statutory objectives and/or breaches of legislation.
Moderate adverse	Intermediate change in receptor condition, which are likely to be important considerations at a local level.
Minor adverse	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision making process.
Negligible	No discernible change in receptor condition.
Minor beneficial	The impact is of minor significance, but has been assessed as having some environmental benefit.
Moderate beneficial	The impact is assessed as providing a moderate gain to the environment.
Major beneficial	The impact is assessed as providing a significant positive gain to the environment.

1.6.4.4 Confidence

280. Once an assessment of a potential impact has been made, it is necessary to assign a confidence value to the assessment to assist in the understanding of the judgment. This is undertaken on a simple scale of high-medium-low, where high confidence assessments are made on the basis of robust evidence, with lower confidence assessments being based, for example on extrapolation and use of proxies.

1.6.4.5 Mitigation

281. Where impact assessment identifies that an aspect of the development is likely to give rise to significant environmental impacts, mitigation measures will be proposed and discussed with the relevant authorities to avoid impacts or reduce them to acceptable levels and, if possible, to enhance the environment.

282. For the purposes of the EIA, two types of mitigation have been defined and these will be identified in the ES:

- Embedded mitigation, consisting of mitigation measures that are identified and adopted as part of the evolution of the project design, will be included and assessed in the EIA; and
- Additional mitigation, consisting of mitigation measures that are identified during the EIA process to reduce or eliminate any predicted impacts, which are subsequently adopted by the Applicant as project commitments.

1.6.4.6 Assessing residual impacts

283. Following identification of mitigation measures, impacts will be re-assessed and all residual impacts will be described. Where no mitigation measure is proposed, a discussion will explain why the impact cannot be reduced.

1.6.4.7 Inter-relationships

284. The impact assessment will consider the inter-relationship of impacts on individual receptors.

285. Offshore, onshore and wider-scheme inter-relationships are discussed in Sections 2.16, 3.12 and 4.

1.6.4.8 Cumulative impacts

286. Cumulative Impact Assessment (CIA) forms part of the EIA process. The scope of the CIA (in terms of relevant issues and projects) will be established with consultees (including other developers) as the EIA progresses. In addition, the Applicant will look at the experience both from within the former Zone, the wider Southern North Sea, and other UK projects as well as incorporating continuing work from industry-wide initiatives with regard to cumulative impact. Sections 2.17, 3.13, and 4 of this Scoping Report provide a high-level discussion of potential cumulative considerations that are believed to require inclusion within the EIA.

287. The Planning Inspectorate Advice Notes Nine and Seventeen provide guidance on plans and projects that should be considered in the CIA including:

- Projects that are under construction;
- Permitted applications, not yet implemented;
- Submitted applications not yet determined;
- Projects on the Planning Inspectorate's Programme of Projects;
- Development identified in relevant Development Plans, with weight being given as they move closer to adoption and recognising that much information on any relevant proposals will be limited; and
- Sites identified in other policy documents as development reasonably likely to come forward.

288. Only projects which are reasonably well described and sufficiently advanced to provide information on which to base a meaningful and robust assessment will be included in the CIA.

289. Projects which are sufficiently implemented during the site characterisation for Norfolk Boreas will be considered as part of the baseline for the EIA. This will include Norfolk Vanguard.

290. Offshore cumulative impacts may come from interactions with the following activities and industries:

- Other wind farms;
- Aggregate extraction and dredging;
- Licensed disposal sites;
- Navigation and shipping;
- Commercial fisheries;
- Sub-sea cables and pipelines;
- Potential port/harbour development; and
- Oil and gas activities.

291. Onshore plans or projects that may be considered include (but not limited to):

- Other offshore wind farm infrastructure;
- Other energy generation infrastructure;
- Building/housing developments;
- Installation or upgrade of roads;
- Installation or upgrade of cables and pipelines;
- Coastal protection works; and
- National Grid works.

292. The full list of plans or projects to be included in the CIA will be developed as part of on-going consultation with technical consultees.

1.6.4.9 Transboundary impacts

293. Regulation 24 of the EIA regulations sets procedures to address issues associated with a development that might have significant impact on the environment in another European Member State.

294. The procedures involve providing information to the Member State and for the Planning Inspectorate to enter into consultation with that State regarding the significant impacts of the development and the associated mitigation measures. Further advice on transboundary issues, in particular with regard to consultation is given in the Planning Inspectorate Advice Note Twelve (Planning Inspectorate, 2015c).

295. The Applicant has provided an outline of the key transboundary considerations that are believed to require inclusion within the assessment (Section 2.17).

1.6.5 Draft outline of the environmental statement

296. The ES will document the EIA process and will describe the project and the EIA process with regard to the latest legislation, policy and guidance. Subject to the outcomes of the scoping process, the ES may comprise the following documents, parts and chapters:

- Volume 1 Non-Technical Summary
- Volume 2 Environmental Statement
    - Part 1: Introductory chapters
        i. Introduction
        ii. Need for the Project
        iii. Policy and Legislative Context
        iv. Site Selection and Assessment of Alternatives
        v. Project Description
        vi. EIA Methodology

    - Part 2: Offshore environment
        i. Marine Geology, Oceanography and Physical Processes
        ii. Marine Water and Sediment Quality
        iii. Benthic and Intertidal Ecology
        iv. Fish and Shellfish Ecology
        v. Marine Mammal Ecology
        vi. Offshore Ornithology
        vii. Commercial Fisheries
        viii. Shipping and Navigation
        ix. Offshore Archaeology and Cultural Heritage
        x. Aviation and Radar
        xi. Infrastructure and Other Users

    - Part 3: Onshore environment
        i. Ground Condition and Contamination
        ii. Air Quality
        iii. Water Resources and Flood Risk
        iv. Land Use
        v. Onshore Ecology
        vi. Onshore Ornithology
        vii. Onshore Archaeology and Cultural Heritage
        viii. Noise and Vibration
        ix. Traffic and Transport
        x. Health

- Part 4: Wider Scheme Aspects
  i. Landscape and Visual
  ii. Socio-economics
  iii. Tourism and Recreation

- Part 5: Cumulative and Transboundary Impacts
  i. CIA within the former East Anglia Zone
  ii. Wider Offshore CIA
  iii. Transboundary Impacts
  iv. Onshore CIA

- Part 6: Summary of Impacts

- Volume 3: Technical appendices

1.6.6 Other DCO documents

297. In support of the ES there are a number of documents that will be produced for the DCO application, these are likely to include:

- Consultation Report
- Environmental protection statement of engagement
- Report to inform Habitat Regulations Assessment
- Consents and licences required under other legislation
- Schedule of Mitigation
- Works plan
- Access to works plan
- Plan of Plans illustrating interrelationships across the various plans and topic areas (including reference to their security within the DCO)
- Plan showing public rights of way to be temporarily stopped up
- Plan showing streets to be temporarily stopped up
- Plan of statutory/non-statutory sites or features of nature conservation
- Plan(s) showing statutory or non-statutory historic or scheduled monument sites/features of the historic environment
- Plan showing any Crown land
- Important hedgerows plan
- Book of Reference
- Code of Construction Practice
- Planning Statement
- Design and Access Statement

- Public Rights of Way Strategy
- Outline written scheme of investigation (onshore)
- Outline written scheme of investigation (offshore)
- Public Rights of Way Strategy
- Outline landscape and ecological management strategy
- Draft Great Crested Newt Licence Application
- Outline traffic management plan
- Outline travel plan
- Outline Access Management Plan
- Abnormal Loads assessment
- Construction Environmental Management Plan
- In Principle Monitoring Plan
- Outline Offshore Operations and Maintenance Plan
- Site Characterisation Report
- Draft Marine Mammal Mitigation Protocol
- In Principle Site Integrity Plan

2 PART 2: OFFSHORE

2.1 Introduction

298. This section presents the main baseline characteristics of the environment within the offshore project area (the Norfolk Boreas site and the provisional offshore cable corridor, also defined as the offshore scoping area) and the surrounding area, where relevant. The potential impacts of Norfolk Boreas during construction, O&M and decommissioning are considered. Where there is no pathway for a potential impact, a proposal is made for that impact to be scoped out of the EIA. Where impacts are proposed to be scoped in, an overview of the approach to the EIA is provided.

299. As stated in Section 1.6.3 study areas will be determined on a receptor by receptor basis. These will be clearly defined as the EIA progresses and will be agreed with relevant stakeholders through the EPP. Therefore study areas have not been defined for each receptor within the offshore sections of this scoping report.

300. The following questions are suggested for consideration while reviewing each offshore section and providing responses to the Planning Inspectorate for inclusion in the Scoping Opinion:

We have taken account of the Norfolk Vanguard Scoping Opinion within this scoping report, however if you have any further responses to the questions below we would be very grateful to receive them.

Q1. Please tell us about further data sources that could be reviewed as part of the site characterisation for each topic?

Q2. Tell us about any other relevant potential impacts for each topic?

Q3. Do you agree with the potential impacts that have been scoped out for each topic? If not, please provide details.

Q4. Have the relevant potential cumulative impacts been identified? If not, please provide details

Q5. Have the relevant potential transboundary impacts been identified? If not, please provide details

Q6. Do you agree with that the proposed approach to assessing each impact is appropriate? If not, please provide details.

Q7. Is there any further guidance relating to each topic that we should be aware of? If so, please provide details.

2.2 Marine Geology, Oceanography and Physical Processes

2.2.1 Baseline

2.2.1.1 Data sources

301. Information to support the Scoping Report and the EIA for Norfolk Boreas has come

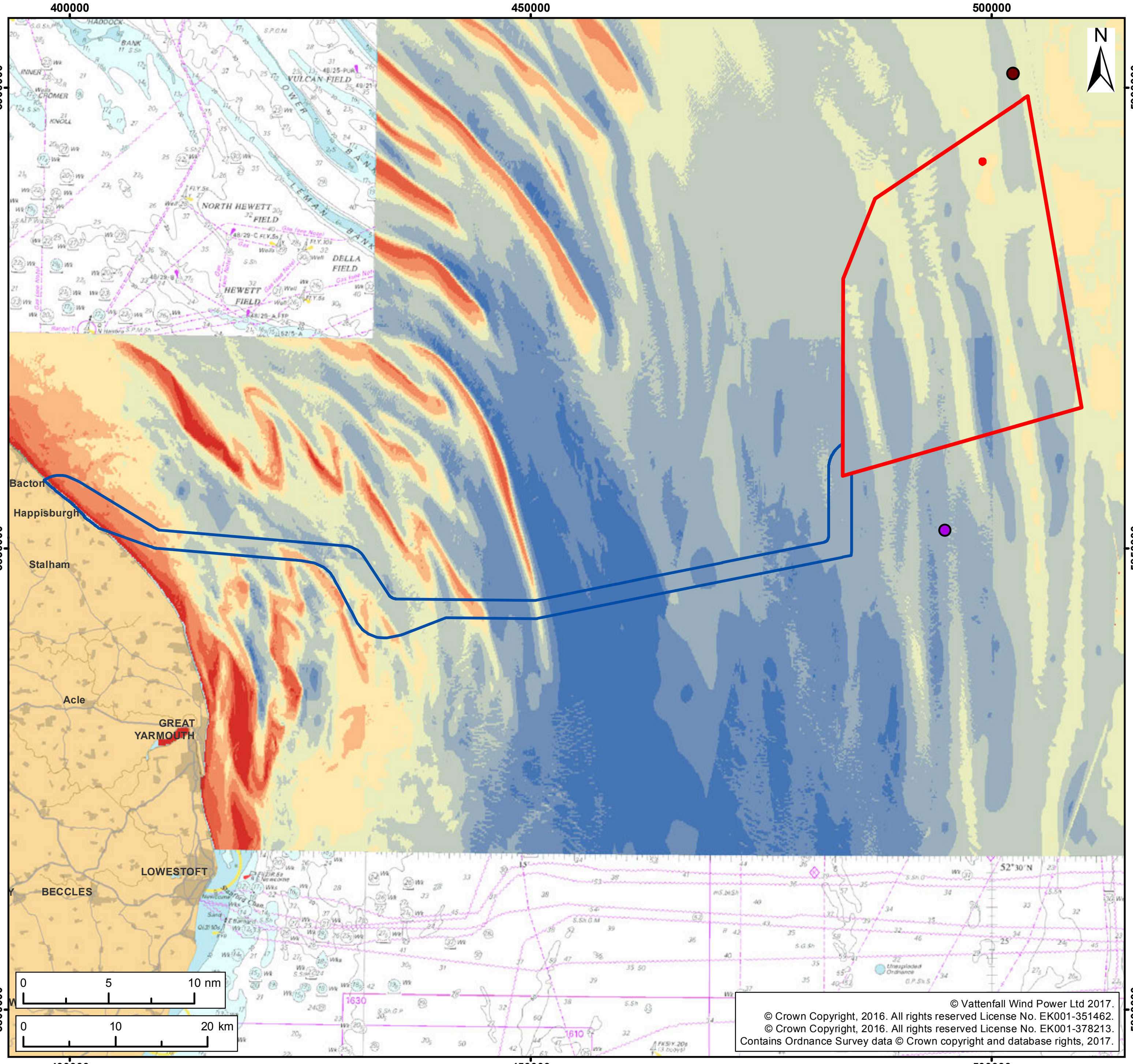
from a series of previous surveys and studies, including numerical modelling studies, which were undertaken to inform the ZEA for the former East Anglia Zone (EAOW, 2012a), the ES for the East Anglia ONE project (EAOW, 2012b) and the East Anglia THREE project (EATL, 2015). The provisional offshore cable corridor was subject to geophysical and geotechnical surveys in autumn 2016 and a coastal erosion study was undertaken for the landfall locations in early 2017 as part of the Norfolk Vanguard project.

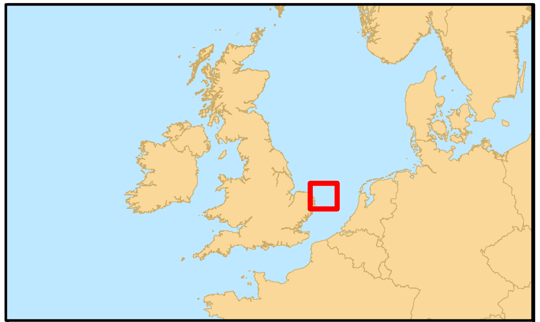
302. In addition, a range of information sources are available, many of which were collated for the ZEA, including:

- Marine Renewable Atlas (BERR, 2008);
- Wavenet (Cefas, undated);
- National Tide and Sea Level Forecasting Service (NTSLF, undated);
- Extreme sea levels database (Defra *et al.* 2011);
- United Kingdom Hydrographic Office (UKHO) tidal diamonds;
- British Oceanographic Data Centre;
- National Oceanographic Laboratory Class A tide gauges;
- Baseline numerical model runs (ABPmer 2012a; 2012b; GL Noble Denton 2011);
- United Kingdom Climate Projections '09 (UKCP09) (Lowe *et al*. 2009);
- British Geological Survey 1:250,000 sea bed sediment mapping;
- British Geological Survey bathymetric contours and paper maps; and
- Admiralty Charts and United Kingdom Hydrographic Office survey data.

2.2.1.2 Bathymetry

303. Water depths across the Norfolk Boreas site vary (Figure 2.1) between approximately 22 and 41m (CD). The Haisborough sand bank system lies to the west of the site, comprising a series of north-west to south-east oriented en-echelon (approximately parallel) sand ridges. The provisional offshore cable corridor for Norfolk Boreas passes through the southern end of this sand bank system. Results from the 2016 geophysical surveys showed that where the cable corridor crosses these banks their crest depths are between -15 and -25m LAT with troughs between -30 and -40m LAT (Fugro Group, unpublished). The banks are also covered by fields of subaqueous dunes (sand waves) with heights ranging from 0.2m to 7m.





Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast
- BODC Current Sampling Location (580507)
- BODC Current Sampling Location (580556)

Bathymetry Depth (m CD)[1]

- >45
- -45 to -40
- -40 to -35
- -35 to -30
- -30 to -25
- -25 to -20
- -20 to -15
- -15 to -10
- -10 to -5
- >-5

[1] Oceanwise, 2016.

Project: Norfolk Boreas

Report: Environmental Impact Assessment Scoping Report

Title: Bathymetry

Figure: 2.1 | Drawing No: PB5640-102-005

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:600,000
01	31/01/17	JE	JM	A4	1:600,000

Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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2.2.1.3 Water levels

304. The Norfolk Boreas site is located within an area of seabed that is subject to a micro-tidal regime, with an average spring tidal range of approximately 0.1m – 1.5m. This low tidal range is due to proximity to an amphidromic point that is positioned approximately 51km south of the Norfolk Boreas site. At the amphidromic point, the tidal range is near zero. Tidal range then increases with radial distance from this point. The crest of the tidal wave at high water circulates around this point once during each tidal period. With progression west along the provisional offshore cable corridor, the tidal range increases.

305. At the landfall locations (Bacton to Happisburgh South) the tidal range is approximately 2.6m on mean spring tides. The suite of astronomical tidal levels reported by the UK Hydrographic Office's Admiralty Tide Tables for Winterton-on-Sea, approximately 15km south of the provisional offshore cable corridor, is presented in Table 2.1.

Table 2.1 Astronomical tidal levels at Winterton-on-Sea (Admiralty Tide Tables, 2017)

Water Level	Abbreviation	Level (m CD)
Mean High Water of Spring tides	MHWS	3.2
Mean High Water of Neap tides	MHWN	2.6
Mean Sea Level	MSL	1.8
Mean Low Water of Neap tides	MLWN	1.2
Mean Low Water of Spring tides	MLWS	0.6
Mean Spring Tidal Range	MWHS - MLWS	2.6
Mean Neap Tidal Range	MWHN - MLWN	1.4

306. The North Sea is particularly susceptible to storm surges and water levels can become elevated between 1.5m and 1.7m above astronomical tidal levels under a 1 in 1 year return period surge event, and between 2.3 and 2.5m under a 1 in 100 year return period surge event.

2.2.1.4 Tidal currents

307. Tidal current data and modelling at locations across the former East Anglia Zone show that currents generally flow north to south on the flooding tide and south to north on the ebbing tide. The fastest recorded flows around the Norfolk Boreas site are typically associated with the ebb tide, with speeds reaching approximately 1m/s. The weakest currents are observed in deeper water. The British Oceanographic Data

Centre (BODC) current buoys: 580507 which is located approximately 9km to the south of the Norfolk Boreas site and 580556 which is located 2.8km to the north (Figure 2.1) recorded depth average maximum speeds of 0.88m/s and 0.87m/s respectively. These buoys were deployed in water depths of 35 and 36m.

308. Tidal currents increase in the shallower waters nearer to shore. As the offshore cable corridor approaches the coast of north-east Norfolk the currents here can exceed 1.5m/s.

309. Storm surges can potentially elevate currents by up to 0.4m/s during a 1 in 50 year return period event, typically oriented in a south-south westerly direction.

2.2.1.5 Wave regime

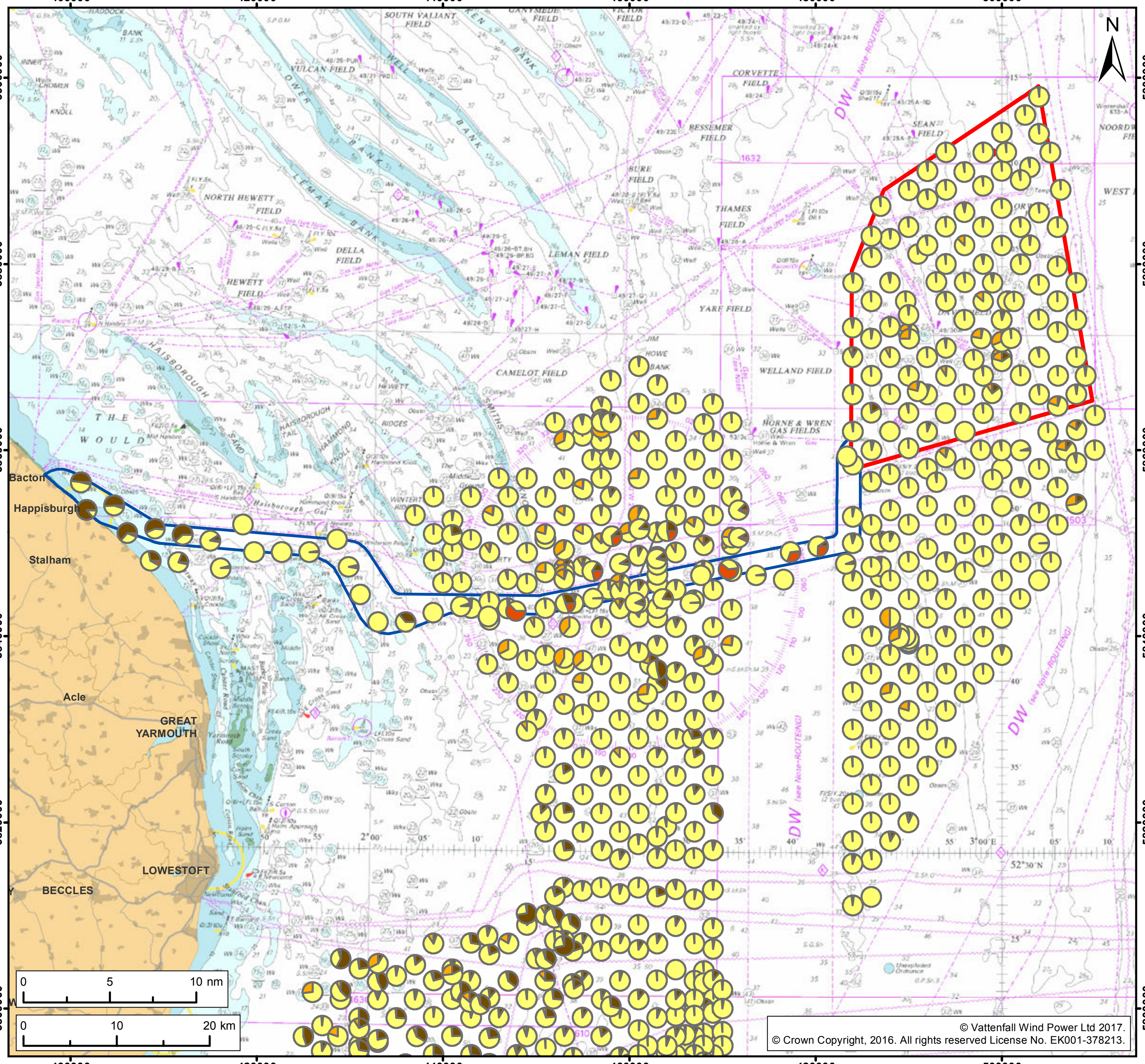
310. The wave regime across Norfolk Boreas, which is highly episodic and exhibits strong seasonal variation, is comprised of swell waves generated offshore and locally-generated wind-waves. Wave data at wave rider locations close to the southern and northern boundaries of the Norfolk Boreas site show that the predominant waves arrive from the south-southwest with subordinate waves from the north (ABPmer, 2012a).

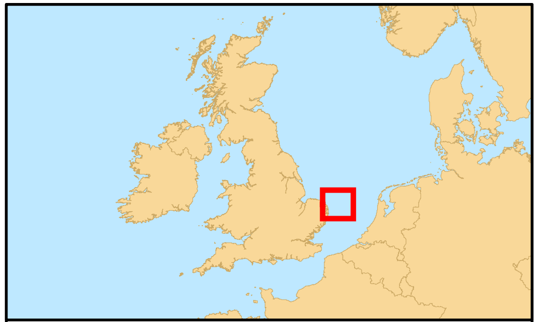
311. Across the wider former East Anglia Zone, there is a general north to south reduction in maximum observed wave heights. On the northern boundary, a 1 in 50 year return period event has a significant wave height in excess of 8m whereas on the southern boundary a corresponding event has a significant wave height below 6.5m.

312. Across the majority of the Norfolk Boreas site, water depths are likely to be sufficient to limit the effect of wave action on seabed sediments, apart from during exceptionally stormy seas or over shallower areas. Closer to shore, within the provisional offshore cable corridor, water depths reduce and wave effects become more important. At shallow-water locations off the north-east Norfolk coast, waves are dominated by short period wind-waves and generally reveal a predominant wave direction from the north.

2.2.1.6 Bedload sediment and transport

313. The geology of the offshore project area generally consists of Holocene sand deposits overlying a series of Quaternary sands and clays. The thickness of the Holocene sediment varies from less than 1m to greater than 20m in the sand wave fields and on the sandbanks.





Legend:

Norfolk Boreas Site

Provisional Offshore Cable Corridor

Sediment Distribution (ZEA) [1]

Gravel

Sand

Silt

Sediment Distribution (Provisional Offshore Cable Corridor) [2]

Gravel

Sand

Mud

[1] MESL, 2010/11.
[2] Fugro, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Seabed Sediment Distribution

Figure: 2.2 Drawing No: PB5640-102-006

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:600,000
01	31/01/17	JE	JM	A4	1:600,000

Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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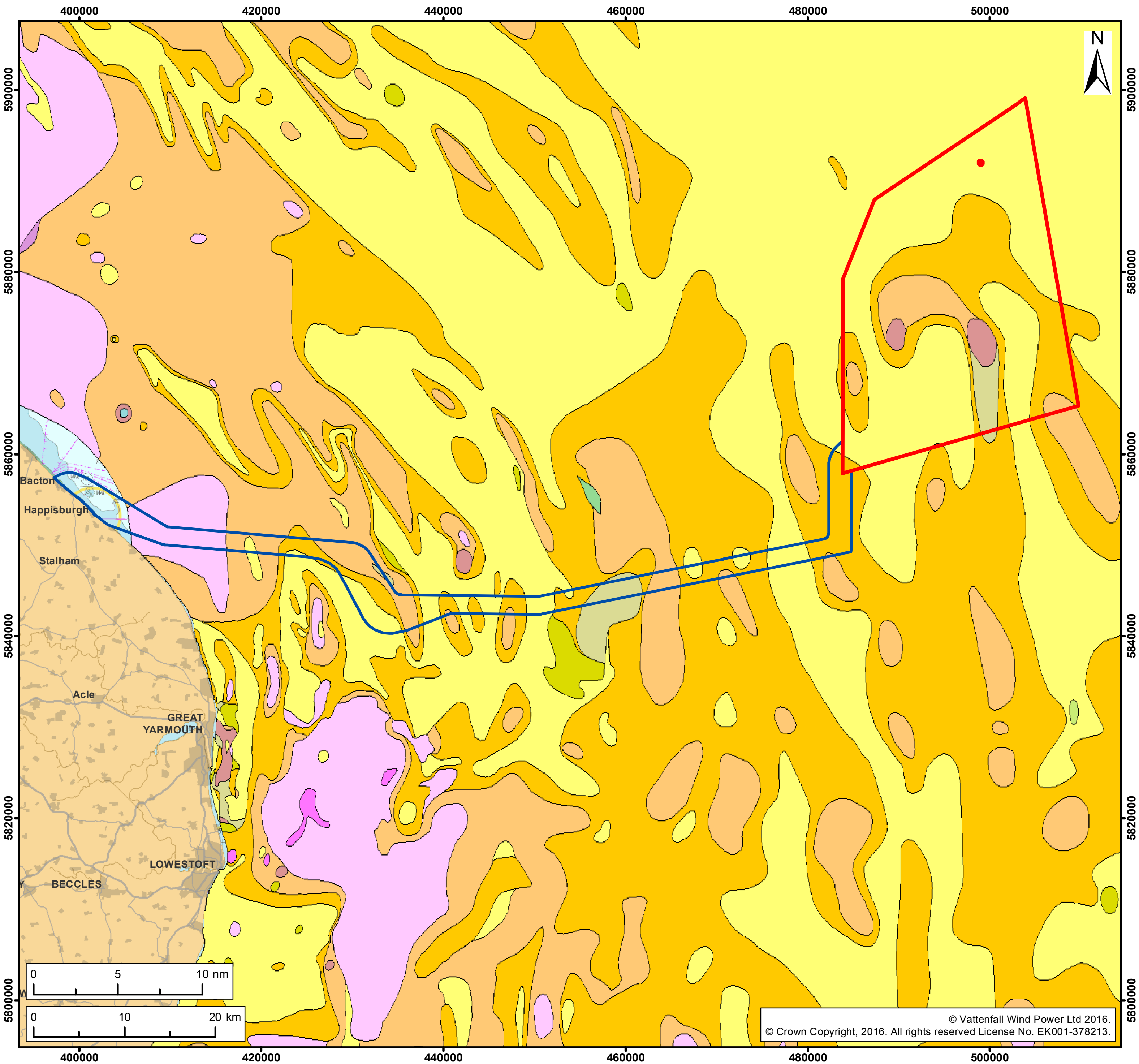

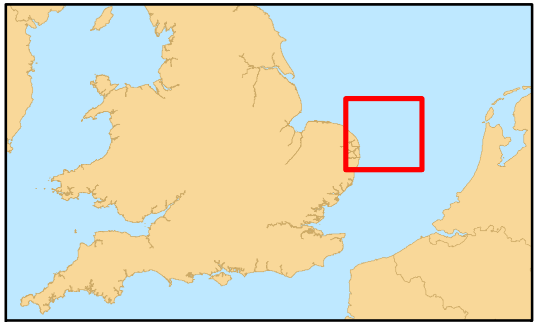

Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast

Sea Bed Sediments[1]

- Gravelly mud
- Gravelly muddy sand
- Gravelly sand
- Muddy sand
- Sand
- Sandy gravel
- Slightly gravelly muddy sand
- Slightly gravelly sand
- Sightly gravelly sandy mud
- Muddy sandy gravel

[1] British Geological Society, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

British Geology Survey Seabed Sediment

Figure:	2.3	Drawing No:	PB5640-102-007

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:600,000
01	31/01/17	JE	JM	A4	1:600,000

Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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314. Sediment grab sample data collected across the former East Anglia Zone (shown in Figure 2.2) correspond well with existing British Geological Survey seabed sediment data (shown in Figure 2.3) and reveal that the Norfolk Boreas site is dominated by sand and slightly gravelly sand but also contains gravelly sand, gravelly muddy sand and slightly gravelly muddy sand.

315. Recent grab sample data collected from the provisional offshore cable corridor during the 2016 Norfolk Vanguard survey revealed a mixed range of sediment types with slightly gravelly sand and gravelly sand being dominant offshore and more heterogeneous, coarser sediments, with higher percentage of the gravel fraction closer to shore (Fugro Group, unpublished).

316. Sediment transport pathways within the former East Anglia Zone have been analysed using the orientation of bedforms. Sand waves are present across parts of the offshore project area, which exhibit a consistent asymmetry that indicates a net direction of transport to the north. Tidal currents are the main driving force of sediment transport and, due to the tidal asymmetry, move sediments in a northerly direction.

317. More complex patterns of sediment transport occur around the Haisborough sand bank system (which comprises Haisborough Sand, Haisborough Tail, Hammond Knoll, Winterton Ridge and Hearty Knoll) to the west of the Norfolk Boreas site and to the north of the provisional offshore cable corridor. These banks have formed as a set of en-echelon (sub-parallel) ridges over the last 5,000 years in response to shoreline recession and sea-level rise. Key driving mechanisms for the formation and maintenance of these banks include tidal currents, waves and sea-level change, whilst sediment transport is important in driving migration of the banks through erosion and accretion.

2.2.1.7 Coastal erosion

318. The coast of north-east Norfolk is an almost continuous line of glacial till cliffs. The coast is exposed and therefore very dynamic. Rapid cliff erosion is currently occurring in places, and foreshore steepening is an issue throughout this frontage. Severe storm events can rapidly change beach levels and the degree of exposure of the natural or defended coastline. Net sediment transport is to the south-east and the potential for transport increases with distance south as the coastline curves clockwise.

319. The Applicant commissioned a study into coastal erosion at the three landfall zones (Royal HaskoningDHV, 2017). The study found that the coastline between Bacton Green and Walcott Gap (Figure 1.3) is characterised by soft cliffs of varying height comprised of clays and fine sands. The Bacton to Walcott coast relies on sediment

input from both cliff and beach erosion further north and a southerly sediment transport pathway. As a result of sediment supply shortages, cliff erosion has progressed rapidly over recent years. The impacts of this were evident following storm surges in 2007, 2013 and most recently January 2017 where the cliff line showed notable erosion. The study estimated that current annual cliff top retreat is approximately 1.3 – 1.7 metres per year at Bacton and 1.0 – 1.2 metres per year at Walcott gap.

320. The cliffs at Happisburgh consist of fine sediment, containing a mixture of silt/clay and fine sand, and therefore contribute only small volumes of sediment to the beach system. The foreshore along this stretch of coast primarily relies on supply of sediment from the north-west, however more sediment is leaving from the south than is entering from the north-west, due in part to the coastal defences, up drift and the orientation of the coastline and this has led to one of the highest levels of coastal erosion anywhere on the Norfolk coastline. Recently erosion has been up to 10m per year. However there is some evidence to suggest that this area is starting to stabilise and the rate of erosion may be slowing, further work is being completed to better understand whether this is the case.

321. The proposed Bacton sandscaping scheme (see section 2.3.2.4) aims to reduce coastal erosion at Bacton Green in the short term and could also reduce erosion at Walcott Gap in the medium term and Happisburgh in the long term as the sediment moves south.

2.2.1.8 Suspended sediment

Suspended sediment concentrations across the Norfolk Boreas site could range from 1mg/l to 35mg/l. During a Land Ocean Interaction Study undertaken as part of the ZEA, measurements within the former East Anglia Zone recorded a maximum turbidity value of 83mg/l, and a mean value of 15mg/l during an 18 month deployment (EAOW, 2012a).

2.2.2 Potential impacts

322. For marine physical processes, the assessment will follow two approaches. The first type of assessment will be of impacts on marine physical processes whereby a number of discrete direct receptors can be identified. These include certain morphological features such as sandbanks, cliffs and beaches. The second type of assessment will be of changes to marine physical processes which in themselves are not necessarily impacts to which a significance can be ascribed; rather, these changes (such as a change in wave climate, tidal regime suspended sediment concentrations) represent effects which may manifest themselves as an impact upon other receptors, most notably water quality, benthic ecology, and fish ecology.

2.2.2.1 Potential impacts during construction

323. **Effects on hydrodynamic regime (waves and tidal currents)**: Whilst there is potential for the physical presence of construction plant and offshore infrastructure to impact upon the hydrodynamic regime, this impact would increase incrementally as the wind farm is constructed with the greatest potential impacts resulting from the completed wind farm. This impact is therefore covered under 'Potential impacts during operation', below.

324. **Effects on sediments and sedimentary structures**: Construction of the wind farm would not change the geomorphology of the site apart from localised effects associated with foundation and cable installation. Due to the localised nature of these effects it is not anticipated that such changes would give rise to significant impacts on seabed features. However, further consideration (using expert geomorphological assessment) will be given to the potential effects on the form and function of the bedload sedimentary processes, including those across the Haisborough, Hammond and Winterton SCI due to cable installation.

325. **Effects on suspended sediment concentrations and transport**: During the construction phase, seabed preparations (foundation and cable laying) would be required which may lead to localised sediment disturbance and increases in suspended sediment concentrations. Constructional effects on suspended sediment will be assessed using expert based assessment predicated on a source-pathway-receptor (S-P-R) conceptual model, and verified and tested against previous numerical modelling for East Anglia ONE and the conceptual assessment for East Anglia THREE and Norfolk Vanguard.

2.2.2.2 Potential impacts during operation

326. **Effects on hydrodynamic regime (waves and tidal currents)**: Multiple foundations are likely to increase local drag forces and tidal flows and potentially diffract and scatter waves which could lead to physical process changes at the coast.

327. Evidence from monitoring work at operational offshore wind farms demonstrates that effects on the hydrodynamic regime are restricted to near-field changes only (i.e. close to the structures); far field effects (such as at adjacent coastlines) have not been observed. This is supported by Walker and Judd (2010) who reviewed the results of monitoring from several UK offshore wind farm projects and found no evidence for far-field effects.

328. The potential for operational effects on waves and tidal currents will be assessed using expert based assessment predicated on a S-P-R conceptual model, and verified and tested against previous numerical modelling for East Anglia ONE and the

conceptual assessment for East Anglia THREE. This approach is also currently being discussed (through the EPP) for the Norfolk Vanguard assessment.

329. The Norfolk Boreas site is located approximately 72km from the coast at the nearest point and given this distance no effect on the hydrodynamic regime as result of foundations is expected at the coastline. During the operational phase the export cables would mainly be buried beneath the seabed and would have no effect on waves and tidal currents at the coast. Hence, any ongoing processes of coastal erosion or accretion (Section 2.2.1.7) would continue to be controlled by natural processes unaffected by the presence of the wind farm.

330. **Effects on sediments and sedimentary structures**: Effects on sediment transport (through accretion or erosion) have been studied at industry level (ABPmer, 2005) as well as for site-specific monitoring studies (Cefas, 2005). Such studies have concluded that minimal effects can be expected on prevailing sediment transport conditions, both within wind farm sites as well as in the far-field, provided that the foundations are adequately spaced (which would vary depending on the details of the foundations and wind farm layout). Effects on sediment transport are likely to be localised to the areas immediately surrounding the individual foundations (or scour protection or cable protection material) in the form of seabed scour where the sediment is soft enough to be mobilised. Scour at each foundation will be assessed using well-established empirical methods applied to offshore wind farms elsewhere.

331. **Effects on suspended sediment concentrations and transport**: During the operational phase, there is potential for sediments to be re-suspended by scouring effects. Consideration will be given (using expert geomorphological assessment) to likely changes in suspended sediment concentrations due to scour during both the construction and operational phases.

2.2.2.3 Potential impacts during decommissioning

332. The removal of the foundations has the potential to affect hydrodynamic regime, sediments and sedimentary structures, and suspended sediment concentrations and transport. Any effects arising from decommissioning are likely to be of lower magnitude than those described for construction.

2.2.2.4 Potential cumulative impacts

333. **Interactions with other wind farms**: Consideration will be given to the potential for interaction with other wind farms within the former East Anglia Zone and wider region. This includes interactions of Norfolk Boreas with Norfolk Vanguard, East Anglia ONE, East Anglia THREE, East Anglia ONE North and East Anglia TWO (Figure 2.23). It is likely that most of the potential effects would be highly localised, small

scale and temporary with limited potential for interactions between wind farms.

334. **Interactions with other activities**: Cumulative impacts upon physical processes may occur between Norfolk Boreas and other plans or projects in the region. The following activities will be taken into account in the assessment:

- Aggregate extraction and dredging (including potential sandscaping at Bacton);
- Existing and planned construction of subsea cables and pipelines;
- Potential port and harbour development; and
- Oil and gas installations.

335. It is likely that potential impacts would be highly localised, small scale and temporary with limited potential for interactions between Norfolk Boreas and other activities.

2.2.2.5 Transboundary impacts

336. Given that the likely hydrodynamic and sedimentary effects of Norfolk Boreas would be restricted to near-field change only, transboundary impacts are unlikely to occur or would be insignificant and therefore the Applicant proposes not to consider transboundary impacts for marine geology, oceanography and physical processes further during the EIA. This approach was also taken by the EIAs for East Anglia ONE (EAOW, 2012b) and East Anglia THREE (EATL, 2015).

2.2.2.6 Summary of potential impacts

Table 2.2 Summary of potential impacts relating to marine geology, oceanography and physical processes

Potential impacts	Construction	Operation	Decommissioning
Effects to hydrodynamic regime (waves and tidal currents)	x	✓	x
Effects on sediments and sedimentary structures	✓	✓	✓
Effects on suspended sediment concentrations and transport	✓	✓	✓
Cumulative impacts	✓	✓	✓
Transboundary impacts	x	x	x

Scoped in (✓) and scoped out (x)

2.2.3 Mitigation

337. It is expected that the impacts on marine geology, oceanography and physical processes would be small scale, localised and temporary. If significant impacts are predicted, suitable potential mitigation options would be discussed with the relevant authorities.

2.2.4 Approach to assessment and data gathering

338. The Applicant has commissioned various surveys to develop a more detailed understanding of the seabed conditions within the offshore project area. These surveys will be undertaken in 2017, and include:

- A geophysical survey including bathymetry and shallow geology of the Norfolk Boreas site;
- Grab samples of surface sediments (results of the grab samples from the wind farm sites will supplement existing zonal data);
- A seabed mobility survey; and
- Geotechnical site investigations (cone penetration testing and vibrocoring).

339. These surveys will supplement the data collected during the 2016 survey of the potential offshore cable corridor and the coastal erosion study completed in early 2017 (Royal HaskoningDHV, 2017).

340. Existing data for the former East Anglia Zone, East Anglia ONE, Norfolk Vanguard and East Anglia THREE will be used as context for the assessment of impacts on marine geology, oceanography and physical processes.

341. Assessment methodologies will be discussed and agreed with the appropriate statutory consultees through the EPP in accordance with the following guidance documents:

- Guidelines for data acquisition to support marine environmental assessments of offshore renewable energy projects (Cefas, 2011);
- Coastal Process Modelling for Offshore Windfarm Environmental Impact Assessment (COWRIE, 2009);
- Marine aggregate dredging and the coastline: a guidance note (The Crown Estate and BMAPA, 2013); and
- Review of Cabling Techniques and Environmental Effects applicable to the Offshore Windfarm Industry (BERR, 2008).

342. In addition, there are a large number of external sources of data which could be used to describe the baseline and assess the potential effects on physical processes. These sources of data include metocean surveys commissioned by the Applicant, wave buoys (e.g. Cefas waveriders) and other data currently acquired via BODC.

343. Should a disposal site be required this will be characterised, and an assessment of the potential impacts on that site will be including within that characterisation. This Site Characterisation document will form part of the DCO submission, but will be a separate document to the EIA.

2.3 Marine water and sediment quality

2.3.1 Baseline

2.3.1.1 Data sources

344. The physical environment datasets which are available for determining the baseline include:

- National Marine Monitoring Programme (NMMP) 1994-2001 (Cefas, 2004b)
- Analysis of contaminant levels in sediment from benthic grab sampling in the provisional offshore cable corridor and Norfolk Vanguard OWF sites (Fugro Group, unpublished);
- Analysis of contaminant levels in NV East (to the south of the Norfolk Boreas site) from EA FOUR surveys (2013), and
- Bathing water profiles (Environment Agency, 2016a and 2016b).

2.3.1.2 Water quality

345. Data from the NMMP sub-surface seawater monitoring stations were used to define the levels of trace metals around the former East Anglia Zone. The data presented in Table 2.3 shows that trace metals in sub-surface seawater at NMMP sample site 395 (shown in the shaded cells of Table 2.3) which is located approximately 10km south of the Norfolk Boreas site (Figure 2.4) are generally lower than in the other, more coastal locations shown in Table 2.3.

Table 2.3 Concentrations of dissolved trace metals in sub-surface seawater from offshore locations, 1991 - 1992 (Cefas, 2001)

Sample Site (NNNP #)	Nickel (microgram per litre ($\mu g\ l^{-1}$))		Copper ($\mu g\ l^{-1}$)		Zinc ($\mu g\ l^{-1}$)		Cadmium (nanogram per litre ($ng\ l^{-1}$))		Lead ($ng\ l^{-1}$)		Mercury ($ng\ l^{-1}$)	
	91	92	91	92	91	92	91	92	91	92	91	92
385 (the Wash)	1	0.28	0.74	0.61	1	0.61	27	10	190	40	0.25	40
375 (the Humber)	0.26	0.29	0.71	0.44	2.2	0.5	22	16	21	45	2.3	45
395 (Southern Bight)	0.42	0.38	0.31	0.57	0.45	0.59	15	22	49	35	1.7	35
465 (the Thames)	0.9	0.64	0.83	0.45	0.92	0.75	32	23	73	41	5	41
475 (Outer Gabbard)	0.59	0.36	0.49	0.43	1.4	0.64	18	4	29	29	1.6	29

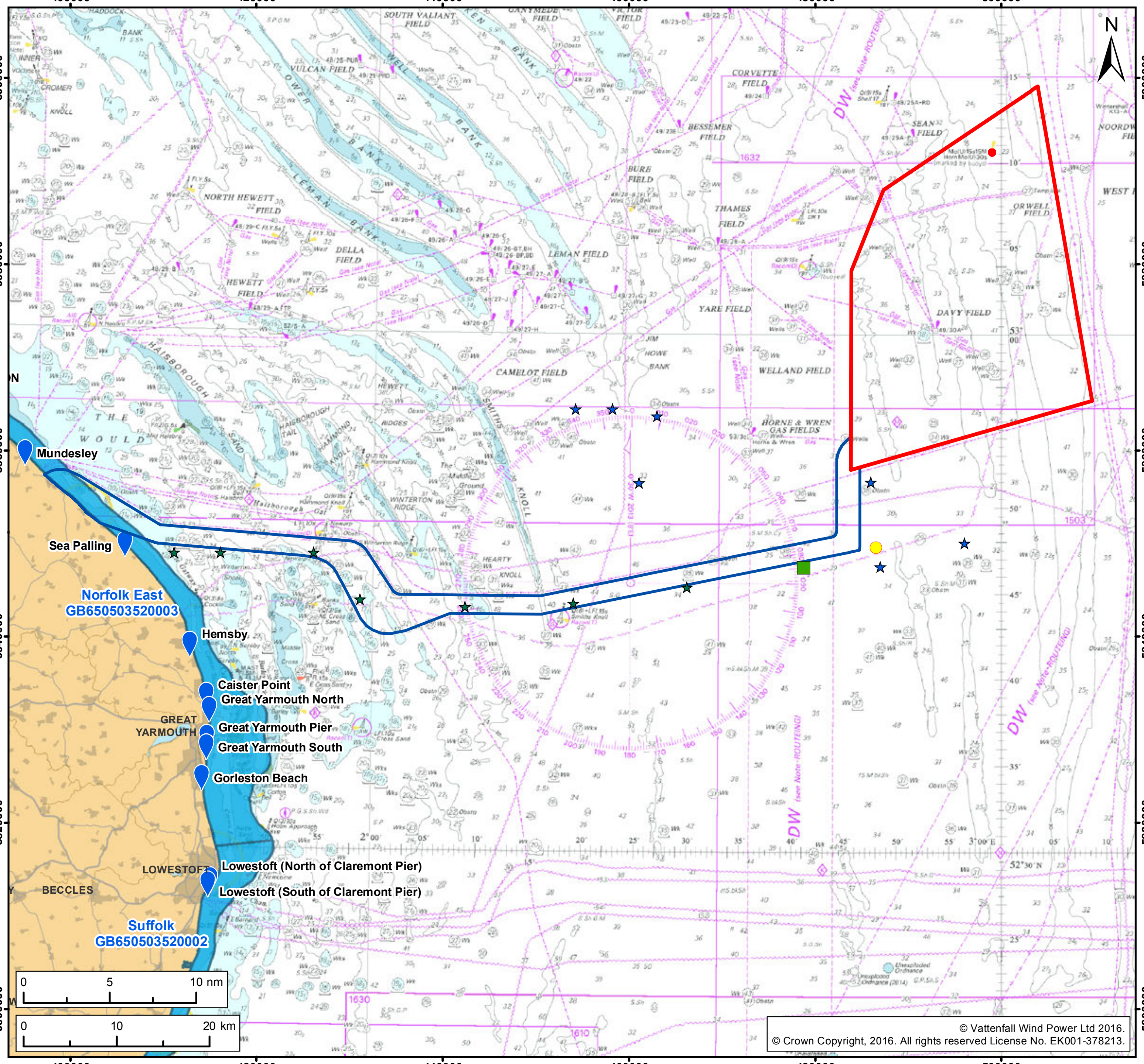
346. The levels of dissolved trace metals taken at NMMP sample site 395, fall within ranges of contaminant levels typically found in surface water of the North Sea (shown in Table 2.4).

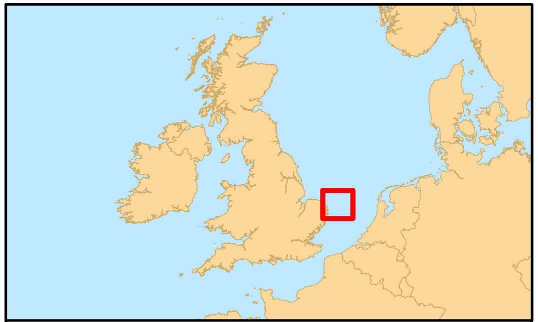
Table 2.4 Summary of potential contaminant levels typically found in surfaces water of the North Sea (DTI, 2001)

Location	THC ($\mu g\ l^{-1}$)	PAH ($\mu g\ l^{-1}$)	PCB ($ng\ l^{-1}$)	Nickel ($\mu g\ l^{-1}$)	Copper ($\mu g\ l^{-1}$)	Zinc ($\mu g\ l^{-1}$)	Cadmium ($ng\ l^{-1}$)	Mercury ($ng\ l^{-1}$)
Oil and Gas installations	1-30	-	-	-	-	-	-	-
Estuaries	12-15	>1	30	-	-	-	-	-
Coast	2	0.02-0.1	1-10	0.2-0.9	0.3-0.7	0.5-2.2	10-32	0.25-41
Offshore	0.5-0.7	Below detection	-	0.2-0.6	0.3-0.6	0.5-1.4	10-51	1.6-69

347. There is no known data source relating to water quality within the Norfolk Boreas site itself. However the waters off the East Anglian coast are permanently mixed (BEIS, 2016) and therefore it is expected that site will have similar characteristics as those sampled at NMMP sample site 395.

348. The provisional offshore cable corridor runs through the Water Framework Directive (WFD) Norfolk East coastal water body (GB650503520003), see Figure 2.4. The North Norfolk WFD bathing waters are approximately 3.1km to the north of the Bacton landfall zone around Mundesley and 3.9km south of the Happisburgh landfall zone at Sea Palling. Mundesley and Sea Palling bathing waters have been classified as having excellent bathing water quality since 2013 and 2012, respectively (Environment Agency, 2016a and 2016b).





Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast
- Water Framework Directive Coastal Waterbody[1]
- Designated Bathing Water[2]
- Contamination sample site[3]
- NMMP Sampling Location - 395
- Norfolk Vanguard Contaminants Grab Sample[4]
- Provisional Offshore Cable Corridor Contaminants Grab Sample[4]

[1] Environment Agency, 2016.
[2] European Environment Agency, 2016.
[3] Fugro, Emu, 2013.
[4] Fugro, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Marine Water and Sediment Quality

Figure: 2.4 Drawing No: PB4650-102-008

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	24/02/17	JE	GK	A4	1:600,000
01	01/02/17	JE	GK	A4	1:600,000

Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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2.3.1.3 Sediment quality

349. Sediment data collected as part of the ZEA (EAOW, 2012a) and Norfolk Vanguard (Fugro Group, unpublished) surveys showed that the Norfolk Boreas project area generally consists of coarse grained sediment low in organic content. Sediments of this nature are not considered to be good sinks for contaminants. The offshore project area does not overlap any active disposal sites but there are active gas wells within the Norfolk Boreas site (see Section 2.14.1) which could be potential sources of contamination.

350. Contaminant analysis from the adjacent Norfolk Vanguard OWF sites and the provisional offshore cable corridor was undertaken in 2016 to inform the Norfolk Vanguard PEI. One contaminant sample was also collected from what is now NV East during the East Anglia FOUR surveys in 2013. Locations of these sample points are displayed in Figure 2.4.

351. There are two sets of guidance levels that are commonly used for sediment contamination assessment; Cefas Action Levels (Cefas, 2000) and Canadian Sediment Quality Levels (CCME, 2002). The use of these levels within the EIA will be agreed with relevant stakeholders through the EPP. Table 2.5 identifies at which sample points these levels were exceeded. Of the samples collected, only three exceeded the guidance levels for any contaminants and they were for Arsenic, Chromium and Nickel.

Table 2.5 Sediment contaminant levels within Norfolk Vanguard OWF sites compared with Cefas Action Levels (Cefas, 2000) and Canadian Sediment Quality Levels (CCME, 2002) for samples that exceed Action levels.

Contaminant (mg/kg)	43 (EA4)	56_CR	03_MS	Cefas Action Level 1[10]	Cefas Action Level 2[11]	Canadian Sediment Quality TEL[12]	Canadian Sediment Quality PEL[13]
Arsenic	47.4	35.2	20.4	20	100	7.24	41.6
Chromium	118	-	-	40	400	52.3	160
Nickel	64	-	-	20	200	15.9	42.8

352. Total Hydrocarbon levels from these samples ranged between <0.9 to 47.3 mg/kg,

[10] Cefas Action Levels were derived for the dredging industry. Sediment with levels greater than Action Level 1 require further consideration.
[11] Sediment with levels greater than Action Level 2 are considered to be unsuitable for disposal at sea and therefore are likely to pose a greater risk
[12] TEL = adverse biological effects are expected to occur only rarely (in some sensitive species for example)
[13] PEL = adverse effects may be expected in a wider range of organisms

none of which exceed the DEFRA action level limit used for dredging material which is 100mg/kg.

2.3.2 Potential impacts

353. The potential for release and dispersion of sediments and any associated contaminants due to construction, O&M and decommissioning of Norfolk Boreas will be informed by the assessment of Marine Physical Processes (Section 2.2).

2.3.2.1 Potential impacts during construction

354. **Deterioration in water quality due to increased suspended sediment concentrations:** An increase in suspended sediments is anticipated during construction from activities such as cable installation or from ground preparation (dependent upon the foundation type used, see Section 1.5.2.2). Modelling of sediment plumes completed as part of the East Anglia ONE EIA (EAOL, 2012) showed that coarser material is likely to settle out within a short distance (between a few hundred meters and 1km) of the activity and limit the overall footprint of the affected area. The significance of impacts associated with temporary increases in suspended sediment will be dependent upon the habitats and communities present within the offshore project area (see Benthic Ecology Section 2.6).

355. There are no designated bathing waters located in the landfall zones; those closest are located approximately 3.1km and 3.9km away and are therefore unlikely to be affected by any increased suspended sediment during installation of the offshore export cables.

356. **Release of contaminated sediments:** The Norfolk Boreas site is located 72km offshore and does not overlap any active disposal sites. There are four active wells within the offshore project area (Section 2.14).

357. The results of sediment sampling within NV East, NV West and the provisional offshore cable corridor indicate that the baseline levels of contaminants are very low with only two samples from 13 containing marginally exceeding levels Cefas Action level 1 (Table 2.5) for one contaminant: Arsenic. Further contaminant sampling across the Norfolk Boreas site is planned for 2017, based on the initial results of this it may be possible to scope out impacts from contaminated sediments through the EPP, however this will be considered further until that point.

358. **Accidental release of contaminants**: The Applicant is committed to the use of good practice techniques and procedures throughout all construction and O&M activities. These will be stated within the ES and will be secured through the DCO or commitment to a relevant certified document such as a Marine Contingency Pollution Plan. This commitment ensures the use of appropriate preventative

measures and serves as an embedded mitigation against all types of pollution incidence. For instance, all vessels involved in the construction, maintenance and decommissioning of the wind farm will comply with the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78, specifically:

- Annex I Regulations for the prevention of pollution by oil – concerning machine waters, bilge waters and deck drainage; and
- Annex IV Regulations for the prevention of pollution by sewage from ships – concerning black and grey waters.

359. Given that these standard procedures would be followed to avoid or mitigate any impact, it is suggested that, subject to consultation with relevant consultees (i.e. Cefas and Natural England) and feedback from this Scoping Report and results of sediment contamination analysis, this impact should be scoped out from further consideration within the EIA.

2.3.2.2 Potential impacts during operation

360. **Deterioration in water quality due to increased suspended sediment concentrations**: Changes in the tidal and wave regimes around each foundation structure have the potential to result in localised scour of the sea bed. This effect would be highly localised (limited to a few hundred metres from the structure) and is not expected to cause any significant change to water quality. However, as the results of the physical processes assessment are not yet available this will be considered further within the EIA, until such time when it may be possible to scope this impact out through the EPP.

361. **Release of contaminated sediments**: There is potential for sediments which may be contaminated to be re-suspended by scouring effects. This effect would be highly localised and as previously discussed, no significantly contaminated sediments are expected within the offshore project area. However, as the results of the analysis from within the Norfolk Boreas site are not yet available, this will be considered further within the EIA until such time when it may be possible to scope this impact out through the EPP.

362. **Accidental release of contaminants:** As per construction, the Applicant is committed to the use of best-practice techniques throughout the project life to avoid spillages during maintenance operations. Therefore it is proposed that, subject to consultation with relevant consultees (i.e. Cefas and Natural England), and feedback from this Scoping Report, this impact should be scoped out from further consideration within the EIA.

2.3.2.3 Potential impacts during decommissioning

363. During decommissioning, the foundation structures would be removed which is likely to result in disturbance to sediments. Any impacts are anticipated to be similar to those outlined during the construction phase and are unlikely to be significant.

2.3.2.4 Potential cumulative impacts

364. **Interactions with other wind farms:** Considering the relatively low levels of potential contaminants within the sediments and given that any re-suspension of sediment is likely to be highly localised, no cumulative impacts are anticipated from the development of wind farms in the region.

365. **Interactions with other activities:** Proposed aggregate extraction activity to the north-west of the Norfolk Boreas site and the construction of the Norfolk Vanguard project have potential to impact cumulatively with Norfolk Boreas. However, due to the timescales of the aggregate dredging (currently planned) and Norfolk Vanguard construction (currently proposed for 2023) in relation to Norfolk Boreas construction from 2025, there is unlikely to be a cumulative impact. Subject to the final plans for both projects, the potential for cumulative impact will be discussed with key stakeholders through the EPP and assessed in the CIA if appropriate.

366. Aggregate extraction for the Bacton Gas Terminal sandscaping scheme, if consented, is likely to be completed long before construction of the Norfolk Boreas project starts and therefore cumulative impacts with this project are not expected.

2.3.2.5 Transboundary impacts

367. As with Marine Geology, Oceanography and Physical Processes (Section 2.2),due to the localised nature of potential impacts, transboundary impacts are unlikely to occur and therefore the Applicant proposes not to consider this further during the EIA.

2.3.2.6 Summary of potential impacts

Table 2.6 Summary of potential impacts relating to marine water and sediment quality

Potential impacts	Construction	Operation	Decommissioning
Deterioration in water quality due to re-suspension of sediments	✓	✓	✓
Release of contaminated sediments	✓	✓	✓
Accidental release of contaminants	x	x	x
Cumulative impacts	✓	✓	✓

Potential impacts	Construction	Operation	Decommissioning
Transboundary impacts	x	x	x

Scoped in (✓) and scoped out (x)

2.3.3 Mitigation

368. Embedded mitigation in the form of adherence to the relevant MARPOL standards listed above would prevent potential impacts from spillages.

2.3.4 Approach to assessment and data gathering

369. Site specific surveys of Norfolk Boreas are planned for summer 2017 which will include collection of 35 sediment samples from the Norfolk Boreas site. A strategic approach will be taken to analysing these samples involving the initial analysis for contaminants of a sub sample and comparing the results to Environmental Quality Standards (EQS). The requirement for further analysis of samples will be discussed with key stakeholders through the EPP. Results will provide primary data for the EIA.

370. Given the likely level of impact as informed by evidence from the East Anglia ONE and East Anglia THREE Environmental Statements (EAOW, 2012b and EATL, 2015), it is proposed that the assessment of potential impacts should take the form of a simple desk-based review.

2.4 Offshore Air Quality

2.4.1 Baseline

371. The main likely source of atmospheric emissions in the offshore project area is from exhaust emissions from shipping. The main pollutants are sulphur dioxide (SO_2), nitrogen oxides (NO_X) and particulate matter (PM). The application of a sulphur emission control area in the North Sea, implemented at the end of 2007, has led to a significant reduction (20.3%) in the output of SO_2 (DEFRA, 2015a). NOx emissions are falling more slowly (8.4%) (Defra, 2015a). Targets set by the UK government under Directive 2001/81/EC on National Emission Ceilings are being achieved (NAEI, 2015).

2.4.2 Potential impacts

372. Engine exhausts from construction, O&M and decommissioning vessels would contribute, at a small scale, to atmospheric emissions from existing shipping traffic. The number of vessels (up to approximately 12 for short periods during construction) and the associated atmospheric emissions would be small in comparison to the total shipping in the southern North Sea. Marine exhaust emissions are limited in line with the provisions of MARPOL Annex VI (MARPOL, 2016) and the recent decision taken by the IMO to implement a global sulphur limit

on vessel fuel of 0.50% m/m (mass/mass) by 2020 (IMO, 2016).

373. Given the likely negligible increases of air pollutants on site and the distance from any shore-based receptors, it is proposed that all offshore air quality impacts should be scoped out from further consideration within the EIA. This is in line with the Scoping Opinion provided for East Anglia THREE and East Anglia FOUR (the Planning Inspectorate, 2012c and 2012d).

2.4.2.1 Summary of potential impacts

Table 2.7 Summary of potential impacts relating to air quality

Potential impacts	Construction	Operation	Decommissioning
Impacts on offshore air quality	x	x	x

Scoped in (✓) and scoped out (x)

2.5 Offshore Airborne Noise

2.5.1 Baseline

374. Offshore airborne noise sources are likely to arise from existing high levels of vessel traffic in the area and natural sources (e.g. wind and waves).

2.5.2 Potential Impacts

375. There is potential for increases in airborne noise levels during offshore construction. Within the Norfolk Boreas site the primary noise source would be pile driving during construction with vessels also contributing a low level of noise. Given the distance of Norfolk Boreas from shore it is considered that offshore works could be audible onshore during still conditions but would not be at a level that would be considered significant to onshore receptors. Any offshore receptors are likely to be transitory and the noise impact of construction works would be temporary and intermittent in nature.

376. There is potential for onshore receptors to be impacted by vessel noise during nearshore cable laying works. It is considered that vessel and associated activity noise would be indistinguishable from the baseline conditions and these works would be short term. However as a landfall location has not been finalised this will be considered further within the onshore noise EIA (Section 3.9).

377. During operation, turbine movement would cause low levels of airborne noise. Given the distance of Norfolk Boreas from shore it is not considered that offshore works would be audible to shore-based receptors during operation.

378. Increased airborne noise levels may arise from the removal of offshore structures

during decommissioning. The potential impact during decommissioning is likely to be less than during construction due to the absence of piling during decommissioning.

2.5.2.1 Summary of potential impacts

379. It is proposed that all offshore airborne noise impacts should be scoped out from further consideration within the EIA. This is in line with the Scoping Opinion provided for East Anglia THREE and East Anglia FOUR (the Planning Inspectorate, 2012c and 2012d). The scoping opinion provided for Norfolk Vanguard advised that due to the fact that there are a number of villages and hamlets close to the landfall zones and the landfall location has not been determined vessel and associated activity noise during cable installation in the near shore should be scoped in. Therefore this has been considered with Section 3.9 (Onshore noise and vibration).

Table 2.8 Summary of potential impacts relating to airborne noise from the offshore project area

Potential impacts	Construction	Operation	Decommissioning
Impacts of airborne noise from the offshore project area	x	x	x

Scoped in (✓) and scoped out (x)

2.6 Benthic and intertidal ecology

2.6.1 Baseline

380. The primary sources of information used in this section are provided by studies undertaken for the ZEA report (EAOW, 2012) and the Norfolk Vanguard benthic survey campaign (Fugro Group, unpublished). These will also be used to inform the EIA along with site specific survey data.

381. Benthic sampling of the former East Anglia Zone was conducted in 2010 and 2011; this included what is now the Norfolk Boreas site. These surveys include a combination of benthic grabs, trawls and seabed imagery. In total there are 98 grab samples from the Norfolk Boreas site as well as 13 epibenthic trawls. The surveys undertaken are summarised in Table 2.9 and sample locations are shown in Figure 2.5.

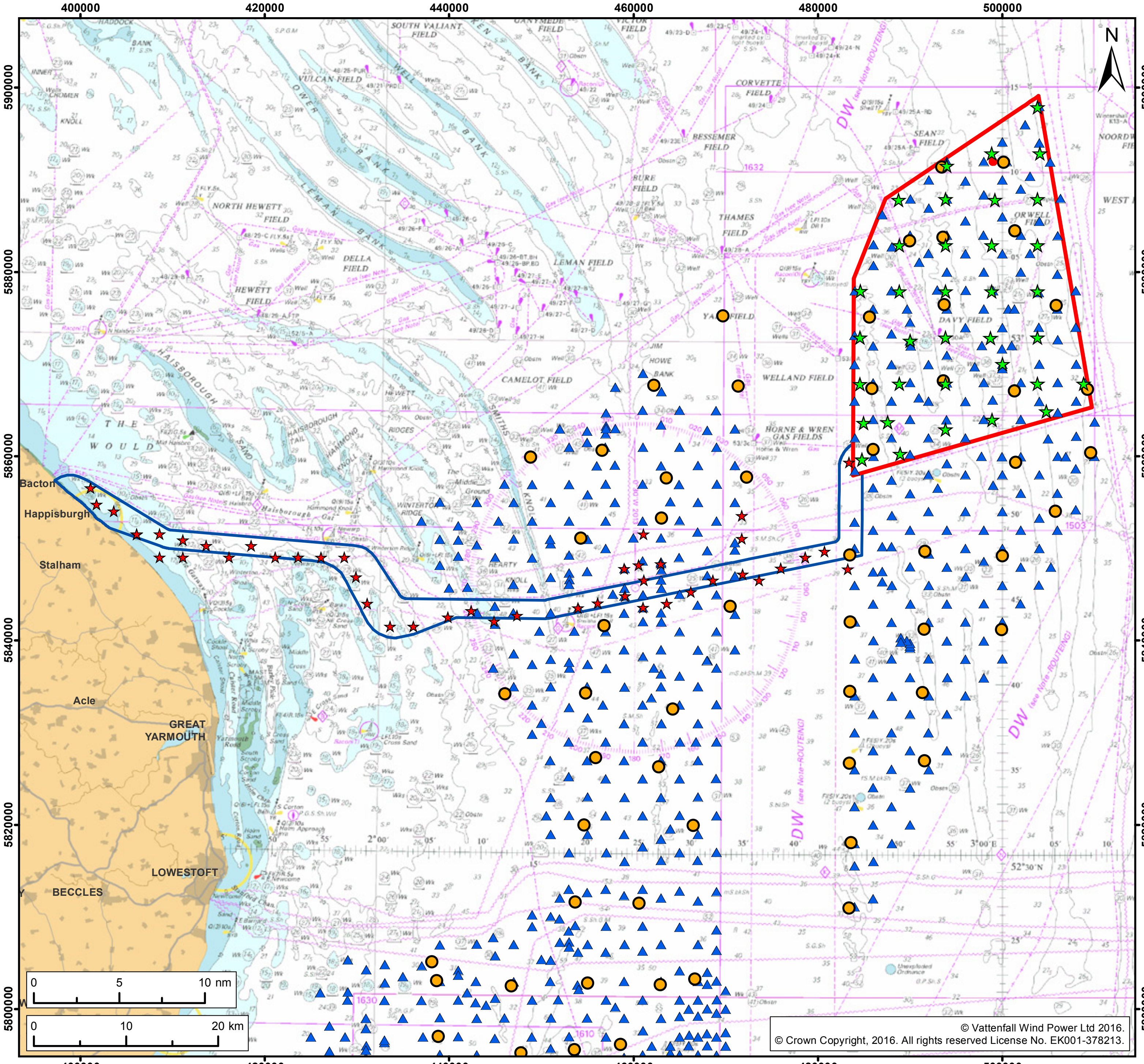
382. During the Norfolk Vanguard survey campaign the Norfolk Vanguard OWF sites and the provisional offshore cable corridor were subject to grab and video sampling. Samples were taken at 15 locations within NV West, eight within NV East and 43 along the provisional offshore cable corridor. Although the sample locations within the Norfolk Vanguard OWF sites are not directly relevant to the Norfolk Boreas site, they are helpful for characterisation of the general area. The samples within the

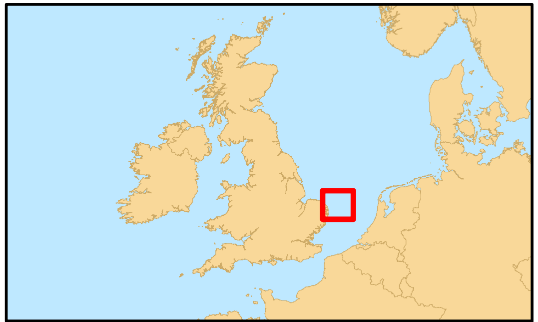
shared provisional offshore cable corridor are however directly relevant to the Norfolk Boreas as the majority of the cable corridor is shared. There were 30 sample locations collected during the Norfolk Vanguard survey campaign which are located within the Norfolk Boreas provisional offshore cable corridor (See Figure 2.5)

383. Existing information will be supplemented by the collection of grab samples and seabed imagery from the Norfolk Boreas site during the survey planned for summer 2017. Table 2.9 summarises existing and planned data collection which will be used to inform the benthic ecology EIA.

Table 2.9 Available and planned site-specific benthic datasets

Data	Coverage	Date
Benthic survey (grabs, trawls and video) by Marine Ecological Surveys Ltd reported in the ZEA (EAOW, 2012a)	East Anglia Zone	2010 - 2011
Geophysical survey by Gardline Geophysical Ltd reported in the ZEA (EAOW, 2012a)	East Anglia Zone	2010
Benthic survey (grabs and video) by Fugro EMU Ltd (Fugro Group, unpublished)	NV East, NV West and the provisional offshore cable corridor	2016
Geophysical survey by Fugro EMU Ltd (reporting will be provided in the ES for Norfolk Vanguard)	NV East, NV West and the provisional offshore cable corridor	2016
Benthic survey (grabs and video) by Fugro EMU Ltd (reporting will be provided in the ES for Norfolk Boreas)	Norfolk Boreas site	2017
Regional Environmental Characterisation (REC) studies (Limpenny *et al.* 2011)	East Coast	2011
National Biodiversity Network (NBN) gateway	East Anglia coast	collation of various data sources
Marine Life Information Network (MarLIN)	UK species information	collation of various data sources
UKSeamap 2010 Interactive Map	UK	collation of various data sources up to 2010
European Marine Observation and Data Network (EMODnet) Seabed Habitats	Europe	2004-2014





Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast
- Suggested Norfolk Boreas Grab Sample
- Provisional Offshore Cable Corridor Grab Sample Location[1]
- Trawl Location[2]
- Grab Station[2]

[1] Fugro, 2016.
[2] MESL, 2010/11.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Benthic Survey Locations

Figure: 2.5 Drawing No: PB5640-102-009

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	24/02/17	JE	JM	A4	1:600,000
01	01/02/17	JE	JM	A4	1:600,000

Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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2.6.1.1 Sediment types

384. During the 2010 and 2011 ZEA surveys, a total of 564 benthic grab samples within the former East Anglia Zone were analysed for sediment type. Many of these were located within what are now the Norfolk Boreas site and the shared provisional offshore cable corridor (eastern section of). They show that the majority of the Norfolk Boreas site is comprised of coarser sediments with samples containing over 90% sand. Patches of more mixed sediment exist within southern and middle section of the site where samples contain greater percentages of silt and gravel (EAOW, 2012a and Figure 2.2). Data collected from the provisional offshore cable corridor showed that the offshore sections of the survey area were dominated by slightly gravelly sand and gravelly sand. The inshore section was comprised of heterogeneous, coarser sediments, with higher percentage of the gravel fraction.

385. British Geological Survey (BGS) data (Figure 2.3) indicates that the sediments in the Norfolk Boreas site are predominately sand and slightly gravelly sand. The distribution of sediment within the provisional offshore cable corridor is aligned with the survey data showing predominantly slightly gravelly sand and sand at the eastern extent, moving to a mixture of slightly gravelly sand, gravelly sand and sand along the central region and sandy gravel closer to shore.

2.6.1.2 Infauna

386. A total of 643 benthic grab samples were collected and analysed for benthic fauna during the ZEA survey. From these, 428 taxa were identified, with an average of 70 individuals and 16 taxa recorded per sample (EAOW, 2012a). Of these grabs, 98 were taken from within what is now the Norfolk Boreas site.

387. Within the former East Anglia Zone, annelid worms were the most abundant taxa present (contributing to 58% of the abundance) and were the most diverse group, making the largest contribution to the taxonomic richness (41%). Echinoderms (brittlestars starfish and sea urchins) made the largest contribution to biomass (as ash-free dry weight (AFDW) in grams) (37%) followed by annelids (32%) (EAOW, 2012a).

388. Within the top ten taxa recorded in the former East Anglia Zone, the most abundant across the zone were the Ross worm *Sabellaria spinulosa*, the polychaete worm *Spiophanes bombyx,* brittlestars (Ophiurodea) and the white furrow shell *Abra alba* (EAOW, 2012a). Together these accounted for nearly 40% of the total abundance. Overall abundance across the former East Anglia Zone was low with the majority of samples containing less than 210 individuals.

389. The majority of samples supporting higher numbers of individuals, biomass and

taxonomic diversity were located in the western part of the former East Anglia Zone, including overlap with the provisional offshore cable corridor. There were two stations within the western side of the Norfolk Boreas site which contained relatively high abundance and five samples in the southern part with relatively high biomass and species diversity.

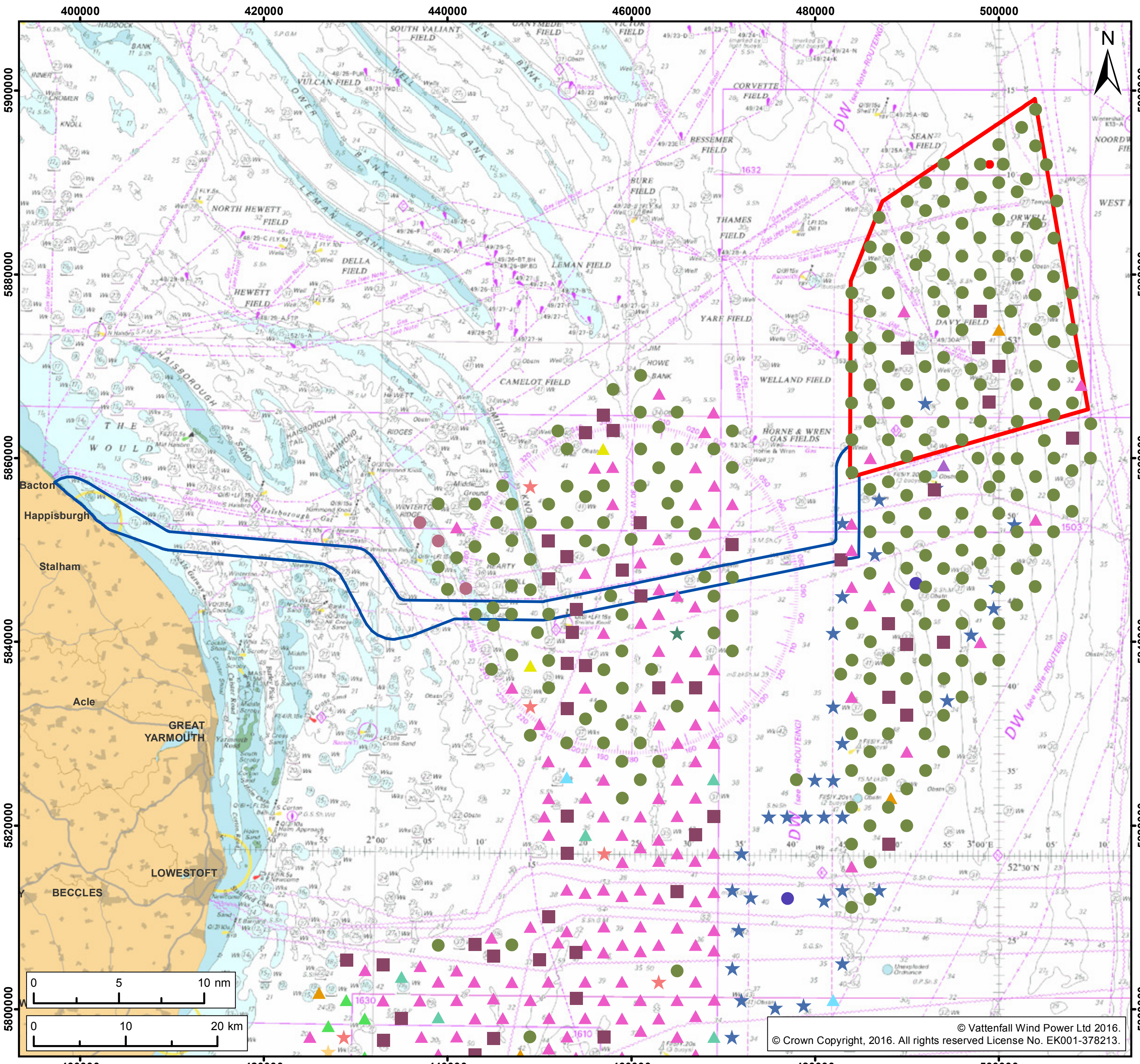
390. Multivariate analysis of the Zonal benthic infaunal data (including data from the East Anglia THREE, and East Anglia ONE surveys) was carried out using the PRIMER V6 software package; this analysis identified 18 faunal groups. The Norfolk Boreas site and provisional offshore cable corridor was dominated by four groupings of benthic infaunal communities (assigned as communities N with L, M and Q also present). The main characterising taxa in these groups were:

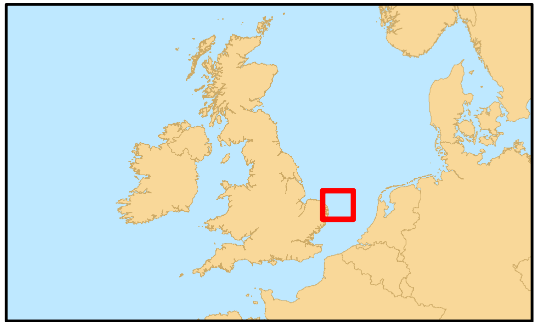
- Group L: the polychaete[14] worms *Asclerocheilus intermedius*, *Nephtys cirrosa* and Ophelia borealis;
- Group M: the polychaete worms *N. cirrosa* and *S. bombyx* as well as Nemertea (ribbon worms);
- Group N: the polychaete worms *N. cirrosa* and *S. bombyx* and the gastropod *Polinices pulchellus*;
- Group Q: Nemertea*,* Ophiuroidea (brittlestars) and the polychaete worm *S. bombyx*.

391. Infaunal communities identified from the ZEA, East Anglia THREE & FOUR and East Anglia data are shown in Figure 2.6.

392. Grab samples were also collected from the provisional offshore cable corridor in 2016, this data has not yet been merged with the ZEA data for overall multivariate analysis however initial studies show that it is mainly dominated by two faunal groups which are mainly differentiated by the presence of *S.spinulosa*. The group containing *S.spinulosa* was more diverse and also contained Nemertea, the echinoderms *A. squamata*, Ophiuridea (juv.) and the long-clawed porcelain crab *P. longicornis* with the other group being less diverse and dominated by polychaete worms such as *N. cirrosa* (Fugro group, Unpublished).

[14] A class of annelid worm that have bristles (“chaetae”) on each body segment





Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast

Faunal Group[1]

A	L
C	M
F	N
G	O
H	P
I	Q
J	R
K	Outlier

[1] MESL 2010/11. Fugro EMU 2013.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Infaunal Groups Across the Former East Anglia Zone

Figure: 2.6 | Drawing No: PB5640-102-010

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:600,000
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Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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2.6.1.3 Epifauna

394. A total of 78 epibenthic trawls were taken during the survey of the former East Anglia Zone; 13 were located within what is now the Norfolk Boreas site. The zone surveys identified 95 taxa, with an average of 956 individuals and 24 taxa per trawl. Epifaunal abundance ranged from 110 to 15,252 individuals per trawl, with the majority of trawls supporting less than 565 individuals. Epibenthic abundance and diversity are generally low across the Norfolk Boreas site (EAOW, 2012a).

395. There is no epibenthic trawl data available for the provisional offshore cable corridor; however the results of the grab survey indicate the area of the offshore cable corridor which overlaps with the former East Anglia Zone is broadly comparable with the benthic ecology within the Norfolk Boreas site identified during the ZEA surveys.

396. Multivariate analysis of the former East Anglia Zone epifaunal data identified four faunal groups. The Norfolk Boreas offshore project area contains only one of these groups which is characterised by the following key taxa:

- The flatfish *Buglossidium luteum*;
- The brittlestars *Ophiura ophiura* and *O.albida*;
- The fish family, Gobiidae; and
- The shrimp *Crangon allmanni*.

2.6.1.4 Habitats Directive Annex 1 habitats

397. There are two habitat types listed in Annex I of the Habitats Directive that were identified through the ZEA which are located in the offshore project area: sandbanks and biogenic reefs.

398. The provisional offshore cable corridor runs through the Haisborough, Hammond and Winterton SCI which is designated for Annex I sandbanks which are slightly covered by sea water all the time and reefs (JNCC, 2017a). To date, no Annex I sandbanks have been identified within the Norfolk Boreas site.

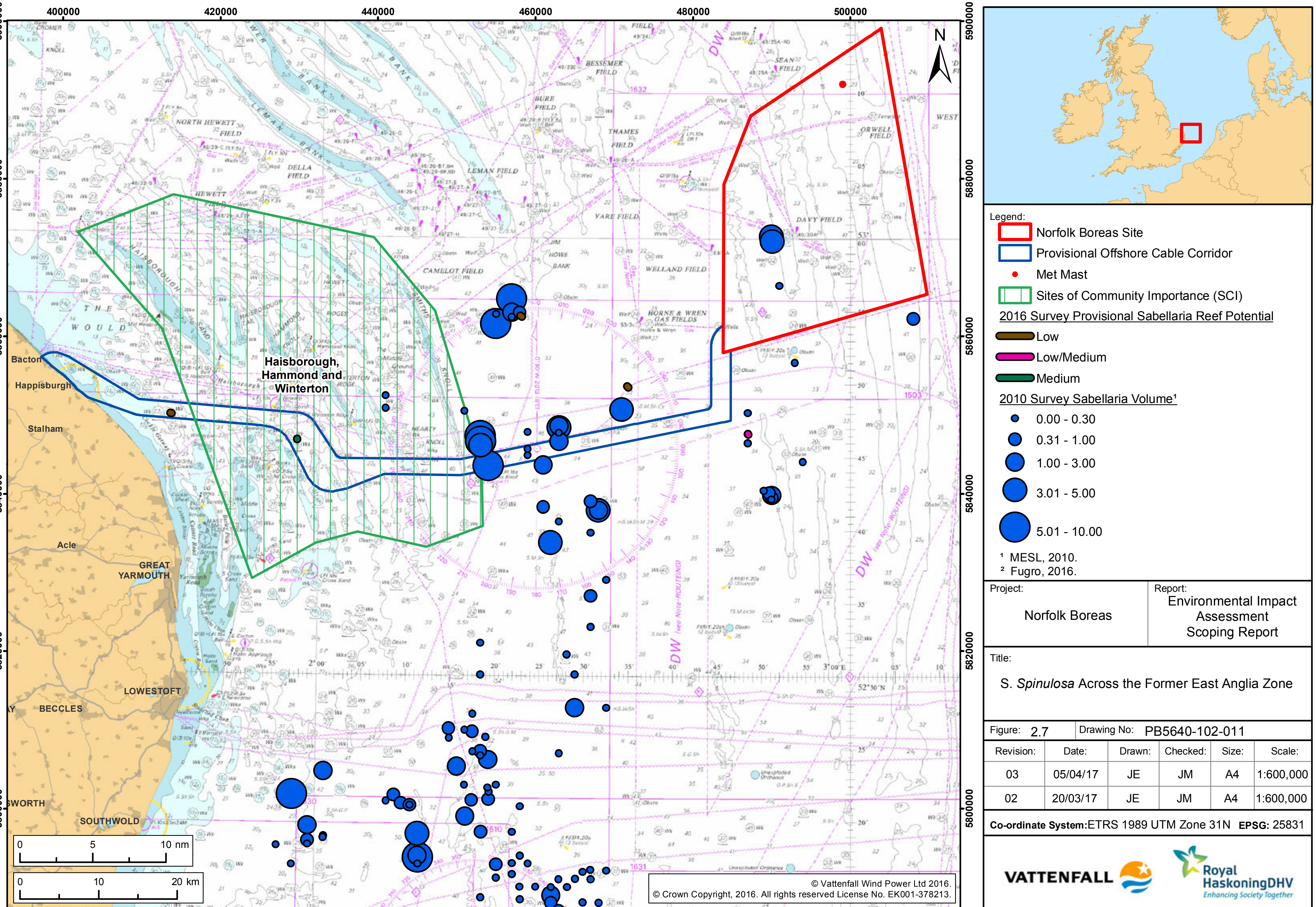
399. Potential reef structures, identified during the benthic surveys within the former East Anglia Zone were biogenic aggregations made by the *S. spinulosa*. *S. spinulosa* can form dense aggregations on the seabed, which can take the form of crusts or reef where aggregations are up to several meters across and up to 60cm in depth (Gubbay, 2007). The drop-down video sites selected for the benthic survey were specifically targeted to areas deemed likely to support *S. spinulosa* based on the analysis of the previously collected geophysical survey data. *S. spinulosa* was identified as present in less than 10% of the total seabed images taken across the

former East Anglia Zone. Drop down video images containing *S. spinulosa* were categorised using a scoring system for "reefiness" (Hendrick and Foster-Smith, 2006). 14% of grab samples contained *S. spinulosa* and of these, 19% indicated the potential for presence of reef (EAOW, 2012a).

400. Modelling of the distribution of *S. spinulosa* was undertaken for the ZEA process, with areas of *S. spinulosa* aggregations identified in the west of the former East Anglia Zone , including parts of the provisional offshore cable corridor, which have potential to be classified as Annex I reef habitat. In addition, small volumes of *S. spinulosa* that were not deemed to have potential to be reefs during the 2010/11 survey were also recorded within the Norfolk Boreas site and the provisional offshore cable corridor.

401. Provisional analysis of data collected in 2016 indicates that one station supported medium reef and one station as supporting low reef within the Norfolk Boreas provisional offshore cable corridor (Figure 2.7). This data is currently being subjected to further analysis which will be available for the PEIR. *S.spinulosa* was also identified at seven other sample points within the provisional offshore cable corridor by the drop down video survey however early analysis of the data indicates that in these areas reef structures were not present. The location of the site where medium reef was found is within the Haisborough, Hammond and Winterton SCI and the site with low reef is located just to the East of the SCI. Further work is currently being undertaken to map the extent of potential *S.spinulosa* reef using the geophysical data acquired during the survey. The resultant map will be used to inform the EIA and HRA (Section 2.15).

402. No evidence of other types of reef (e.g. cobble reef or mussel beds) was found during the benthic survey of the former Zone.



Legend:

Norfolk Boreas Site

Provisional Offshore Cable Corridor

Met Mast

Sites of Community Importance (SCI)

2016 Survey Provisional Sabellaria Reef Potential

Low

Low/Medium

Medium

2010 Survey Sabellaria Volume[1]

0.00 - 0.30

0.31 - 1.00

1.00 - 3.00

3.01 - 5.00

5.01 - 10.00

[1] MESL, 2010.
[2] Fugro, 2016.

Project: Norfolk Boreas

Report: Environmental Impact Assessment Scoping Report

Title: S. *Spinulosa* Across the Former East Anglia Zone

Figure: 2.7 Drawing No: PB5640-102-011

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2.6.1.5 UK Post-2010 Biodiversity Framework

403. The UK Post-2010 Biodiversity Framework, published in July 2012, succeeded the UK Biodiversity Action Plan (BP) and ‘Conserving Biodiversity – the UK Approach’. The Biodiversity Framework is now focussed at country-level rather than a UK-level to demonstrate how the work of the four countries and the UK contributes to achieving those targets (JNCC, 2015). Priority species and habitats that were identified under the UK BAP remain important and are now referred to as habitats and species of principal importance.

404. The following habitats of principal importance are present within the former East Anglia Zone and Norfolk Boreas offshore project area:

- Mud habitats;
- *S. spinulosa* reefs;
- Subtidal sands and gravels;
- Subtidal chalk; and
- Peat and clay exposures.

405. Habitat mapping during the ZEA identified small areas of mud habitats in deep water in the north-west of the former East Anglia Zone, with none being identified within the Norfolk Boreas site (EAOW, 2012a). As discussed above some aggregations of *S. spinulosa* were found within the Norfolk Boreas site and also within the provisional offshore cable corridor and potential for the existence of *S. spinulosa* biogenic reef structures has been identified through the Norfolk Vanguard surveys.

406. As discussed above the subtidal sands and gravels cover large areas of the site.

407. Peat and clay exposures have been identified within the Cromer Shoal Chalk Beds MCZ (see below) to the north of the provisional offshore cable corridor. The presence of these is a key reason for the site's designation. The data collected within the provisional offshore cable corridor as part of the Norfolk Vanguard survey campaign has not yet been processed and therefore it is not possible to determine the extent of these features within the Norfolk Boreas offshore cable corridor. This work will be available to inform the EIA.

408. Four species of principal importance (As defined by the Natural Environment and Rural Communities (NERC) Act 2006) were identified in the ZEA surveys; mantis shrimp *Rissoides desmaresti*, spider crab *Achaeus cranchii*, the amphipod *Apherusa ovalipes*, and Streptosyllis spp. (EAOW, 2012a). No species of conservation importance were found during the Norfolk Vanguard benthic surveys.

2.6.1.6 Marine Conservation Zone features

409. The features of conservation importance within the Cromer Shoal Chalk Beds MCZ are subtidal chalk as well as peat and clay exposures. Mapping of these features (Defra, 2015a and 2016) indicates the area of the MCZ which overlaps with the provisional offshore cable corridor could include subtidal chalk as well as subtidal coarse sediment. As discussed above further habitat mapping is being undertaken by the applicant using the geophysical data collected during the survey; initial mapping indicates presence of pitted seafloor, which may be chalk, and Circalittoral mixed sediment (corresponding to the JNCC biotope code of SS.SMx.CMx).

2.6.1.7 Intertidal

410. The intertidal area within the landfall zones is dominated by highly mobile clean sand. This area of coast is partly defended with seawalls, revetments and groynes aimed at limiting the movement of sediment (Section 2.2.1). The diversity of infauna in the intertidal zone is likely to be low. Once the landfall location has been selected, an intertidal survey will be undertaken to allow characterisation of the intertidal ecology. The methodology for the survey will be agreed with key stakeholders (e.g. Natural England) through the EPP.

2.6.2 Potential impacts

411. A range of potential impacts on benthic ecology may occur during the construction, operation and decommissioning of Norfolk Boreas. Sensitivities of the benthic communities will be judged for each of these impacts on the basis of expert judgement and reference to Marine Evidence-based Sensitivity Assessments (MarESA) available on the Marine Life Information Network (MarLIN) website[15].

2.6.2.1 Potential impacts during construction

412. **Physical disturbance:** There is potential for direct physical disturbance of the seabed during foundation and cable installation from jack-up vessel legs, piling, seabed preparation (dredging) and cable installation. Areas affected by jack-up operations and cable installation would be relatively small and seabed recovery is expected quickly following cessation of installation activities, given the likely tolerance and recoverability of the communities present.

413. **Increased suspended sediments:** The installation of foundations and offshore cables may cause an increase of suspended sediment concentrations in the water column. Such concentrations have the potential to affect benthos through blockage of filter feeders and/or smothering sessile species.

[15] http://www.marlin.ac.uk/

414. **Smothering:** Sediment disturbance from construction activities, such as cable and foundation installation could have an adverse and indirect impact on the benthic communities through increased turbidity or as a result of smothering from deposition. However, given the substrate at the site and the existing dynamic conditions, it is likely that the communities are habituated to smothering from natural events and therefore have some tolerance. Evidence suggests that this is the case given the dominant species and communities detailed above.

415. **Re-mobilisation of contaminated sediments:** Sediment disturbance could lead to the mobilisation of contaminants (if present) that could be harmful to the benthos. This will be assessed in the EIA based on the results of sediment sampling already collected within the provisional offshore cable corridor and that planned for the Norfolk Boreas site.

416. **Underwater noise and vibration:** Research into the effects of underwater noise upon benthos is ongoing. However it is likely that there is habituation to noise created by the existing shipping which occurs in the area (see Section 2.11). There may be reactions from some benthic species to episodic noise such as that from pile driving (Lovell *et al*, 2005, Heinisch and Weise, 1987). Any impact is likely to be localised and temporary (i.e. occurring only during piling).

417. **Loss of habitat:** The installation of turbine foundations and any cable protection measures would result in a long term temporary loss of habitat. As the loss of habitat is an on-going impact through the lifetime of the project this will be considered under operation rather than construction to avoid double counting.

418. **Potential impacts on sites of Marine Conservation Interest:** The provisional offshore cable corridor runs through Haisborough, Hammond and Winterton SCI and Cromer Shoal Chalk Bed MCZ. The effects of the offshore project upon the integrity of these designated features will be dependent on the choice of a final landfall, the methods used for cable installation and use and design of cable protection. These will all be taken account of and assessed within the EIA. The impacts on Natura 2000 sites will also be considered further within the HRA.

2.6.2.2 Potential impacts during operation

419. **Physical disturbance:** There is potential for ongoing physical disturbance of the seabed from the catenary mooring systems of the floating foundations (if used). Temporary disturbance could be caused by jack-up vessel legs during planned maintenance or, in the case or a cable failure, excavation and reburial of cables. In general, the impacts from planned maintenance should be temporary, localised and smaller in scale than during construction.

420. **Smothering:** Small volumes of sediment could be re-suspended during maintenance activities; the volumes would be lower than for construction. As discussed above, it is not expected that there would be significant smothering effects.

421. **Re-mobilisation of contaminated sediments:** Given the likely low levels of sediment contamination it is unlikely that a pathway exists for impacts from the remobilisation of contaminants from within the offshore sediments.

422. Therefore, subject to consultation with relevant consultees (i.e. Cefas and the MMO), feedback from this Scoping Report and the results of sample analysis from the 2017 survey, this impact should be scoped out from further consideration within the EIA through the EPP.

423. **Loss of habitat:** The presence of foundations on the seabed (including catenary systems from floating foundations) would result in a relatively small footprint of lost habitat in the context of the habitat available in the former East Anglia Zone and the surrounding region. As previously discussed there are potentially Annex I habitats (*S. spinulosa* reefs) present within the offshore project area. There may also be some loss of habitat over time associated with scour around foundations, which will also represent a comparatively small footprint.

424. **Colonisation of introduced substrate:** The sub-sea structures (foundations, scour, and cable protection) are expected to be colonised by a range of species leading to a localised increase in biodiversity. The presence of the structures would also provide habitat for mobile species and for example serve as a refuge for fish. Although potentially viewed as a positive effect, this represents a change from the baseline ecology and may also increase the potential for colonisation by non-native species. Overall, the area available for colonisation would be low and to date there is no evidence of significant changes of the seabed beyond the vicinity of the foundation structures due to the installation of windfarms (Lindeboom *et al*, 2011).

425. **Potential impacts on sites of Marine Conservation Interest:** As previously discussed, the provisional offshore cable corridor runs through Haisborough, Hammond and Winterton SCI and Cromer Shoal Chalk Bed MCZ. The impacts described above will be considered in relation to the conservation objectives, sensitivities of the Annex I and II habitats and species and the habitats and species of conservation importance, as well as the potential impact magnitude within the HRA.

426. The potential presence of cable protection (most likely as rock dumping or concrete mattresses) within the Haisborough, Hammond and Winterton SCI would represent a new and different substrate from that which the site is designated for (Sandbanks which are slightly covered by sea water all the time). Each export cable is likely to make two cable crossings and one pipeline crossing. Each cable crossing would

require cable protection, of which there are several types available. In order to make an assessment of impacts (Likely Significant Effects (LSE)) to the SCI the applicant will undertake studies to define in as far as possible the footprint of protection required, suitable material to employ and the recoverability of cable protection measures. The impacts on the SCI and other relevant Natura 2000 sites will also be considered further within the HRA.

427. **Underwater noise and vibration:** Noise and vibration generated by the operational wind turbine generators can be conducted through the tower and foundations into the water. Monitoring studies of underwater noise from operational turbines have shown the noise levels from North Hoyle, Scroby Sands, Kentish Flats and Barrow wind farms to be only marginally above ambient noise levels. There is no evidence to suggest this low level of noise and vibration has a significant impact on benthic ecology, it is therefore proposed that this impact should be scoped out from further consideration within the EIA.

428. **Electromagnetic fields (EMF):** EMFs as a result of the presence of offshore cables may be detected by some benthic species. Effects are likely to be highly localised, as EMFs are strongly attenuated and decrease as an inverse square of distance from the cable (Gill and Barlett, 2010). Bochert & Zettler (2006) report that the brown shrimp *Crangon crangon,* common starfish *Asterias rubens* and polychaete worm *Nereis diversicolor* (also known as *Hediste diversicolor)* do not react when exposed to EMF. *C. crangon* and *A. rubens* were both recorded in the former East Anglia Zone and Nereididae (*Nereis zonata*) were also recorded (EAOW, 2012a). Gibb *et al.* (2014) state there is no evidence of EMF impacting *Sabellaria spinulosa.* It is therefore proposed that this impact should be scoped out from further consideration within the EIA due to the lack of evidence to suggest an impact. The impacts of EMF on fish and shellfish are considered separately in Section 2.7.

2.6.2.3 Potential impacts during decommissioning

429. The potential impacts arising during the decommissioning phase are envisaged to be similar to those described for the construction phase. These will be assessed within the EIA.

2.6.2.4 Potential cumulative impacts

430. **Wind farms:** Potential cumulative impacts with proposed adjacent offshore wind farms, East Anglia THREE and Norfolk Vanguard could occur. Given the predicted localised nature of potential impacts and staggered construction programmes, there is unlikely to be significant overlap in impact zones during construction.

431. Although there would be an aggregated direct and permanent loss of habitat during

the operational phase of the wind farms it is anticipated that, given the recoverability of the species found in Norfolk Boreas and across the wider southern North Sea, cumulative impacts would not be considered significant. If the situation were to arise where a number of export cables were to be under construction concurrently, there may be potential for cumulative impacts to occur however these are not expected to be significant.

432. **Other activities:** Seabed preparation for cable and foundation installation within the Norfolk Vanguard OWF sites and offshore cable corridor could involve a large amount of dredging activity. This as well as the proposed aggregate extraction to the north of the Norfolk Boreas site and provisional offshore cable corridor to support the aggregate industry and proposed 'sand engine' beach nourishment coastal protection measures for the Bacton Gas Terminal has potential to impact cumulatively with Norfolk Boreas. The dredging for the Bacton scheme is planned for 2018, however at the time of writing it has not been given consent. Norfolk Boreas offshore construction is likely to start from 2025 at the earliest and therefore is unlikely to have a cumulative effect with the Bacton project but may have a cumulative affect with the Norfolk Vanguard project which is currently scheduled for construction between 2023 and 2027. The projects for inclusion within the cumulative impact assessment will be discussed and agreed with key stakeholders through the EPP and assessed in the EIA if appropriate.

2.6.2.5 Transboundary impacts

433. Similarly to the general case with cumulative impacts, the localised and small scale nature of the impacts on the benthos and the distance to the other planned and proposed wind farm projects means that significant transboundary impacts are unlikely. The Applicant therefore proposes that transboundary benthic impacts should be scoped out from further consideration within the EIA, in line with the ES for East Anglia THREE (EATL, 2015).

2.6.2.6 Summary of potential impacts

Table 2.10 Summary of potential impacts relating to benthic and intertidal ecology

Potential impacts	Construction	Operation	Decommissioning
Physical disturbance	✓	✓	✓
Increased suspended sediments	✓	✓	✓
Smothering	✓	✓	✓
Re-mobilisation of contaminated sediments	✓	x	✓
Underwater noise and vibration	✓	x	✓
Loss of habitat	✓	✓	x

Potential impacts	Construction	Operation	Decommissioning
Colonisation of foundations	x	✓	x
Sites of Marine Conservation Interest	✓	✓	✓
Electromagnetic fields (EMF)	x	x	x
Cumulative impacts	✓	✓	✓
Transboundary impacts	x	x	x

Scoped in (✓) and scoped out (x)

2.6.3 Mitigation

434. It is expected that within the Norfolk Boreas site the impacts upon the benthos would be small scale, localised and temporary. It is not considered that there are any highly sensitive benthic ecology receptors within the Norfolk Boreas site. Infrastructure would be micro-sited to avoid impacts to *S. spinulosa* reef as informed by preconstruction surveys. Cable installation within the Haisborough, Hammond and Winterton SCI and Cromer Shoal Chalk Beds MCZ may require some mitigation, including: micro-siting where possible to avoid sensitive features, designing cable installation methodologies to minimise impacts, minimising footprint of cable protection, and maximising the ability to recover cable protection at the end of life.

2.6.4 Approach to assessment and data gathering

435. The benthic survey campaign undertaken in summer 2016 (including geophysical data, geotechnical data, subsampling for contaminants, grab sampling and drop down video) collected data for the provisional offshore cable corridor. Further benthic survey campaign will be undertaken in summer 2017 across the Norfolk Boreas site. The survey methodology which is very similar to the 2016 survey, has been agreed with the MMO and Natural England.

436. Site characterisation for secondary impacts (such as those arising from potential changes to marine physical processes) will be undertaken using the data sources described in Table 2.9 such as REC studies, NBN gateway and UK Seamap 2010.

437. The assessment of the potential impacts upon the benthos will be cross-referenced where relevant to the assessments of physical processes and water and sediment quality.

2.7 Fish and Shellfish Ecology

2.7.1 Baseline

2.7.1.1 Data sources

438. Given that fish are mobile, data sets with large scale coverage are particularly relevant and useful for characterising the fish community present within the site. A key data source is fisheries landings data; these provide information on large scale spatial coverage and fishing effort, although the data have some limitations (i.e. they will be skewed towards commercial species with many non-commercial species being discarded at sea). International Bottom Trawl Survey (IBTS) data will also inform the EIA, although these data are skewed towards demersal species. Site-specific data from East Anglia THREE and FOUR surveys are available and a summary is provided below.

439. Norfolk Boreas lies within the International Council for the Exploration of the Sea (ICES) [16] rectangles 34F1, 34F2, 34F3, 35F2 and 35F3. Data from ICES rectangles covering Norfolk Boreas are discussed further in Section 2.10 and are also referred to below.

440. All relevant available environmental datasets will be used to inform EIA. These will include but are not limited to those listed in Table 2.11.

Table 2.11 Available fish datasets

Data	Coverage	Date
East Anglia FOUR Offshore Wind Farm Fish and Shellfish Surveys	Former East Anglia FOUR site boundary which overlaps with ICES Rectangles 34F2 and 34F3	February and May 2013
East Anglia THREE Offshore Wind Farm Fish and Shellfish Surveys	Former East Anglia THREE site boundary which overlaps with ICES Area IV (c)	February and May 2013
Landings data (MMO)	ICES Rectangles, 34F1, 34F2, 34F3, and 35F2	2008 – 2017 (currently available up to 2015)
International Bottom Trawl Survey (IBTS) CPUE (ICES)	ICES Rectangles, 34F1, 34F2, 34F3, and 35F2	2011 – 2016
Spawning and nursery grounds (Coull *et al*, 1998)	North Sea	-
Spawning and nursery grounds (Ellis, 2012)	North Sea	-
International Herring Larval Survey	North Sea	1967- 2016

[16] ICES Rectangles are the smallest spatial units used for collating fisheries data. Rectangles boundaries align to 1°longitude and 30' latitude, and for the most part have sea areas equating to approximately 900nm^2

2.7.1.2 Surveys within the former East Anglia Zone

East Anglia THREE and FOUR

441. Within East Anglia THREE and FOUR Otter trawls and commercial beam trawls were undertaken to inform the former East Anglia FOUR draft PEI and the East Anglia THREE EIA. Surveys were undertaken in February and May 2013 in the East Anglia FOUR site. A total of 13 and 15 species were caught in the otter trawl surveys in February and May respectively, and 17 and 18 species in the beam trawl surveys. Dab *Limanda limanda*, plaice *Pleuronectes platessa* and whiting *Merlangius merlangus* were the most abundant species caught; all other species were caught in relatively low numbers (BMM Ltd, 2013a, 2013b). Within the East Anglia THREE site a total of 11 and 12 species were caught in the otter trawl surveys in February and May respectively, and 16 and 18 species in the beam trawl surveys. As with the East Anglia FOUR survey dab, plaice and whiting were the most abundant species recorded (BMM Ltd, 2013c).

442. Scientific beam trawl surveys were also undertaken within East Anglia FOUR and East Anglia THREE and the export cable corridor for those projects in May 2013. The East Anglia FOUR surveys caught a total of 16 species of fish with solenette *Buglossidium luteum* the most abundant followed by sand goby *Pomatoschistus minutus*, with all other species found in relatively low numbers (BMM Ltd., 2013b). Within the East Anglia THREE site and export cable corridor a total of 28 species were caught; 20 within East Anglia THREE site and 27 along the export cable corridor. Solenette was the most abundant species along the export cable whereas sand goby was more abundant within East Anglia THREE, followed by lesser weever *Echiichthys vipera* and scaldfish *Arnoglossus laterna*. All other species were caught in relatively low numbers (BMM Ltd, 2013d).

2.7.1.3 Commercial species

443. Table 2.12 gives an indication of the species found within ICES rectangles 34F1, 34F2, 34F3, 35F2 and 35F3 (MMO, 2016). Only species where an average landed weight of over 1 ton, recorded between 2011 and 2015, are listed.

Table 2.12 Average landed weight (tonnes) for fish species recorded by UK fleets within ICES rectangles 34F1, 34F2, 34F3 35F2 and 35F3 (2010-2014) (MMO, 2016)

Common name	Latin name	Mean landed weight (tonnes) per year
Plaice	*Pleuronectes platessa*	253.4
Sprats	*Sprattus sprattus*	112.7
Sole	*Solea solea*	92.7
Cod	*Gadus morhua*	21.6

Common name	Latin name	Mean landed weight (tonnes) per year
Herring	*Clupea harengus*	19.1
Dabs	*Limanda limanda*	14.1
Turbot	*Scophthalmus maximus*	13.6
Brill	*Scophthalmus rhombus*	9.1
Thornback Ray	*Raja clavata*	8.9
Tub Gurnards	*Chelidonichthys lucerna*	8.4
Blonde Ray	*Raja brachyura*	8.4
Flounder or Flukes	*Platichthys sp.*	8.1
Spotted Ray	*Raja montigui*	2.2
Bass	Dicentrarchus labrax	1.6
Whiting	*Merlangius merlangus*	1.6
Gurnard and Latchet	*Triglidae sp.*	1.5
Lemon Sole	*Microstomus kitt*	1.3

444. The landings data show that the most abundant species by weight across those ICES rectangles which overlap with Norfolk Boreas are plaice, sprat *Sprattus sprattus*, sole *Solea solea*, cod *Gadus morhua* and herring *Clupea harengus*. Bottom dwellers such as turbot *Scophthalmus maximus*, flounders *Platichthys sp.* and dab were also common.

445. Another key source of information is the IBTS. This survey is carried out annually twice a year by eight countries and covers the entire North Sea and Skagerrak/Kattegat with the principal objectives of looking at patterns of recruitment for commercial fish species (e.g. herring, cod, whiting, haddock, Norway pout, mackerel, sprat and saithe) and ecosystem monitoring. The IBTS data from ICES rectangles which overlap with the Norfolk Boreas offshore project are listed in Table 2.13.

Table 2.13 Average catch per unit effort (CPUE) for species recorded in IBTS surveys within the ICES rectangles 34F1, 34F2, 34F3, 35F2 and 35F3 (January 2010 – December 2016). Only species with CPUE >2 individuals per hour are shown (ICES, 2016)

Common name	Latin name	Average CPUE/hr (individuals)
Solenette	*Buglossidium luteum*	104.0
Dab	*Limanda limanda*	101.7
Scaldfish	*Arnoglossus laterna*	55.8
Lesser weever	*Echiichthys vipera*	53.6
Plaice	*Pleuronectes platessa*	26.3

Common name	Latin name	Average CPUE/hr (individuals)
Whiting	*Merlangius merlangus*	24.4
Pogge	*Agonus cataphractus*	19.2
Common dragonet	*Callionymus lyra*	12.9
Grey Gurnard	*Eutrigla gurnardus*	6.4
Gobies	*Pomatoschistus*	6.2
Tub Gurnard	*Chelidonichthys lucerna*	3.4
Shorthorn sculpin	*Myoxocephalus scorpius*	2.1

446. The Catch Per Unit Effort (CPUE) data from IBTS show that the most abundant species landed within Norfolk Boreas and surrounding area are Solenette *Buglossidium luteum*, Dab, scaldfish *Arnoglossus laterna*, Lesser weever *Echiichthys vipera* Plaice and Whiting.

447. Of the listed species from both the landings by weight and IBTS data, plaice, sprat, sole, cod herring and mackerel, are commercially important. As discussed in Section 553, these species are not only important to UK fisheries interests but also to the non-UK fleets that operate within the area.

448. Other species which are of relatively low importance to commercial fisheries (such as herring and whiting) play an important role in the North Sea ecosystem as prey items for marine mammals and birds.

449. Although not a feature of the landings data, five individuals from the family Ammodytidae (Sandeel) were recorded at four sample stations during the Norfolk Vanguard benthic survey. This could indicate the presence of Raitt's sand eel *Ammodytes marinus* which is a BAP species of principal importance. Sandeel will therefore be considered within the EIA.

Shellfish

450. Whelk *Buccinum undatum*, edible crab *Cancer pagurus*, mussel *Mytilus edulis* and lobster *Homarus gammarus* all featured highly in the landings from the relevant ICES rectangles. These are likely to be important to the inshore fishery. The shellfish reported in ICES rectangles covering the former East Anglia Zone are presented in Table 2.14.

Table 2.14 Shellfish reported in ICES rectangles covering the former East Anglia Zone (EAOW, 2012a)

Common name	Latin name
Brown shrimp	*Crangon crangon*
Common prawn	*Palaemon serratus*
Velvet Crab	*Necora puber*
Edible Crab	*Cancer pagurus*
Crawfish	*Palinurus* spp
Green crab	*Carcinus maenas*
Squat lobster	Galatheoidea
Lobster	*Homarus gammarus*
Nephrops	*Nephrops norvegicus*
Spider crab	Majidae
Queen scallop	*Aequipecten opercularis*
King scallop	*Pecten maximus*
Cuttlefish	Sepiidae
Octopus	Octopoda
Squid	Teuthida
Whelks	*Buccinum undatum*

2.7.1.4 Elasmobranchs

451. The landings (IBTS and MMO) data above indicate the presence of a number of elasmobranch (sharks and rays) species within the area, including spotted ray *Raja montagui*, blonde ray *Raja brachyura*, thornback ray *Raja clavata*, common stingray *Dasyatis pastinaca* , spurdog *Squalus acanthias,* starry smooth hound *Mustelus asterias* and common smoothhound *Mustelus mustelus*. Tope were also identified in the ZEA as having been recorded in the former East Anglia Zone in past IBTS surveys (EAOW, 2012a).

452. Nursery areas that overlap with the offshore project area have been defined for tope and thornback ray (Table 2.15). Thornback ray may transit the offshore project area as part of their migration out of the Thames Estuary towards the central southern North Sea.

2.7.1.5 Diadromous fish

453. Diadromous species (i.e. those that migrate between fresh and salt water) of conservation importance identified as potentially present within the former East Anglia Zone include European eel *Anguilla anguilla*, sea trout *Salmo trutta*, salmon

Salmo salar, shads (Clupeidae), smelt (Osmeridae) and river and sea lamprey (*Lampetra fluviatilis* and *Petromyzon marinus*). These have been occasionally recorded in landings data and/or in the IBTS data, and may transit the former East Anglia Zone as part of their migratory or foraging activity (EAOW, 2012a). In the particular case of sea trout, the East Anglian coast is thought to be an important feeding area for sea trout post-smolts originating from rivers of north-east England. Sea trout that have spent at least one year at sea and which are maturing to spawn the following winter are targeted by licensed fisheries operating off the coast of East Anglia.

2.7.1.6 Fish and shellfish spawning and nursery areas

454. Those fish and shellfish species deemed to be potentially important within the offshore project area are presented in Table 2.15 . Their relative contribution to the landings and IBTS catch data presented earlier is also illustrated.

455. The spawning and nursery grounds of species that overlap with the offshore project area (where known) according to Coull *et al*. (1998) and Ellis *et al,* (2012) are also stated in Table 2.15. It is recognised by the Applicant that the Coull *et al*, (1998) study is now nearly 20 years old and that the Ellis *et al*, (2010) study uses ICES rectangles which present the data at coarse resolution. Therefore consultation with MMO and local bodies such as the EIFCA will also be important in defining the spawning and nursery grounds of which species would be impacted by the project.

Table 2.15 Key fish and shellfish species in the Norfolk Boreas offshore project area

Species	Spawning	Nursery	Contribution to landings or IBTS catches	Conservation designations	Further Information
Plaice	High Intensity zone begins ~15nm along provisional offshore cable corridor from landfall and covers Norfolk Boreas	Low intensity zone up to ~15nm along provisional offshore cable corridor from landfall	High	UK BAP, IUCN (least concern)	
Sole	High Intensity ground south of Norfolk Boreas site. Low intensity ground covering cable corridor	Low intensity zone up to ~15nm along provisional offshore cable corridor from landfall	High	UK BAP	
Cod	Spawning ground of unidentified intensity (Coull *et al.* 2010 data) begins ~15nm along cable corridor from landfall and covers Norfolk Boreas	Low intensity area covers Norfolk Boreas	Medium	UK BAP, OSPAR, IUCN (vulnerable)	
Sandeel	Low intensity area covers Norfolk Boreas	Low intensity area covers south western part of the Norfolk Boreas site and the provisional offshore cable corridor	Low	UK BAP	Important as prey to other species, demersal spawners and dependant on the presence of an adequate sandy substrate in which to bury
Sprat	Spawning ground of unidentified intensity (Coull *et al.* data) Begins ~15nm along cable corridor from landfall and covers Norfolk Boreas	South and east of Norfolk Boreas	High	UK BAP	Important as prey to other fish, seabirds and marine mammals. Hearing specialist
Herring	Area to the south of the provisional offshore cable corridor	Low intensity area covers Norfolk Boreas. Small area of high intensity south of provisional offshore cable corridor	Medium	UK BAP, IUCN (least concern)	Important as prey to other fish, seabirds and marine mammals Substrate specific demersal spawners (gravelly substrates). Hearing specialist

Species	Spawning	Nursery	Contribution to landings or IBTS catches	Conservation designations	Further Information
Nephrops	Area to the north of Norfolk Boreas	Area covering the northern third of the Norfolk Boreas site	Low	IUCN (least concern)	Commercially important crustacean
Thornback ray	No data	Low intensity zone up to ~15nm along provisional offshore cable corridor from landfall	Medium	OSPAR, IUCN (near threatened)	Potentially transiting the zone during migrations
Tope shark	No data	Low intensity zone begins ~15nm along provisional offshore cable corridor from landfall and covers Norfolk Boreas	Low	UK BAP, IUCN (vulnerable)	Potentially transiting the zone during migrations. The tope shark is highly migratory, moving towards the poles in summer and towards the equator in winter (Shark Trust, 2010)
Mackerel	No data	Low intensity area covers Norfolk Boreas.	Low	UK BAP, IUCN (least concern)	Potentially transiting the zone during migrations
Whiting	Low intensity begins ~15nm along provisional offshore cable corridor from landfall and covers Norfolk Boreas	Low intensity area covers Norfolk Boreas	Medium	UK BAP, IUCN (least concern)	
Sea Trout	None	None	Low	UK BAP, IUCN (lower risk/least concern)	Potentially feeding in the Zone and transiting the Zone during migration Species are targeted by licenced fisheries off the coast of East Anglia)

2.7.2 Potential impacts

2.7.2.1 Potential impacts during construction

456. **Physical Disturbance:** There would be physical disturbance of the seabed during construction from the installation of offshore cables and foundations. This has potential to impact demersal (bottom or near bottom dwelling) fish and shellfish as well as potential impact upon spawning or nursery grounds. Disturbance would be limited in extent and duration. The overall footprint of works will be determined during the EIA and is anticipated to be relatively small in the context of the wider habitat which is relatively homogeneous (see Section 2.6).

457. **Increased suspended sediments and smothering:** The construction activities may have the potential to cause mobilisation of sediments in the water column and an increase in suspended sediment concentrations (SSC) (see Section 2.3). Sensitive species may react to this through physical or reproductive decline or it may impact upon migration or spawning behaviour. Impacts are likely to be temporary and localised and will need to be assessed in the context of background SSC levels and natural variations from storm events and seasonal changes. The assessment of the potential impact will be based upon the results the physical processes assessment.

458. **Re-suspension of contaminants:** Sediment disturbance and subsequent deposition could lead to the mobilisation of harmful contaminants if contained in those sediments. As discussed in Section 2.3, there are few potential sources of contamination within the offshore project area and the analysis of sediments undertaken in 2016 as part of the Norfolk Vanguard benthic survey campaign revealed only two sample stations out of 13 within the OWF sites and provisional offshore cable corridor where levels of contaminants were above Cefas Action Level 1 for the presence of Arsenic. This will be assessed further in the EIA based on the results of sediment sampling of the Norfolk Boreas site planned for 2017.

459. **Underwater noise and vibration disturbance:** Construction activities are potential sources of underwater noise including vessels, seabed preparation, rock dumping and cable installation. However, of the potential sources, piling is the greatest source of noise and is subject to a great deal of study within the industry (Nedwell *et al.,* 2007, Lindeboom *et al.,* 2011).

460. Noise from piling has the potential to cause impacts ranging from death to behavioural changes in susceptible fish species. The magnitude of noise impacts depends upon a range of factors including foundation type and size, installation method (e.g. hammer energy), local geology and bathymetry will determine the energy needed for hammer blows and the subsequent propagation of noise from the source.

461. The potential for disturbance to spawning/nursery fish species will be addressed in the EIA using the available data on spawning location and timing, and the predicted noise generated by piling events.

2.7.2.2 Potential impacts during operation

462. Monitoring studies conducted at operational wind farms indicate that any changes recorded once a wind farm is operational are difficult to distinguish from expected natural variation (Judd, 2009; Vattenfall, 2009; Lindeboom *et al*, 2011). Whilst monitoring studies have been conducted over relatively short periods, the lack of evidence of gross changes to the fish and shellfish community at operational wind farms should be borne in mind when considering potential operational impacts.

463. **Physical Disturbance:** Routine maintenance activities may require jack-up or anchoring of vessels and there would be some seabed disturbance as a result. Furthermore the movement of catenary mooring systems for floating foundations may also create seabed disturbance. Any disturbance would be localised, temporary and overall impacts would be lower than for construction.

464. **Increased suspended sediments and smothering:** Routine maintenance and mooring system movement (discussed above) may increase SSC levels, however this would be localised and temporary and overall impacts would be lower than for construction.

465. **Re-suspension of contaminants:** Given the likely levels of sediment contamination no pathway exists for impacts from contaminants.

466. Therefore, subject to consultation with relevant consultees (i.e. Cefas and the MMO), feedback from this Scoping Report and the results of sample analysis from the 2017 survey, this impact should be scoped out from further consideration within the EIA through the EPP.

467. **Noise and vibration disturbance:** Operational noise would come from two sources; vessel movements and turbine operation. Given the small number of vessels on site during O&M and the volume of traffic in the waters around Norfolk Boreas it is not likely that this would be a significant source of noise or impact.

468. Operational turbines would produce noise and vibrations which would be transmitted into the seabed and water column (Nedwell *et al,* 2007). Measurements made at four operational wind farms (North Hoyle, Scroby Sands, Kentish Flats and Barrow) indicate that operational noise would only be a few decibels above background noise within the wind farm, which is significantly lower in magnitude than those produced by other activities in the marine environment such as dredging or commercial fishing (CMACS 2003, Nedwell *et al*, 2007). Although these turbines

were much smaller than those envisaged for Norfolk Boreas, it is not expected that operational noise levels from Norfolk Boreas would cause a significant impact.

469. **Loss of habitat:** The construction of the wind farm would lead to a permanent loss of habitat in the footprint of the foundations; scour protection and potential areas of cable protection. The loss of area would represent a small percentage of the development area and would be dependent upon the foundation type chosen and need for cable protection; the magnitude of any impact would be relatively small. As discussed previously, the seabed is relatively homogeneous across the offshore project area and therefore there would be sufficient alternative habitat available to fish and shellfish.

470. **Fish aggregation:** The presence of wind farm infrastructure (in the form of turbine towers and foundations, scour protection and cable protection) would modify the existing habitat adding new hard substrate which would be colonised by a range of species which may not normally be present in the area; this effect has the potential to attract and aggregate fish (Hoffman *et al.,* 2000; Reubensa *et al*, 2013). To date, there is no clear evidence of any gross changes in local fish communities as a result of operational wind farms. Any change is expected to be of low magnitude and limited to the immediate vicinity of each wind turbine foundation.

471. **Electromagnetic fields (EMF):** Some species of fish utilise EMF for activities such as hunting prey and navigation. These species include elasmobranchs and some bony fish species such as cod. Several studies have been undertaken to understand the potential impacts of EMF on fish, however to date, research has been inconclusive as to whether EMF causes attraction or repulsion or has a significant effect (Gill *et al.,* 2009). CMACS (2012) reviewed available literature and assessed potential EMF impacts for East Anglia ONE. This review concluded that any impacts would be limited to within a few metres of the cables and would not be significant.

2.7.2.3 Potential impacts during decommissioning

472. During decommissioning the potential impacts are anticipated to be similar to those described above for the construction phase although on a smaller scale (for example, noise impacts would be lower as there would be no piling).

2.7.2.4 Potential cumulative impacts

473. **Offshore wind farms:** Potential cumulative impacts with proposed adjacent offshore wind farms, East Anglia THREE and Norfolk Vanguard could occur. For most of the potential impacts of offshore wind farms it is considered that impacts would be temporary, small scale and localised and therefore, whilst there would be an additive effect across projects these would not be significant.

474. Underwater noise could have cumulative impacts spatially (i.e. if two or more piling operations are undertaken simultaneously) or temporally (if piling operations are happening consecutively) with the potential for displacement impacts across the southern North Sea, noise 'barriers' blocking migration routes, or consecutive piling programmes displacing sensitive fish from large areas for sustained periods. Noise modelling will be undertaken for the Norfolk Boreas project in isolation and cumulatively with other potential projects within the former East Anglia Zone, for sensitive fish species of relevance to the area. Furthermore, consideration will be given to the potential cumulative impacts from vessel noise and wind farm operational noise as well as other developments in the southern North Sea.

475. **Other activities:** There is the potential for cumulative impacts from other activities occurring in the region. These include aggregate dredging, shipping and oil and gas exploration and development. Whilst it is not considered likely that there would be significant cumulative impacts, all potential impacts (i.e. those listed for Norfolk Boreas in isolation) will be assessed as part of the EIA.

2.7.2.5 Transboundary impacts

476. Given the level of development in the southern North Sea in other EU Member States' waters there is potential for transboundary impacts especially with regard to noise and given that populations of fish may be highly mobile. The noise modelling for East Anglia ONE and East Anglia THREE indicated that given the distance between site and other developments there would be no spatial overlap in terms of the likely underwater noise impact zones (EAOW, 2012b; EATL, 2015). However, as discussed above, there is still potential for cumulative displacement or migration barrier impacts from noise. Given the international nature of fisheries, there is potential for indirect transboundary impacts if commercial fish species are impacted. Potential transboundary impacts will be assessed as with the other cumulative impacts and the Applicant, where possible, will liaise with developers in other Member States to obtain up to date project information to feed into the assessment.

2.7.2.6 Summary of potential impacts

Table 2.16 Summary of potential impacts relating to fish ecology

Potential impacts	Construction	Operation	Decommissioning
Physical Disturbance	✓	✓	✓
Suspended sediments	✓	✓	✓
Re-suspension of contaminants	✓	x	✓
Loss of habitat	x	✓	x
Noise and vibration disturbance	✓	✓	✓

Potential impacts	Construction	Operation	Decommissioning
Fish aggregation	x	✓	x
EMF	x	✓	x
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓

Scoped in (✓) and scoped out (x)

2.7.3 Mitigation

477. The impacts on fish and shellfish are anticipated to be localised and temporary and it is considered unlikely that mitigation will be appropriate. This would be considered through consultation with key stakeholders during the EPP, based on the findings of the EIA.

2.7.4 Approach to assessment and data gathering

478. In accordance with the Cefas (2004a) guidance the assessment phase of the EIA will consider the following aspects for fish and shellfish resource in the area:

- Spawning grounds;
- Nursery grounds;
- Feeding grounds;
- Shellfish production areas (including oyster beds);
- Overwintering areas for crustaceans (e.g. lobster and crab); and
- Migration routes.

479. Existing broadscale information (landings data and IBTS data) for the study area will be updated, further to the information provided in this Scoping Report where new data are available. These data will be reviewed along with other sources, including those from nearby wind farm sites, Cefas' ground fish survey stations and specific research. As confirmed with the MMO and Cefas as part of the EPP, owing to the existing fish trawl data within the former East Anglia Zone as well as the availability of extensive fisheries data for the area, it is not necessary to undertake any further project specific fish surveys.

480. Assessment of impacts will be informed through reference to monitoring results from operational offshore wind farms which have described the spatial and temporal distribution of key fish and shellfish species in the area, the findings from industry-wide studies (e.g. COWRIE funded research) such as those on EMF and piling noise impacts, as well as information obtained through consultation with local sea fisheries committees and commercial fishermen. EMF effects were comprehensively reviewed by CMACS in 2012 for East Anglia ONE; therefore it is not proposed to undertake

further desk-based review of this topic. With regard to noise, it is likely that modelling will be undertaken utilising site-specific physical parameters (geology and bathymetry) and project specific detail.

2.8 Marine mammal ecology

2.8.1 Baseline

2.8.1.1 Data sources

481. As with fish (Section 2.7) Marine mammals are highly mobile and therefore a number of different data sets both site specific and regional will be used to define the baseline within the EIA. A significant amount of marine mammal data has been collected from within the former East Anglia Zone and these are listed Table 2.17.

Table 2.17 Marine Mammal and offshore ornithology datasets

Data	Coverage	Date
Surveys that overlap with the Norfolk Boreas site		
APEM aerial survey data	Norfolk Boreas Site and a 4km buffer	August 2016 to a date to be agreed with stakeholders
The Crown Estate Enabling Action data (video aerial survey) - HiDef Aerial Surveying Ltd	The former East Anglia Zone	November 2009 to March 2010
APEM aerial survey data	The former East Anglia Zone including Norfolk Boreas	April 2010 to April 2011
APEM aerial survey data	NV East with 4km buffer (small overlap with Norfolk Boreas due to the 4km buffer).	2015 to April 2016
Surveys that do not overlap with the Norfolk Boreas site but are used for context		
APEM aerial survey data	NV West with 4km buffer.	September 2015 to August 2017
APEM aerial survey data	East Anglia FOUR site with 4km buffer	March 2012 and February 2014
APEM aerial survey data	East Anglia THREE and 4km buffer	September 2011 to August 2013
Boat based surveys	East Anglia ONE	May 2010 to April 2011
APEM aerial survey data	East Anglia ONE	April 2010 to October 2011

482. Further to the survey data available from the former East Anglia Zone, a range of information for the wider area is available and will be incorporated in the EIA, including, but not limited to:

- Revised Phase III data analysis of Joint Cetacean Protocol (JCP) data resources (Paxton et al., 2016);
- The identification of discrete and persistent areas of relatively high harbour porpoise density in the wider UK marine area (Heinänen and Skov, 2015);
- Small Cetaceans in the European Atlantic and North Sea (SCANS) II Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management (Hammond et al., 2013) and SCANS III data, (anticipated to be available to inform EIA);
- Atlas of Cetacean distribution in northwest European waters (Reid et al., 2003);
- Management Units for cetaceans in UK waters (IAMMWG, 2015);
- UK grey and seal usage maps (Jones et al., 2016) (anticipated to be updated in 2017); and
- Special Committee on Seals (SCOS) annual reporting of scientific advice on matters related to the management of seal populations (SCOS, 2015; updated reports expected during the EIA).

483. Consultation with key marine mammal stakeholders will be ongoing during the EIA through the Evidence Plan Process (EPP) and will include discussion of the best available information to use, for example, to determine species density estimates and define reference populations for the assessment.

2.8.1.2 Cetaceans

484. During the 2009-2011 surveys (which included Enabling Action aerial survey data plus APEM aerial survey data), comparatively low numbers of cetaceans were recorded across the former East Anglia Zone, with only 108 cetaceans identified from the 17 months of aerial data (EAOW, 2012a). The majority of the cetaceans positively identified in aerial surveys were harbour porpoise *Phocoena phocoena*, which accounted for 38% of sightings with a further 53% listed as 'small cetaceans' (harbour porpoise or patterned dolphins). A further 6% of aerial sightings were identified as 'patterned dolphins' (EAOW, 2012a). 'Patterned dolphins' includes Atlantic white-sided dolphin *Lagenorhynchus acutus*, common dolphin *Delphinus delphis* and white-beaked dolphin *Lagenorhynchus albirostris*, although most were considered to be white-beaked dolphin.

485. The abundance of cetaceans across the Zone was modelled from the combined Enabling Action aerial survey data (2009-2010) and APEM aerial survey data for the former East Anglia Zone (2010-2011) (APEM, 2017a). The results show low densities across the Zone including within the Norfolk Boreas site for winter and spring, with slightly higher densities in summer over the central area and slightly higher density again in autumn over the east and north-west areas of Norfolk Boreas (EAOW, 2012a). The pattern of densities seen from modelling suggests that there might be a

correlation between water depth and density, with higher densities of cetaceans potentially relating to shallower areas of seafloor to the eastern edge of Norfolk Boreas which may be related to foraging activity around shallow sub-tidal sand banks (EAOW, 2012a).

486. During the 24 months of aerial surveys covering the East Anglia ONE site, 181 cetaceans in total were recorded, 130 of which (72%) were positively identified as harbour porpoise, and a further 12.5% identified as either a porpoise or a dolphin and 15% as unknown cetaceans (EAOW, 2012a).

487. The boat based survey data from East Anglia ONE identified 83% of all cetaceans recorded as being harbour porpoise. The boat surveys also recorded low numbers of three dolphin species: white-beaked dolphin (8%), bottlenose dolphin *Tursiops tursiops* (6%) and Risso's dolphin *Grampus griseus* (2%) as well as unidentified dolphin species (2%) (EAOW, 2012a). On the basis of the boat-based survey results it was considered likely that the majority of 'small cetaceans' recorded from the Zone aerial surveys were harbour porpoise (EAOW, 2012a).

488. During the 24 months of East Anglia THREE aerial surveys (approximately 12km south of Norfolk Boreas) 341 cetaceans in total were recorded within the site and buffer area, 149 of which (44%) were positively identified as harbour porpoise, and a further 188 (55%) identified as either a porpoise or a dolphin ((EATL 2015). Four white-beaked dolphin were also recorded as part of this survey campaign.

489. Cetacean species/groups recorded within Norfolk Vanguard East and Norfolk Vanguard West (plus 4km buffer areas) between September 2015 and August 2016 (APEM, 2017b) include:

- Harbour porpoise (0 to 46 individuals per month);
- Unidentified small cetacean (dolphin / porpoise; up to 78 individuals per month);
- Dolphin sp. (two records of a group of 11 individuals and a separate recording of a lone individual); and
- White-beaked dolphin (two separate individuals during the survey period).

490. This is analogous to the East Anglia THREE surveys which reported

- Harbour porpoise (0 to 49 individuals per month)
- Unidentified small cetacean (dolphin / porpoise; up to 56 individuals per month);
- White-beaked dolphin (0 to 4 individuals per month).

491. Cetacean species recorded within the Norfolk Boreas site (plus 4km buffer areas) during surveys so far include:

- Harbour porpoise; and

- Unidentified small cetacean.

492. Data analysis of the Norfolk Boreas site survey results has still to be conducted and will be undertaken during the EIA and reported in the PEIR.

493. Data within the former East Anglia Zone are supported by the findings of previous desk-based studies and results of surveys for other offshore wind farms in the southern North Sea, confirming that the harbour porpoise is the most abundant cetacean species present within this region, with white-beaked dolphin and other dolphin species having much lower abundances in the area (Reid *et al*., 2003).

494. For conservation and management purposes in the UK, populations of marine mammals have been divided into Management Units (MUs) (IAMMWG, 2015). Norfolk Boreas is located in the North Sea MU for harbour porpoise, the Greater North Sea MU for bottlenose dolphin, and the Celtic and Greater North Seas MU for other species of cetacean found in UK waters.

Designated sites and conservation importance

495. All cetaceans in UK waters are classed as European Protected Species (EPS) under Annex IV of the Habitats Directive (European Union (EU) Directive 92/43/EEC) and therefore internationally important. Bottlenose dolphin and harbour porpoise are also listed under Annex II of the Habitats Directive and are afforded protection through the designation of Natura 2000 sites.

496. The Southern North Sea candidate Special Area of Conservation (cSAC) site is proposed for designation as an SAC for harbour porpoise (see Section 2.15). JNCC undertook consultation on the site in 2015, which has been identified as being within the top 10% of persistently high density areas for harbour porpoise in UK waters (JNCC, 2015). The cSAC (which has now been submitted to the European Commission for Review) covers the vast majority of the Norfolk Boreas site.

497. JNCC (2015) state that the harbour porpoise within the site cannot be considered in isolation as they are a wide-ranging species. The impact assessment for Norfolk Boreas will therefore be based on the harbour porpoise North Sea MU reference population (IAMMWG, 2015) unless further information becomes available.

498. During the HRA Screening process, a review of wider Natura 2000 sites which are designated (or are proposed for designation) for mobile species such as cetaceans will be undertaken to consider potential connectivity with Norfolk Boreas.

2.8.1.3 Pinnipeds

499. The exact landfall area for Norfolk Boreas will be decided through ongoing site selection and design development work, incorporating consultation responses, as

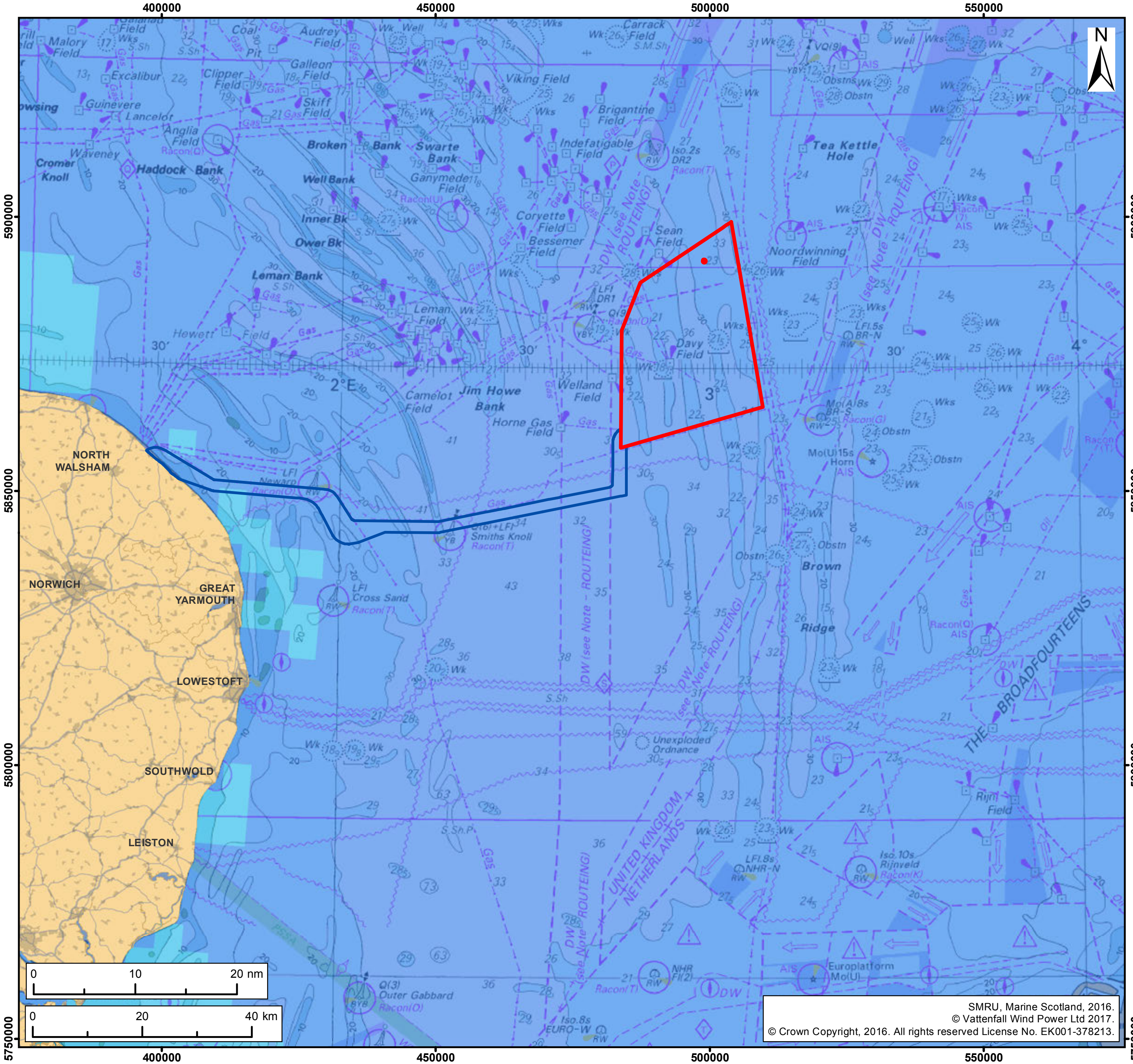
well as environmental and engineering constraints. The landfall zones are located between Bacton in the north to Eccles-on-Sea in the south (Figure 1.3). This is approximately 8.5km from the Horsey seal haul out site to the south of the landfall zone and 37km from the Blakeney Point haul out site to the north. Blakeney Point is important for grey and harbour seal and is a National Nature Reserve (within the Wash and North Norfolk Coast SAC).

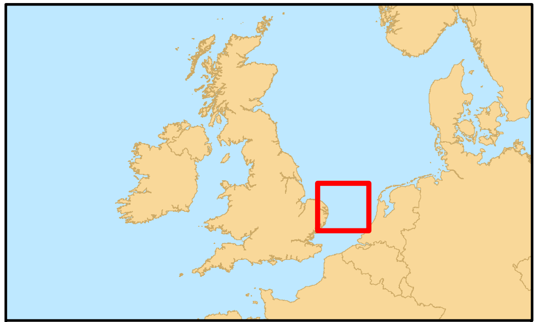
500. Grey seal *Halichoerus grypus* generally forage up to about 50km from their haul out sites and harbour seal *Phoca vitulina* shorter distances (generally 25 to 45km) although both species are known to undertake longer trips (Thompson and Miller, 1990; McConnell *et al*., 1999; Cunningham *et al*., 2009). Tagging studies undertaken by Sea Mammal Research Unit (SMRU) (Sharples *et al*., 2008) in The Wash showed that harbour seal returned to specific foraging areas, with those excursions being between 75km to 120km offshore.

501. The Norfolk Boreas site is approximately 75km and 115km, from the nearest haul out sites of Horsey and Blakeney Point respectively. The sites may therefore be within foraging range of harbour and grey seal. However during the aerial surveys for the ZEA (2009-11), only 8 individuals in June 2009 and 10 individuals in July/August 2009 (EOAW, 2012a) were recorded within the former East Anglia Zone. During the East Anglia ONE surveys, only three seals were recorded (EAOW, 2012a) and during East Anglia THREE surveys two individuals were recorded (EATL, 2015). During the Norfolk Vanguard East and Norfolk Vanguard West surveys (plus 4km buffer areas) currently only two seals have been recorded during the survey period (September 2015 to August 2016; APEM, 2016) and none have thus far been recorded in the Norfolk Boreas site surveys.

502. It is noted that aerial surveys are not the most appropriate method to determine at sea densities of seals, however Figure 2.8 and Figure 2.9 confirm grey seal and harbour seal use of the provisional offshore cable corridor and Norfolk Boreas site is very low. The mean at-sea density estimates are 0 to 0.2 individuals per km^2 for grey and harbour seals based on UK wide mapping by Jones *et al*. (2016). This mapping is based on analysis of telemetry and haul out data by the SMRU.

503. The boundary of the seal MUs for both species of seal are defined out to 12nm and the Norfolk Boreas landfall and provisional offshore cable corridor are located in the South-east England MU (IAMMWG, 2013). In accordance with the approach agreed with Natural England for other offshore wind farms in the former East Anglia Zone, the reference population extent for grey seal will incorporate the South-east England, North-east England and East Coast IAMMWG MUs and the Waddenzee population and for harbour seal the reference population will be based on the South-east England MU and the Waddenzee region.





Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast

Grey Seal (Halichoerus grypus) at-sea estimated usage[1]

- 0.0 - 1.0
- 1.1 - 5.0
- 5.1 - 10.0
- 10.1 - 50.0
- 50.1 - 100.0
- 100.1 - 150.0
- 150.1 - 457.0

[1] Jones et al., 2016

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Mean Grey Seal At-Sea Usage around Norfolk Boreas Offshore Project Area

Figure: 2.8 Drawing No: PB5640-102-012

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:1,000,000
01	01/02/17	JE	JM	A4	1:1,000,000

Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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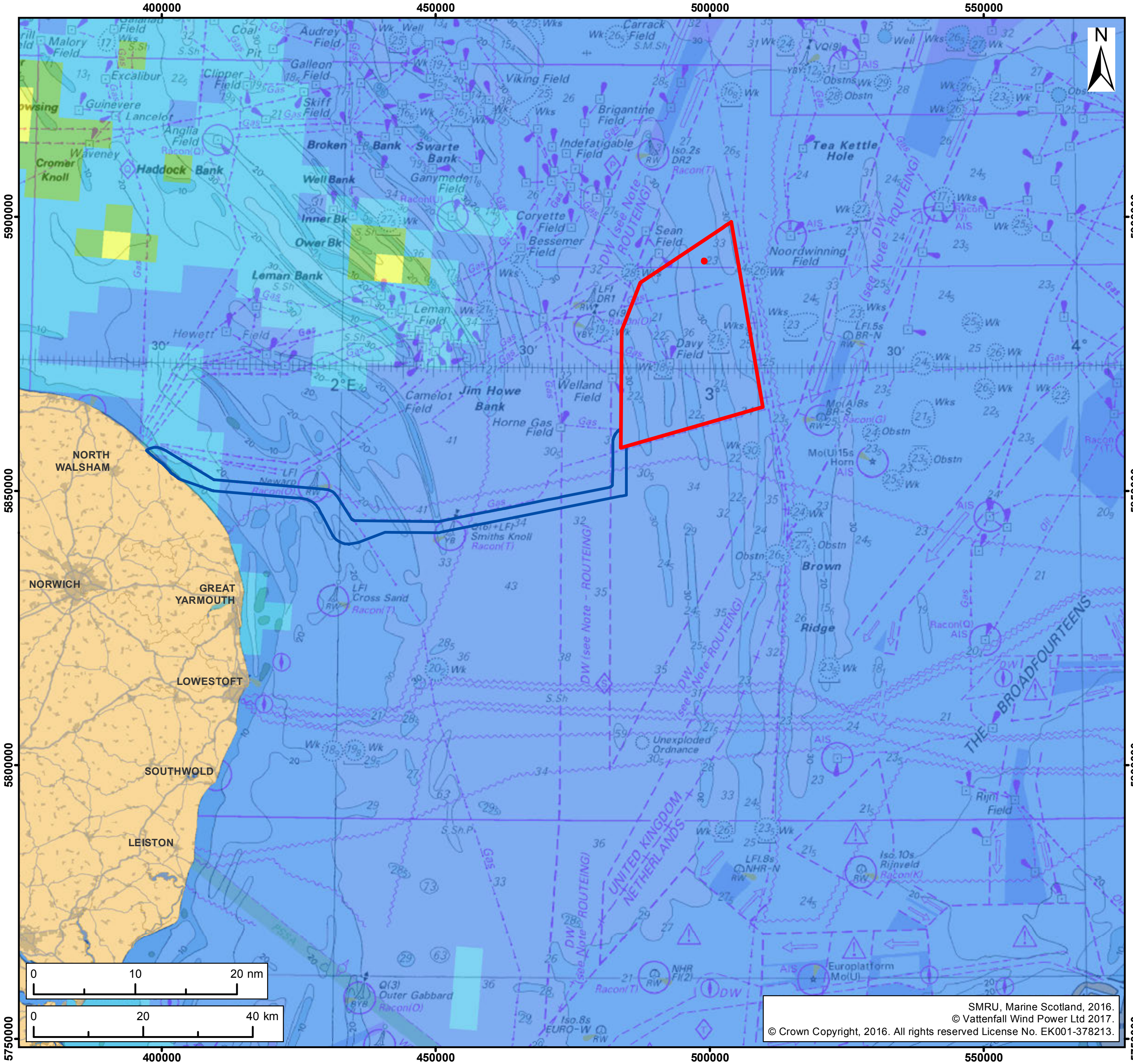

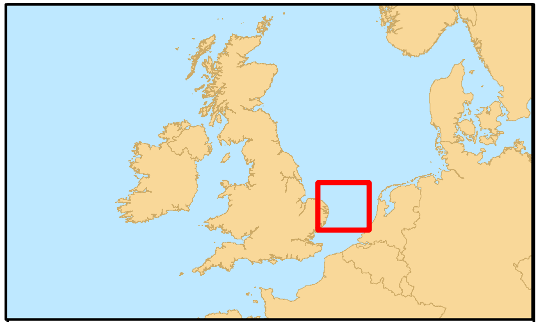

Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast

Harbour seal (Phoca vitulina) at-sea estimated usage[1]

- 0.0 - 1.0
- 1.1 - 5.0
- 5.1 - 10.0
- 10.1 - 50.0
- 50.1 - 100.0
- 100.1 - 150.0
- 150.1 - 257.0

[1] Jones et al., 2016

Project: Norfolk Boreas

Report: Environmental Impact Assessment Scoping Report

Title: Mean Harbour Seal At-Sea Usage around Norfolk Boreas Offshore Project Area

Figure: 2.9 Drawing No: PB5640-102-013

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:1,000,000
01	01/02/17	JE	JM	A4	1:1,000,000

Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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Designated sites and conservation importance

504. Grey seal and harbour seal are both listed under Annex II of the Habitats Directive. Grey seal and harbour seal are also listed on Annex V of the Habitats Directive, which requires their exploitation or removal from the wild to be subject to management measures.

505. The Wash SAC, designated for harbour seal, is the closest SAC at approximately 110km from the Norfolk Boreas site and 28km from the provisional offshore cable corridor. There are no designated sites for grey seal in the south-east of England.

506. During the HRA Screening, a review of wider Natura 2000 sites which are designated for mobile species such as seals will be undertaken to consider potential connectivity with the Norfolk Boreas offshore project area.

2.8.2 Potential impacts

2.8.2.1 Potential impacts during construction

507. **Underwater noise:** This has the potential to cause impacts upon marine mammals ranging from behavioural disturbance to injury and death. The noise generated by piling activities has the potential to disturb marine mammals at a considerable distance from the activity (i.e. tens of kilometres from the source) (Thomsen *et al*., 2006; Nedwell *et al*., 2007; Brandt *et al*., 2011, and NMFS, 2016) and for the entire duration of piling activities (although intermittently due to breaks in between piles). In very close proximity to piling activities injuries, and in extreme cases, fatalities can occur (Nedwell *et al*., 2007).

508. Other sources of noise and vibration associated with offshore wind farm construction include vessel noise, seabed preparation, rock dumping and cable installation. However, of these potential sources, piling is of greatest concern.

509. The potential impact will depend on a number of factors which include:

- The source levels of noise, subject to factors such as:
    - Foundation type
    - Foundation size; and
    - Installation method.
- The spatial footprint of the impact as a feature of noise propagation conditions which will depend on:
    - Sediment/sea floor composition;
    - Water depth; and
    - The sensitivity of marine mammal species present in the area.

510. With the application of soft-start piling protocol employed (whereby the energy of the hammer is slowly ramped up allowing marine mammals to flee the immediate area of piling) it is not anticipated that any marine mammals would be at risk of any physical injuries. With respect to avoidance/displacement effects, there may be large areas around the piling activity which marine mammals might avoid while piling is underway; however this impact would be temporary.

511. Auditory masking occurs when a noise (e.g. piling) partially or entirely reduces the audibility of vocalisations from cetaceans. This may reduce the distance over which cetaceans are able to communicate, navigate or detect prey and obstacles (Touggard *et al.*, 2009).

512. A displacement and barrier effect could potentially be caused by the noise emitted as part of the construction phases of Norfolk Boreas; for example as a result of the underwater noise emitted during piling. The noise levels could cause marine mammals to 'avoid' an area, potentially limiting movements between feeding grounds, breeding areas or haul-out sites.

513. As part of the Offshore Renewables Joint Industry Programme (ORJIP), Harwood *et al.* (2014) provides an interim methodology for modelling the Population Consequences of Disturbance (PCOD). VWPL leads an initiative to further developing understanding of disturbance effects on the harbour porpoise population in the North Sea (DEPONS). The project aims to develop a model to enable the assessment of underwater noise impacts from offshore wind farms on harbour porpoise. However this remains an area of ongoing research and development within the offshore wind industry and the approach to assessing population level effects will be discussed with key stakeholders through the EPP, taking account of best available guidance and information.

514. The impacts associated with underwater noise will be considered fully during the EIA, taking into account the most recent and robust research available.

515. **Impacts upon prey species:** Piling noise has the potential to injure or to displace fish species that are sensitive to noise impacts. The potential impacts on fish due to underwater noise and vibration is discussed in Section 2.7.2.1. Impacts are expected to range from death to behavioural changes in susceptible fish species. Other potential impacts on prey species could include loss of seabed habitat, increased sediment concentrations and sediment re-deposition and direct physical disturbance.

516. The impact upon the fish is not expected to have a significant resultant impact on marine mammals given the mobile nature of marine mammals and wide range of

prey species taken. However, due to the potential for cumulative impacts, this will be considered further during the EIA.

517. **Vessel Interaction:** Collisions between vessels and marine mammals are possible. Despite the potential for marine mammals to detect and avoid vessels, ship strikes are known to occur (Wilson *et al*., 2007). At present the type and number of vessels to be used in the construction of Norfolk Boreas is unknown. An increase in vessels could lead to an increase in vessel noise as well as collision risk. The risk of collision with marine mammals and the associated increase in vessel noise will be given further consideration in the EIA.

518. **Disturbance at seal haul-out sites:** Increased activity around landfall, including increased vessel and human activity could have the potential to disturb seals from haul-out sites. However, due to the distance between the landfall zones and significant haul out sites (minimum 8.5km), it is expected that there would be no discernible effect and therefore it is proposed that this is scoped out of the assessment.

519. Disturbance from vessel transits to Norfolk Boreas from a construction port has the potential to disturb seals at haul-out sites. The primary construction port for the project is currently unknown but options will be developed during the pre-application phase. Depending on where these options are located an increase in vessel usage would have the potential to disturb seals at haul-out sites and this will be assessed within the EIA.

520. **Changes to water quality:** The accidental release of contaminants, increased suspended sediment or potential mobilisation of sediment contaminants could have the potential to impact directly or indirectly on marine mammals. The risk of accidental release of contaminants (e.g. through spillage) would be mitigated through appropriate contingency planning and remediation measures for the control of pollution. Reduced visibility as a result of suspended sediments could impact on marine mammals, however the effect of any increase in suspended sediments would be localised and is therefore unlikely to have an effect on the success of marine mammal feeding.

521. The foundation types, installation methods and therefore the volume of sediment that have the potential to be mobilised is not yet known, therefore the potential impact of the release of contaminated sediments and increased suspended sediment will be assessed further within the EIA.

522. **Potential impacts on sites of Marine Conservation Interest:** Potential impacts on Natura 2000 sites designated for marine mammals will be considered within the EIA and in the HRA. The HRA will draw on information from the ES in relation to the

impacts outlined above, where applicable.

2.8.2.2 Potential impacts during operation

523. **Underwater noise:** Noise generated by the operational turbines can be conducted through the tower and foundations into the water. Operational wind turbine noise mainly originates from the gearbox and the generator and has tonal characteristics (Madsen *et al*., 2006; Tougaard *et al*., 2009). The main contribution to the underwater noise emitted from the wind turbines is expected to be from acoustic transfer of the vibrations of the substructure into the water rather than from transmission of in-air noise from the wind turbines into the water column (Lidell, 2003).

524. Monitoring studies of underwater noise from operational turbines have shown the noise levels from North Hoyle, Scroby Sands, Kentish Flats and Barrow wind farms to be only marginally above ambient noise levels (Nedwell *et al*., 2007; Edwards *et al*., 2007). Operational noise is not considered to be able to mask acoustic communication by seals and porpoises (Tougaard, 2009).

525. Additional noise sources may include engine noise of maintenance and supply vessels and any maintenance work, such as any additional rock dumping or cable re-burial. Underwater noise from operational and maintenance activities has the potential to cause disturbance to marine mammals.

526. With regard to vessel noise, the area has high levels of existing shipping activity and therefore the increase in noise levels from maintenance activities is unlikely to be significant.

527. Due to the increased size range of wind turbines proposed at Norfolk Boreas, compared with existing operational wind farms, the potential impacts from operational and maintenance noise will be given further consideration in the EIA.

528. **Impacts upon prey species:** To date, there is no clear evidence of any significant changes in fish abundance as a result of the presence of operational offshore wind farms (e.g. Lindeboom *et al*., 2011; Bergström *et al*., 2014). Any change to prey species (Section 2.7) is expected to be limited to the immediate vicinity of each wind turbine foundation with no significant consequence on marine mammals. However, the potential impacts from operational and maintenance on prey species will be given further consideration in the EIA.

529. **Disturbance at seal haul-out sites:** As outlined above, due to the distance of the landfall zones to a significant haul-out site (minimum 8.5km), it is expected that there would be no discernible effect and therefore this is scoped out of the assessment for any operational and maintenance activities at the landfall site.

530. Disturbance from vessel transits from Norfolk Boreas to an operational port has the potential to disturb seals at haul-out sites, however there would be significantly less vessels and movements associated with operation and maintenance compared to during construction. The number of vessels transiting during operation and maintenance is likely to be within current baseline vessel movements. Any increase in vessel usage during operation and maintenance is unlikely to result in any significant disturbance to seals at haul-out sites; it is therefore proposed that this impact should be scoped out from further consideration within the EIA.

531. **Vessel Interactions:** At present the type and number of vessels that would be used in the operational phase is unknown. As with construction vessels, maintenance vessels present potential interactions with marine mammals, however there would be significantly fewer vessels and movements associated with operation and maintenance. Further consideration will be given to any collision risk and potential disturbance from vessels during the impact assessment for marine mammals.

532. **Entanglement:** At present the parameters for floating foundations, if used, are being reviewed (Section 1.5) however given the potential for a large number of mooring lines to be present within the Norfolk Boreas site the risk of entanglement will be considered with the EIA.

533. **Physical Barrier Effects:** Norfolk Boreas is not located on any known migration routes for marine mammals. If traditional foundation types are used (non- floating) the large spacing between wind turbines is not expected to impinge animal movement, and both seals and harbour porpoise have been shown to forage within operational wind farm sites (Teilmann *et al*., 2006; Lindeboom *et al*., 2011; Marine Scotland, 2012; Russell *et al*., 2014).

534. Floating foundations if used could result in the installation of up to 12 mooring lines per turbine. The spacing of the mooring lines is currently unknown however there is potential for these to act as a barrier and therefore this will be considered further within the EIA.

535. **Electromagnetic Fields (EMF):** It is widely believed that harbour porpoise are capable of detecting small differences in relative magnetic field strength; however there is, at present, no evidence to suggest that existing cables have influenced cetacean movements. Harbour porpoise move in and out of the Baltic Sea with several crossings over operating subsea HVDC cables in the Skagerrak and western Baltic Sea without any apparent effect on their migration pattern (Faber Maunsell, 2007). There is no evidence that pinnipeds respond to EMF (Gill *et al*., 2009). It is therefore proposed that this impact should be scoped out from further consideration within the EIA.

536. **Changes to water quality:** Accidental release of contaminants, increased suspended sediment, or mobilisation of contaminants contained within sediments could have the potential to impact on marine mammals. The risk of accidental release of contaminants (e.g. through spillage) would be mitigated through appropriate contingency planning for the control of pollution. Reduced visibility as a result of suspended sediments could impact on marine mammals, however the effect of any increase in suspended sediments would be highly localised and is therefore unlikely to have an effect on the success of marine mammal feeding.

537. If floating foundations with catenary mooring are used, movement of the mooring lines on the seabed has the potential to cause suspension of sediments. In addition, small volumes of sediment could be re-suspended during maintenance activities as a result of the physical disturbance for example during any additional rock dumping or cable re-burial. Therefore given the current uncertainty, further consideration will be given to any potential changes to water quality during operational and maintenance in the impact assessment for marine mammals.

538. **Potential impacts on sites of Marine Conservation Interest:** Potential impacts on Natura 2000 sites designated for marine mammals will be considered within the EIA and in the HRA. The HRA will draw on information from the ES in relation to the impacts outlined above, where applicable.

2.8.2.3 Potential impacts during decommissioning

539. The impacts of decommissioning of the wind farm would be similar in nature to those of the construction phase, but likely to be of lower magnitude. There would be no piling and therefore noise impacts would be significantly reduced, although there would still be noise from activities required to remove infrastructure.

2.8.2.4 Potential cumulative impacts

540. **Offshore wind:** The impacts of Norfolk Boreas are likely to be small in isolation, with respect to marine mammals. This is largely due to the area of the Norfolk Boreas site and potential impact ranges relative to the MUs for marine mammals. However, Norfolk Vanguard in combination with Norfolk Boreas may result in a significant cumulative impact within the former East Anglia Zone. In addition, given the scale of development across the southern North Sea, particularly with regard to future offshore wind, there is the potential for even small impacts associated with Norfolk Boreas to be part of a significant cumulative impact. The cumulative impact assessment would consider projects within the former East Anglia Zone and across the southern North Sea.

541. Potential impacts on Natura 2000 sites designated for marine mammals, in particular

the Southern North Sea cSAC, will be considered within the EIA and in the HRA. This will draw on information from the ES in relation to the cumulative and in-combination impacts, where applicable.

542. A key cumulative impact is likely to come from underwater noise during pile driving. There is the potential for this impact to have a large spatial footprint with regard to disturbance effects (and displacement of prey species). This could have cumulative impacts spatially (i.e. if two or more piling operations are undertaken simultaneously) or temporally (i.e. if piling operations are happening consecutively). There is potential for displacement impacts across the southern North Sea to cause barrier effects to marine mammal movements or consecutive piling programmes displacing marine mammals from large areas for sustained periods.

543. It is necessary to consider that even if a piling programme is scheduled for many months, the actual duration of pile driving would be limited to a few hours per pile (given the experience of other projects in the southern North Sea). A range of realistic scenarios for cumulative noise impacts will be developed for the cumulative impact assessment, based on publicly available information, liaison with other developers where possible, particularly within the former East Anglia Zone, as well as consultation with the Regulators and stakeholders.

544. **Other activities:** There is the potential for other activities occurring in the area surrounding Norfolk Boreas to create cumulative impacts; these include aggregate dredging, shipping, oil and gas exploration and development. Some potential cumulative impacts are unlikely to be significant, for instance behavioural disturbance from noise associated with dredging area operations would not have a spatial footprint on the scale of pile driving and there would therefore be limited cumulative impact (Robinson *et al*., 2011). However, these will be assessed as part of the EIA once the list of other projects is established.

2.8.2.5 Transboundary impacts

545. Given the level of development in the southern North Sea by other EU Member States (i.e. Belgium, Holland, Germany and Denmark) and that populations of marine mammals (particularly cetaceans) are highly mobile and wide ranging there is potential for transboundary impacts, especially with regard to noise.

546. In addition, there is potential for Norfolk Boreas to impact on marine mammals from international designated sites (see Section 2.15).

547. Transboundary impacts will be assessed as with the other cumulative impacts and the Applicant will, where possible, liaise with developers in other Member States to obtain up to date project information to feed into the assessment.

2.8.2.6 Summary of potential impacts

Table 2.18 Summary of potential impacts relating to marine mammal ecology

Potential impacts	Construction	Operation	Decommissioning
Underwater noise	✓	✓	✓
Barrier effects	✓	✓	✓
Entanglement	x	✓	x
Impacts upon prey species	✓	✓	✓
Vessel interactions	✓	✓	✓
EMF	x	x	x
Disturbance at haul out sites	✓	x	✓
Changes to water quality	✓	✓	✓
Potential impacts on sites of Marine Conservation Interest	✓	✓	✓
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓

Scoped in (✓) and scoped out (x)

2.8.3 Mitigation

548. A Marine Mammal Mitigation plan (MMMP) would be prepared in consultation with key stakeholders, based on the latest guidance.

549. The Applicant is aware of the need to address marine mammal issues at a site specific and strategic (i.e. cumulative) level and is open to working with other developers where appropriate.

550. Where possible, mitigation would be embedded in the design of the project, for example in construction methods through the use of soft-start piling in order to reduce the potential for auditory injury.

2.8.4 Approach to assessment and data gathering

551. As previously discussed, aerial surveys are currently being undertaken across Norfolk Boreas (including a 4km buffer). This will be considered against wider data sources within the former East Anglia Zone as well as available information for the southern North Sea.

552. Underwater noise modelling will be undertaken using the best available information, in particular relating to criteria for predicting the noise impact ranges for marine mammal species (e.g. Southall *et al*., 2007; Lucke *et al*., 2009; NMFS, 2016).

2.9 Offshore ornithology

553. This section describes the baseline, potential impacts and approach to assessment for offshore ornithology. Onshore ornithology, including potential impacts on coastal birds around the landfall works and intertidal area is considered in (Section 3.7).

2.9.1 Baseline

2.9.1.1 Data sources

Site specific surveys

554. The former East Anglia Zone has been subject to extensive surveys for ornithology (Table 2.17), starting with 18 months of high resolution aerial survey data across the former East Anglia Zone for the purposes of ZEA, including:

- The Crown Estate Enabling Action data (video aerial survey) from November 2009 to March 2010; and
- APEM aerial survey data from April 2010 to April 2011.

555. Given the age of these data, since August 2016 APEM have been undertaking monthly aerial surveys of the Norfolk Boreas site and an associated 4km buffer around this site. These are ongoing and may provide up to 24 months (subject to agreement with stakeholders) of aerial survey data (August 2016 – July 2018). The results from these surveys will be reviewed in consultation with key stakeholders including Natural England and the MMO.

556. The EIA baseline will be informed by the Norfolk Boreas site surveys and the previous surveys across the ZEA, East Anglia THREE and East Anglia ONE (Table 2.17). Evidence from the EIAs of these earlier projects, as well as the distance of the Norfolk Boreas site from major seabird breeding colonies (Mitchell *et al.,* 2004), indicates that key species and populations of concern in the Norfolk Boreas assessment are likely to be migrant and non-breeding seabirds (EAOW, 2012b; EAOW, 2015).

557. The offshore cable corridor has also been subject to data collection in the western section as part of the designation process for the Greater Wash Potential SPA (pSPA) (Lawson *et al*. 2015; Perrow and Skeate, 2010) and in the eastern section as part of the ZEA (EAOW 2012a). These data will be used for characterisation assessments, however as effects resulting from cable laying operations will be short term and localised, this aspect will be assessed on the basis of existing seabird data from this area.

Desk-based literature review

558. Relevant literature and data sources will be reviewed and used to inform the EIA. These will include, but are not limited to:

- Information on breeding and wintering birds (Balmer *et al.* 2013; Musgrove *et al.,* 2013; Taylor and Merchant 2011; Stone *et al*., 1995);
- Information on bird populations, distributions, foraging ranges and migrations (Norfolk and Norwich Naturalist Society, 2016; Furness, 2015; Kober *et al*., 2010; Wernham *et al*., 2002; Wright and Austin 2012; Thaxter *et al*., 2012; Wakefield *et al.*, 2013; Skov *et al*. 1995; Snow and Perrins, 1998);
- Relevant literature on collision risk, flight heights and avoidance rates (Band 2012, Wright *et al*., 2012; Johnston *et al.,* 2014a, b; Cook *et al*., 2014; WWT Consulting, 2014; SNCBs 2014; Masden, 2015);
- Relevant literature on disturbance and displacement (SNCBs 2017; Natural England and JNCC, 2012; Garthe and Hüppop, 2004);
- Existing offshore wind farm Environmental Statements and Monitoring Reports (e.g. SMartWind, 2013; SMart Wind, 2015; ScottishPower Renewables, 2015); and
- A review of assessment methodologies for offshore wind farms (Maclean *et al.*, 2009)

2.9.1.2 Overview of likely ornithological interest

559. Species that have been recorded during monthly aerial surveys[17] undertaken between August 2016 and November 2016 (inclusive) at the Norfolk Boreas site are:

- Red-throated diver *Gavia stellata*
- Fulmar *Fulmarus glacialis*
- Gannet *Morus bassanus*
- Cormorant *Phalacrocorax carbo*
- Arctic skua *Stercorarius parasiticus*
- Great skua *Stercorarius skua*
- Unidentified small gull species
- Black-headed gull *Chroicocephalus ridibundus*
- Common gull *Larus canus*
- Little gull *Hydrocoloeus minutus*
- Kittiwake *Rissa tridactyla*
- Unidentified Large gull species
- Herring gull *Larus argentatus*

[17] At the time of writing (April 2017), this is based on raw data only, with no external verification yet undertaken on the species identification.

- Great black-backed gull *Larus marinus*
- Lesser black-backed gull *Larus fuscus*
- Unidentified tern species
- Sandwich tern *Thalasseus sandvicensis*
- 'Commic' tern[18],
- Black tern *Chlidonias niger*
- Guillemot *Uria aalge*
- Razorbill *Alca torda*

560. Additional species that have recorded during previous surveys of the ZEA, EA THREE EA ONE and Norfolk Vanguard sites are:

- Black-throated diver *Gavia arctica*
- Great northern diver *Gavia immer*
- Sabine's gull *Xema sabini*
- Puffin *Fratercula arctica*
- Little auk *Alle alle*
- Long-tailed skua *Stercorarius longicaudus*
- Shag *Phalacrocorax aristotelis*
- Common scoter *Melanitta nigra*

561. Data analysis during the Norfolk Boreas EIA will consider seasonal variations in site usage by key species (see Section 2.9.4) as well as the importance of the site for each species' different life stages. Table 2.19 provides an overview of relevant seasons for each species based on information from Furness (2015), where available. The use of this source within the EIA will be agreed with relevant stakeholders during through the EPP.

Table 2.19 Species specific definitions of biological seasons (from Furness, 2015)

Species	Breeding	Migration-free breeding	Migration – autumn	Migration-free Winter	Migration – spring (Return migration through UK waters)	Non-breeding
Wildfowl & Divers						
Red-throated diver	Mar-Aug	May-Aug	Sep-Nov	Dec-Jan	Feb-Apr	-
Black-throated diver	Not included in Furness 2015					

[18] Commic tern is used for records of Arctic and common terns that cannot be identified to the species level.

Species	Breeding	Migration-free breeding	Migration – autumn	Migration-free Winter	Migration – spring (Return migration through UK waters)	Non-breeding
Great northern diver	-	-	Sep-Nov	Dec-Feb	Mar-May	Sep-May
Gulls						
Black-headed gull	Not included in Furness 2015					
Common gull	Not included in Furness 2015					
Great black-backed gull	Mar-Aug	May-Jul	Aug-Nov	Dec	Jan-Apr	Sep-Mar
Herring gull	Mar-Aug	May-Jul	Aug-Nov	Dec	Jan-Apr	Sep-Feb
Lesser black-backed gull	Apr-Aug	May-Jul	Aug-Oct	Nov-Feb	Mar-Apr	-
Kittiwake	Mar-Aug	May-Jul	Aug-Dec	-	Jan-Apr	-
Little gull	Not included in Furness 2015					
Sabine's gull	Not included in Furness 2015					
Auks						
Guillemot	Mar-Jul	Mar-Jun	Jul-Oct	Nov	Dec-Feb	Aug-Feb
Little auk	Not included in Furness 2015					
Puffin	Apr-Aug	May-Jun	Jul-Aug	Sep-Feb	Mar-Apr	Mid-Aug-Mar
Razorbill	Apr-Jul	Apr-Jul	Aug-Oct	Nov-Dec	Jan-Mar	-
Other						
Common tern	May-Aug	Jun-mid July	Jul-Sep	Oct-March	Apr-May	Sept – April
Arctic tern	May-Aug	Jun	Jul-Sep	Oct-Mar	Apr-May	Mid Aug-Apr
Black tern	Not included in Furness 2015					
Sandwich tern	Apr-Aug	Jun	Jul-Sep	Oct-Feb	Mar-May	Sep-Mar
Arctic Skua	May-Jul	Jun-Jul	Aug-Oct	-	Apr-May	-
Cormorant	Apr-Aug	May-Jul	Aug-Oct	Nov-Jan	Feb-Apr	Sep-Mar
Fulmar	Jan-Aug	Apr-Aug	Sep-Oct	Nov	Dec-Mar	-
Gannet	Mar-Sep	Apr-Aug	Sep-Nov	-	Dec-Mar	-

Species	Breeding	Migration-free breeding	Migration – autumn	Migration-free Winter	Migration – spring (Return migration through UK waters)	Non-breeding
Great skua	May-Aug	May-Jul	Aug-Oct	Nov-Feb	Mar-Apr	-
Long-tailed skua	Not included in Furness 2015					
Common scoter	Not included in Furness 2015					
Shag	Not included in Furness 2015					

562. The conservation status (Table 2.20) of each species will also be taken into consideration during the EIA.

Table 2.20 Summary of Nature Conservation Value

Species	Conservation Status
Wildfowl & Divers	
Red-throated diver	Birds Directive Migratory Species, Birds Directive Annex 1, Birds of Conservation Concern (BoCC) (Eaten et.al, 2015) Green listed, International Union for Conservation of Nature (IUCN) Red List 'Least Concern' status.
Black-throated diver	BOCC Amber listed, Birds Directive Migratory Species, Birds Directive Annex 1
Great northern diver	BoCC Amber listed, Birds Directive Migratory Species, Birds Directive Annex 1
Gulls	
Black-headed gull	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status
Common gull	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status
Great black-backed gull	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status
Herring gull	BoCC Red listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status
Lesser black-backed gull	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status
Kittiwake	BoCC Red listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status
Little gull	BoCC Green listed IUCN Red List 'Least Concern' status
Sabine's gull	IUCN Red List 'Least Concern' status
Auks	
Guillemot	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status
Little auk	IUCN Red List 'Least Concern' status
Puffin	BoCC Red listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status

Species	Conservation Status
Razorbill	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List ‘Near Threatened’ status
Others	
Arctic tern	BoCC Amber listed, Birds Directive Migratory Species, Birds Directive Annex 1
Common tern	BoCC Amber listed, Birds Directive Migratory Species, Birds Directive Annex 1
Arctic Skua	BoCC Red listed, Birds Directive Migratory Species, IUCN Red List ‘Least Concern’ status
Black tern	BoCC Amber listed, IUCN Red List ‘Least Concern’ status
Sandwich tern	BoCC Amber listed, Birds Directive Annex I and Migratory Species, IUCN Red List ‘Least Concern’ status
Cormorant	BoCC Green listed, Birds Directive Migratory Species, IUCN Red List ‘Least Concern’ status
Fulmar	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List ‘Least Concern’ status
Gannet	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List ‘Least Concern’ status
Great skua	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List ‘Least Concern’ status
Long-tailed skua	BoCC Amber listed, IUCN Red List ‘Least Concern’ status
Common scoter	BoCC Red listed, Birds Directive Migratory Species, IUCN Red List ‘Least Concern’ status
Shag	BoCC Red listed, Birds Directive Migratory Species, IUCN Red List ‘Least Concern’ status

2.9.1.3 Designated sites

563. The Greater Wash Marine potential SPA (pSPA) stretches from Bridlington Bay in the north to approximately Great Yarmouth in the south which overlaps with the provisional offshore cable corridor. A consultation on the potential SPA concluded in January 2017 (Defra, 2017); at the time of writing (April 2017) the results of this consultation have not been published. During the EIA, a review of wider SPAs and Ramsar sites will be undertaken to consider potential connectivity with Norfolk Boreas. HRA screening will be undertaken in consultation with key ornithology stakeholders through the EPP.

564. The Greater Wash Marine pSPA encompasses the following ornithology features:

- Foraging areas of little tern *Sternula albifrons* from the following colonies;
    - The Humber Estuary;
    - Gibraltar Point;
    - The Wash;
    - North Norfolk Coast; and
    - Great Yarmouth and North Denes SPA colonies.
- Foraging areas of Sandwich tern *Thalasseus sandvicensis* at;
    - The Wash and North Norfolk Coast SPA colonies

- Foraging areas of common tern *Sterna hirundo* at;
    - North Norfolk Coast and Breydon Water SPA colonies;
- Areas of importance for non-breeding common scoter *M. nigra* protected under the North Norfolk Coast SPA (JNCC, 2016);
- Areas of importance for non-breeding red-throated diver *G. stellata*; and
- Areas of importance for non-breeding little gull *H. minutus*.

565. Although no fully designated SPAs currently overlap the offshore project area, sites such as Alde-Ore Estuary SPA, Flamborough Head and Bempton cliffs SPA, Flamborough and Filey Coast pSPA, Outer Thames Estuary SPA and Bass Rock Marine Protected Area (MPA) will be considered for their potential connectivity to colonies associated with the Norfolk Boreas site.

2.9.2 Potential impacts

2.9.2.1 During construction

566. **Disturbance and displacement:** Noise and vibration related to construction and installation activities of the offshore wind farm site (particularly pile driving) and construction-related boat traffic (e.g. cable laying vessels) has the potential to disturb and displace bird species from the site for the duration of installation activities, particularly some of the species considered as features of the Greater Wash pSPA (notably red-throated diver and common scoter).

567. In addition, the presence of plant, personnel, wind turbine generators and offshore substation platforms as they are being installed, as well as lighting during night time working may cause localised, temporary disturbance and displacement. However due to the nature of this impact (temporary/localised), any displaced birds may readily redistribute during periods of lower or no activity on site.

568. During the Norfolk Vanguard EPP meeting in February 2017 Natural England noted that in 2016 a large percentage of the little terns that nested on the East Norfolk coast used sites in Eccles and Winterton rather than within the SPAs. Natural England, did however advise that due to the distance from the landfall zones the breeding colonies (listed above) are unlikely to be disturbed by either construction activity or operations and maintenance.

569. The susceptibility of each species to construction disturbance will depend upon factors such as the feeding strategy of the species (i.e. aerial, swimming or surface) and timing of construction activities and behaviour (whether birds are breeding or migrating). The assessment will be informed by reviews of species sensitivity (e.g. Garthe & Hüppop 2004).

570. **Impacts upon prey species**: Indirect effects on birds may occur during the construction phase if there are impacts on prey species and the habitats of prey species. These indirect effects include those resulting from the production of underwater noise (e.g. during piling) and the generation of suspended sediments (e.g. during preparation of the seabed for foundations) that may alter the behaviour or availability of bird prey species. Underwater noise may cause fish and mobile invertebrates to avoid the construction area and also affect their physiology and behaviour. Significantly elevated suspended sediments may cause fish and mobile invertebrates to avoid the construction area and may smother and hide immobile benthic prey within the immediate area. These mechanisms could potentially result in less prey being available in the area adjacent to active construction works to foraging seabirds.

2.9.2.2 During operation

571. **Disturbance and displacement:** The presence of wind turbines has the potential to directly disturb and displace birds from within and around the Norfolk Boreas site. This is assessed as an indirect habitat loss, as it has the potential to reduce the area available to birds for feeding, loafing and moulting. Vessel activity and the lighting of wind turbines and associated ancillary structures could also attract (or repel) certain species of birds and affect migratory behaviour on a local scale.

572. Given that potential impacts along the offshore export cable route would be highly localised and episodic (i.e. limited to any maintenance or repair of the export cables) it is proposed that this impact should be scoped out from further consideration within the EIA in relation to the offshore export cable route, with the focus on the OWF and array cables only.

573. Natural England and JNCC has issued a joint Interim Displacement Guidance Notes (Natural England and JNCC 2012 and SNCBs 2017), which provide recommendations for presenting information to enable the assessment of displacement effects in relation to offshore wind farm developments. This guidance will be used to inform the assessment.

574. There are a number of different measures used to determine bird displacement from areas of sea in response to activities associated with an offshore wind farm. Furness and Wade (2012), for example, use disturbance ratings for particular species, alongside scores for habitat flexibility and conservation importance to define an index value that highlights the sensitivity to disturbance and displacement.

575. A matrix approach will be used to calculate a range of predicted impact magnitudes. These relate varying levels of displacement to varying levels of additional mortality, with consideration then given to the population-level impacts of the potential

additional mortality. Similar methods will be used as those in recent offshore wind farm assessments (e.g. East Anglia THREE), which have been examined and agreed by Natural England (these methodologies are also being agreed for the Norfolk Vanguard assessment).

576. For species at risk of displacement during the nonbreeding season, consideration will be given to a proposed approach for standardising assessments (i.e. to account for different numbers of nonbreeding seasons between species for which data is available).

577. **Indirect impacts through effects on prey species and habitats:** Indirect displacement of birds may occur during the operational phase if there are impacts on prey species and the habitats of prey species (Section 2.6 and 2.7). These indirect effects include those resulting from the production of underwater noise (e.g. the turning of the wind turbine generators), EMFs and the generation of suspended sediments (e.g. due to scour or maintenance activities) that may alter the behaviour or availability of bird prey species. Underwater noise, EMF and elevated suspended sediment could potentially cause fish and mobile invertebrates to avoid the operational area and also affect their physiology and behaviour, however there is very little evidence to support this and in fact there is growing evidence gathered from existing offshore windfarms which suggests that the opposite may be true (Kerckhof *et al*, 2010; Emu 2008; Krone *et al*, 2013; Linley *et al,* 2008 and Wilhelmsson, 2006).

578. Potential impacts along the export cable would be highly localised and episodic (i.e. limited to any maintenance or repair operations). It is therefore proposed that this impact should be scoped out from further consideration within the EIA.

579. **Collision risk:** There is a risk of birds colliding with turbine structures as they fly through the wind farm. The susceptibility of species to collision risk depends upon physiological and behavioural characteristics of the species, in addition to the project design specifications. Collision risk modelling (CRM) will be undertaken using industry-standard approaches (Band, 2012, Masden 2015) to predict potential mortality levels from this impact. The population-level impacts of this potential additional mortality will be considered. The exact option and version of the collision risk model to be used, avoidance rates, flight height data and parameters for modelling will be based upon the best available evidence and will be agreed through the EPP and clearly defined within the ES and HRA.

580. **Barrier effect:** During operation, the presence of the wind turbine generators and offshore substation platforms may act as a barrier to free movement, causing birds to alter and lengthen their flight path to avoid the wind farm. This may increase

energetic expenditure during foraging flights and migration (DECC, 2009b). It has been shown that some species (e.g. divers and scoters) avoid wind farms by making detours around wind turbine arrays, which potentially increases their energetic costs (Petersen *et al.* 2006; Petersen and Fox 2007), with an associated potential risk of decreased survival chances. Such effects may have a greater impact on birds that regularly commute around a wind farm (e.g. birds transiting between foraging grounds and roosting/nesting sites) than migrants that would only have to negotiate around a wind farm once per migratory period, or twice per annum, if flying the same return route (Speakman *et al.,* 2009).

581. The distance of Norfolk Boreas from the coast (72km), together with the distance from large seabird breeding colonies (Mitchell *et al.* 2004) such as the gull colony of the Alde-Ore Estuary (located 113km from the Norfolk Boreas site), means that the area is likely to be of low importance during the breeding season and therefore the likelihood of significant increases in flight distances is very low. The potential for impact during the migration period will be considered further in the EIA. Due to a small increase relative to total migration path and limited exposure, it is not considered likely to be a significant issue.

2.9.2.3 During decommissioning

582. During decommissioning, the potential impacts are anticipated to be similar to those described above for the construction phase but on a smaller scale. There may also be an incremental reduction of impact as the permanent structures are removed from the site.

2.9.2.4 Potential cumulative impacts

583. **Offshore wind:** Given the scale of development in the southern North Sea with operational, consented and planned offshore wind farms, there is potential for impacts on birds to accumulate. Given that many bird species are highly mobile, there is the potential for the same birds to be affected by several wind farms (e.g. if there are barrier effects which impact upon migration routes) or for the scale of development to impact a common feeding resource (e.g. the cumulative impact on prey species). Of particular relevance to the cumulative assessment will be other wind farms in the former East Anglia Zone including East Anglia ONE, East Anglia THREE, Norfolk Vanguard and any further adjacent wind farms which enter the consenting process during the period of the Norfolk Boreas EIA.

584. Other wind farms along the east coast of the United Kingdom are likely to be relevant to some seabird species in considering the approach to assessing cumulative collision risk, given the potential for populations to encounter these wind farms during passage movements. Overall, the potential for cumulative impacts will

be species-specific as the impacts will be dependent upon the individual sensitivities of each species and most importantly where the birds have originated from and their potential to interact with other wind farms (i.e. on migratory or foraging travel).

585. **Other activities**: There is potential for other marine industries (e.g. dredging, oil and gas) to have cumulative impacts with Norfolk Boreas. The cumulative assessment will take into account the fact that birds may already be habituated to on-going activities and therefore these may be considered to be part of the baseline conditions to avoid double-counting or exaggeration of potential impacts.

2.9.2.5 Transboundary impacts

586. Due to the wide-ranging nature of some seabird species, there is potential for Norfolk Boreas to have impacts on birds migrating from other member states. The Applicant will build upon the work undertaken by the former EAOW consortium for East Anglia ONE and East Anglia THREE to identify potential receptors and stakeholders.

2.9.2.6 Summary of potential impacts

Table 2.21 Summary of potential impacts relating to offshore ornithology

Potential impacts	Construction	Operation	Decommissioning
Disturbance and displacement	✓	✓*	✓
Indirect impacts through effects on habitats and prey species.	✓	x	✓
Collision risk	x	✓*	x
Barrier effect	x	✓*	x
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓

*Only assessed in relation to the Norfolk Boreas site and not the export cable. Scoped in (✓), scoped out (x)

2.9.3 Mitigation

587. The need for mitigation (and the feasibility of this) would be dependent on the results of site specific survey and the impact assessment. Consultation with key ornithological stakeholders would be ongoing throughout the EIA process and would include the need for mitigation and the feasibility of potential options.

2.9.4 Approach to assessment and data gathering

588. Full and detailed methodology for the EIA will be agreed with stakeholders (including Natural England and RSPB) through the EPP. This will include the production of a number of EIA method statements and meetings where the methodology will be

discussed and adapted accordingly based on relevant advice and perceived risk. The process and record of agreements and any unresolved issues will be presented within the ES.

589. The ongoing programme of monthly aerial bird surveys for the Norfolk Boreas site (and associated buffer) is likely to encompass the period from August 2016 to July 2018 and will provide the key data source for the ornithology site characterisation and quantification of parameters for the impact assessment (e.g. CRM). Additionally, information from previous surveys of the wider zone (ZEA, East Anglia ONE, East Anglia THREE and for Norfolk Vanguard East and West) (Table 2.17) will provide further contextual information, as will the literature and information sources outlined in Section 2.9.1.1.

590. The aerial surveys provide information on species (or species-groups if species identification is not possible), abundance, distribution, behaviour, location, numbers, sex and age (where possible), flight heights and direction. The EIA will identify the nature of the use of the site by birds recorded - i.e. seasonal differences and activities (i.e. foraging, overwintering, migrating or other) in order to determine the importance of the site relative to the wider area for seabirds throughout the year.

591. Detailed analysis will include abundance and density estimates (with associated confidence intervals and levels of precision).

592. Additional contextual information will come from studies undertaken for the former East Anglia Zone, East Anglia ONE, East Anglia THREE, Norfolk Vanguard as well as any other relevant information available for the region. Further data will be available from the Strategic Ornithological Support Services group (SOSS) and the Royal Society for the Protection of Birds (RSPB) tagging studies from for example Flamborough Head and Bempton Cliffs SPA and Alde-Ore Estuary SPA. Data from other tagging programmes such as FAME/STAR[19] and the DECC Offshore Energy Strategic Environmental Assessment tagging study, may also be used to establish connectivity between relevant colonies and the Norfolk Boreas site.

593. Reference populations for each species and population sizes will be based on the best available information at the time of undertaking the assessment and will be agreed with key stakeholders during consultation through the EPP.

594. The sensitivity of each species will be determined based on the size of its population, its conservation status and its known sensitivity to offshore wind farms. Species identified as sensitive receptors will be subject to full impact assessment against the

[19] FAME (Future of the Atlantic Marine Environment www.fameproject.eu) and STAR (Seabird Tracking and Research) are twin projects which have organised the tracking of seabirds on the coast of Britain and Ireland from 2010 to present.

impacts listed above. The impact assessment will be undertaken in line with guidance by IEEM (2010), CIEEM (2016) and expert opinion.

2.10 Commercial fisheries

2.10.1 Baseline

2.10.1.1 Data sources

595. The Norfolk Boreas offshore project area is within the ICES rectangles 34F1, 34F2, 34F3, 35F2 and 34F3. A key source of information on the commercial fish resource is fisheries landings data; these provide both large spatial coverage and effort. The available datasets upon which this section of the scoping report is, and the EIA will be based are listed in Table 2.22. Other relevant and more recent data is currently being sourced from UK and other European sources to inform the EIA.

Table 2.22: Available site-specific ichthyology datasets

Data	Coverage	Date
Landings data (MMO, 2016)	ICES Rectangles 34F1, 34F2, 34F3, 35F2 and 35F3	2008 - 2014
International Bottom Trawl Survey (IBTS) CPUE (ICES, 2016)	ICES Rectangles 34F1, 34F2, 34F3, 35F2 and 35F3	2007 – 2016
Spawning and nursery grounds (Coull *et al.*, 1998)	North Sea	-
Spawning and nursery grounds (Ellis *et al.*,2012)	North Sea	-
Dutch Annual Effort by Method	ICES Rectangles 34F1, 34F2, 34F3, 35F2 and 35F3	2001 - 2010
Dutch VMS Landing Value Data	ICES Rectangles 34F1, 34F2, 34F3, 35F2 and 35F3	2006 - 2010
UK Annual Effort by Method	ICES Rectangles 34F1, 34F2, 34F3, 35F2 and 35F3	2001 - 2010
UK VMS Landing Value Data	ICES Rectangles, 34F1, 34F2, 34F3, 35F2	2007 - 2010
East Anglia FOUR Offshore Wind Farm Fish and Shellfish Surveys (BMM Ltd., 2013a and 2013b)	ICES Rectangles 34F2 and 34F3	February and May 2013
East Anglia THREE Offshore Wind Farm Fish and Shellfish Surveys (BMM Ltd., 2013c and 2013d)	ICES Area IV (a, b, c)	February and May 2013
Eastern Sea Fisheries Joint Committee Fisheries Mapping Project Charts	EIFCA district boundary (Haile Sand Fort in the north to Felixstowe out to six nautical miles)	2010-2016

2.10.1.2 Commercial fisheries status

596. As presented in Figure 2.10, Dutch registered fishing vessels are responsible for the majority of the effort[20] in ICES rectangles 34F2, 34F3, 35F2 and 35F3 (97.8%, 99.2, 99.1% and 99.1 respectively) with UK registered fishing vessels responsible for the majority of the effort in ICES rectangle 34F1 (98.8%). A small number of Belgian registered fishing vessels are also operating in the area.

597. Landings from Dutch registered vessels have been identified from the Dutch VMS data, however, site specific breakdowns of landings values are not available. As shown in Figure 2.11, landings data within the offshore project area are one of the highest annual landing values in the wider region, with the most valuable areas being located in ICES rectangle 34F2. The majority of this effort is from beam trawlers. Analysis of 2010 VMS data was undertaken for the ZEA which shows landings values of €20 million by Dutch vessels from fishing within Development Areas[21] within the former East Anglia zone (EAOW, 2012a). In 2010, this accounted for 2.7% of the total value of landings for the Dutch over 15m fleet for that year (EAOW, 2012a).

598. Overall patterns for Dutch vessels across the southern North Sea indicate greater effort and landings values from rectangles adjacent to the Netherlands and Belgium, with much lower values moving north and west.

599. Integration of Automatic Identification System (AIS) data (Section 2.11.1.5) and consultation with the fishing industries of other European countries carried out by the Applicant has revealed that vessels from Denmark, Germany and France may also fish within or around the Norfolk Boreas site.

600. The UK registered vessels include UK owned and operated vessels and UK flagged but Dutch owned and operated vessels. This group has a relatively low value of landings across the relevant ICES rectangles for Norfolk Boreas; ICES rectangles 34F1, 34F2, 34F3, 35F2 and 35F3 (which include the offshore project area) accounted for average annual UK landings of £2,235, £144,661, £768,591, £420,003 and £898,345 respectively (see Figure 2.12).

601. The Belgian registered vessels have been identified in the Zone during the ZEA process from the surveillance sightings dataset and the VMS however they are present in low numbers (Figure 2.10).

602. Average annual landings into UK ports, broken down by method, are shown in Figure

[20] Fishing effort is defined as the number of days a vessel is recorded undertaking a fishing trip. This is taken as the time between a vessel leaving port and its subsequent return to port at the end of a trip
[21] The Development Areas being those parts of the Zone that were identified as being areas of potential future development, as shown in the ZEA report.

2.14. The majority of the Dutch vessels are beam trawlers (Figure 2.13) which were recorded as principally targeting sole and plaice and other flat fish in the autumn and winter (EAOW, 2012a).

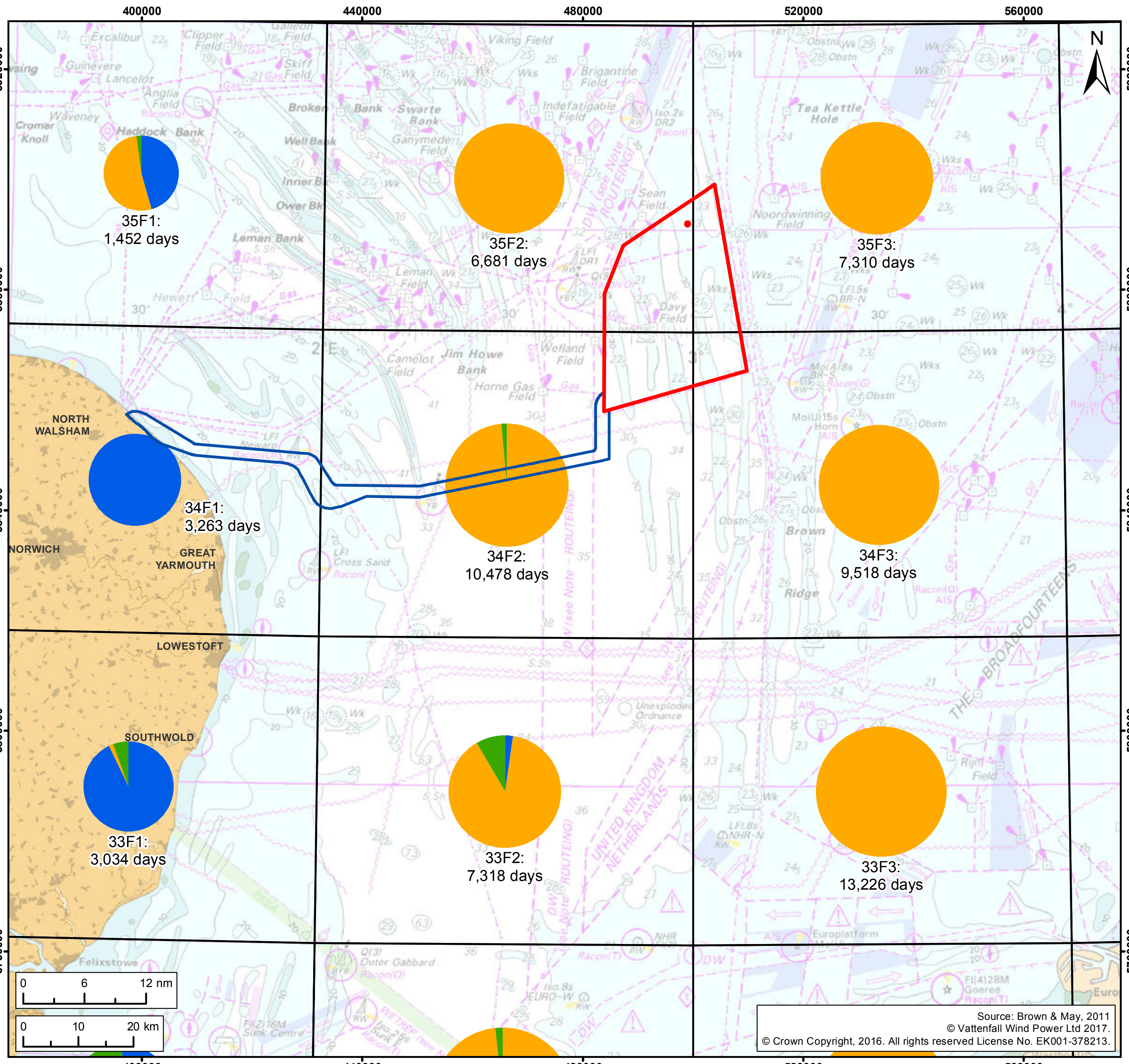
603. The provisional offshore cable corridor crosses (from west to east) the ICES rectangles 34F1 and 34F2. As shown in Figure 2.10, the inshore activity is dominated by UK vessels. These were mainly utilising pots in 34F1 and 35F1 but also longlines and gill nets within 33F1.

604. Where UK registered vessels are found further offshore, their preferred methods are longlines and beam trawls. The landings data from 2008 and 2014 presented in Section 2.7 suggest that these methods target plaice, sole and sprat.

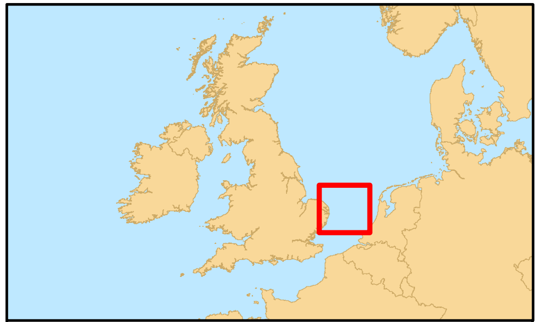
605. As described above the majority of fishing activity beyond the 12nm limit is non-UK, principally vessels from the Netherlands. Due to historical rights, Belgian vessels can operate in the zone between 6 and 12nm, however they seem to have been largely absent from this area between 2005 and 2010. The Applicant is currently sourcing up to date data from relevant sources, including European fisheries organisations.

606. A significant proportion of both Belgian and UK vessels working in the area are 'flag' vessels, owned and operated by Dutch interests but fishing under UK or Belgian licences and quotas (EAOW, 2012a).

607. It should be noted that the initial work on the siting of the Round 3 Zones took constraints, such as commercial fisheries, into account. Subsequent work has then been undertaken by the Applicant and the former EAOW on siting areas for development within the former East Anglia Zone to reduce potential for impacts (see Section 1.2).



Source: Brown & May, 2011
© Vattenfall Wind Power Ltd 2017.



Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast
- ICES Rectangles

Effort by Nationality 2005-2010

- UK
- Netherlands
- Belgium

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Fishing Method by Nationality

Figure: 2.10 Drawing No: PB5640-102-014

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:1,000,000
01	01/02/17	JE	DT	A4	1:1,000,000

Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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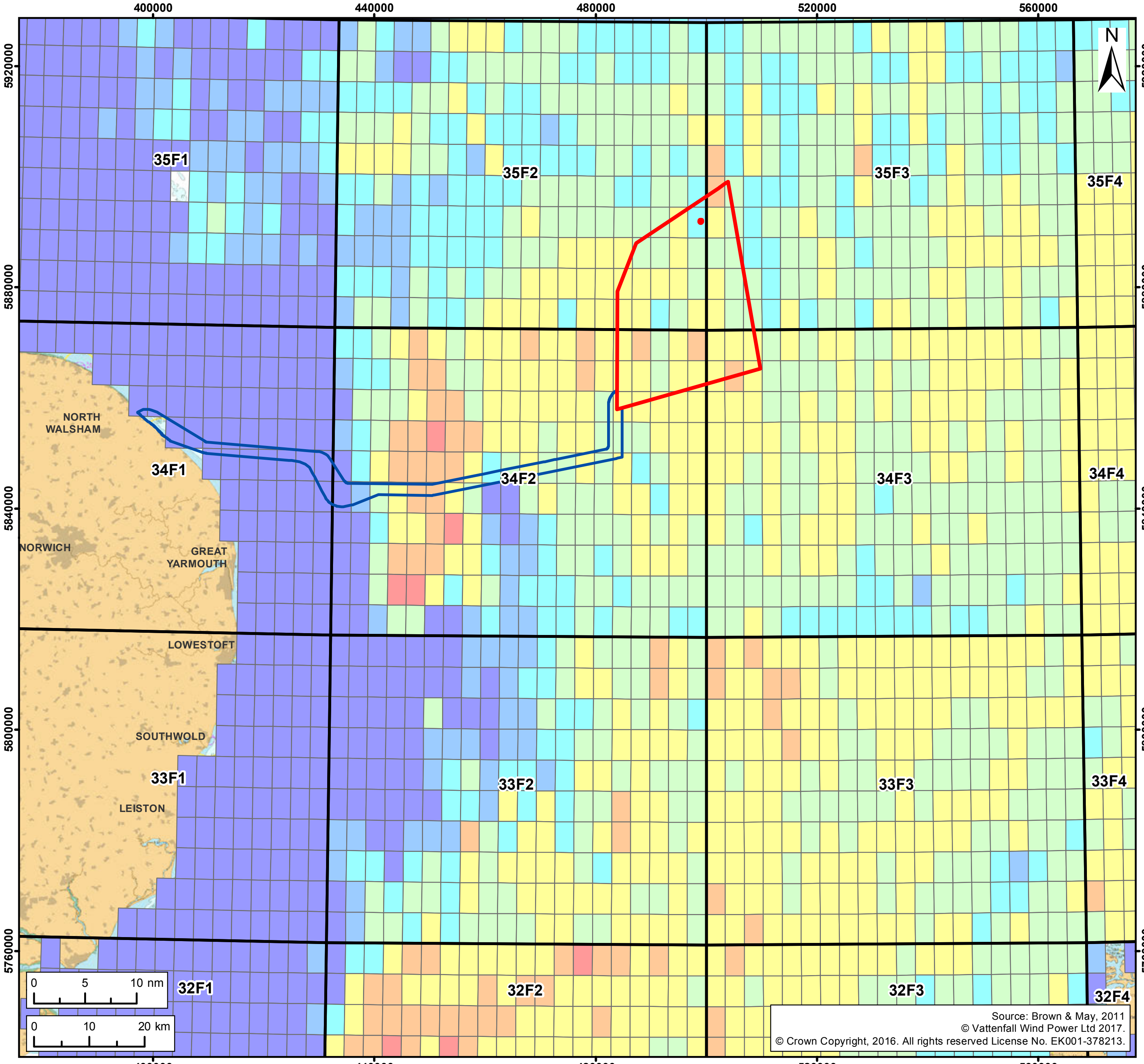

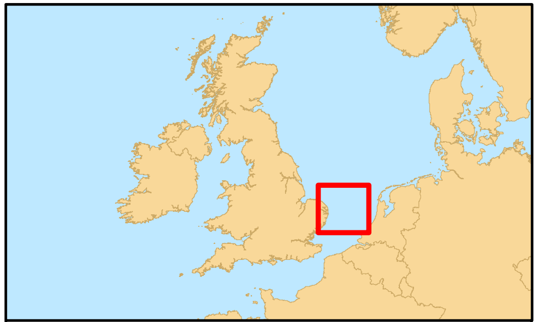

Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast
- ICES Rectangles

Dutch VMS Landings

Average 2006 - 2010

- Less than €10,000
- €10,000 to €30,000
- €30,000 to €60,000
- €60,000 to €100,000
- €100,000 to €200,000
- €200,000 to €350,000
- Over €350,000

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Dutch VMS Landings Values

Figure: 2.11 Drawing No: PB5640-102-015

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:1,000,000
01	01/02/17	JE	JM	A4	1:1,000,000

Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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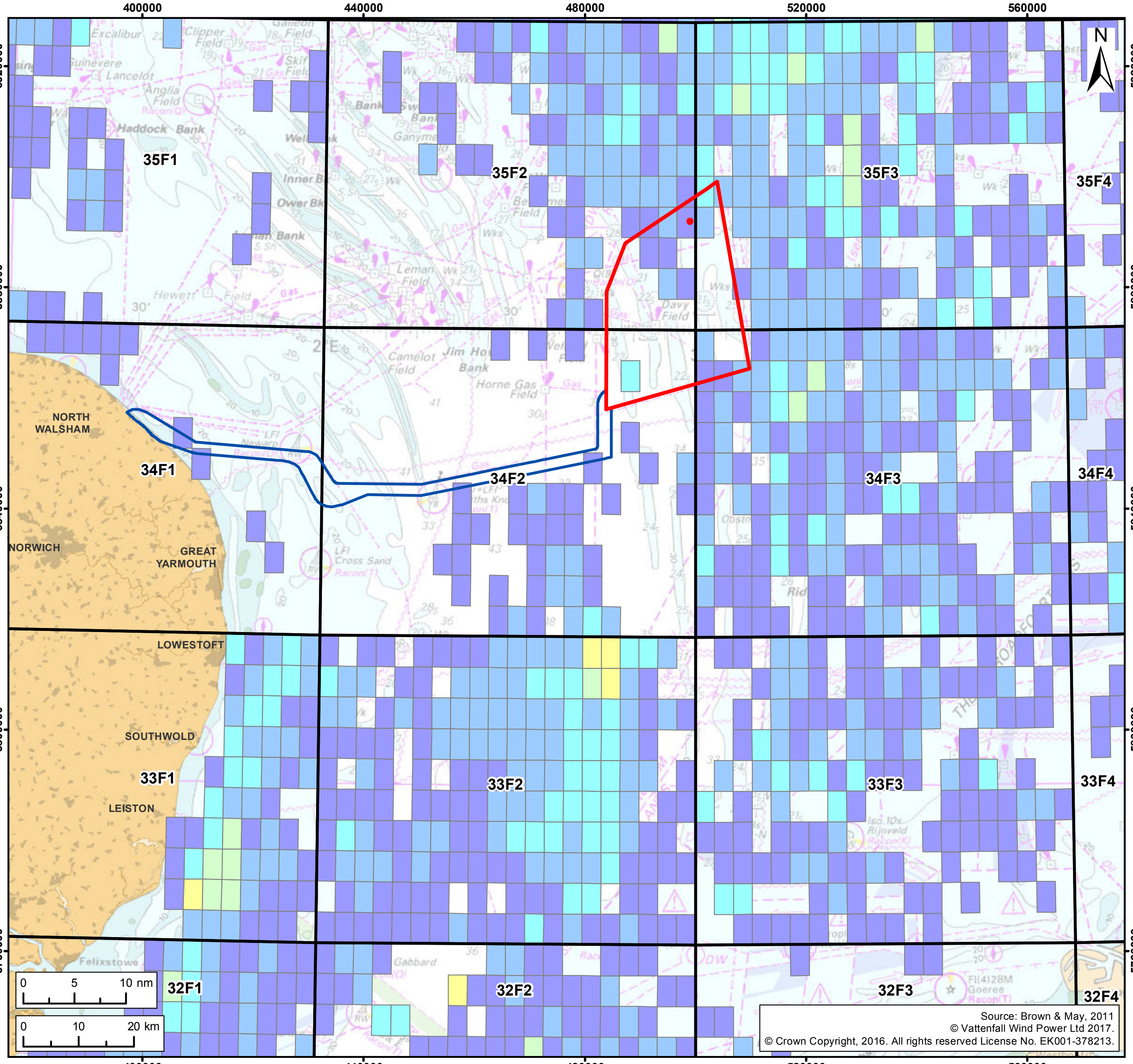

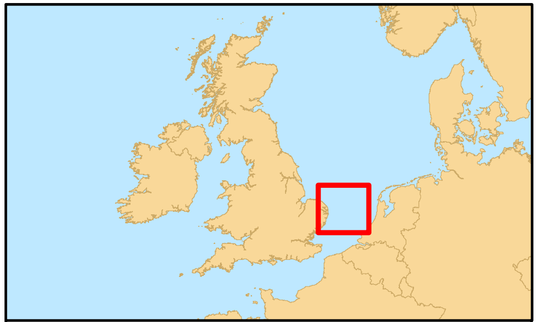

Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast
- ICES Rectangles

UK VMS Landings

Average 2007 - 2010

- Less than £1,000
- £1,000 - £3,000
- £3,000 - £6,000
- £6000 - £10,000
- £10,000 - £20,000
- £20,000 - £35,000
- More than £35,000

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

VMS Landings Values (UK >15m)

Figure: 2.12 | Drawing No: PB5640-102-016

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:1,000,000
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Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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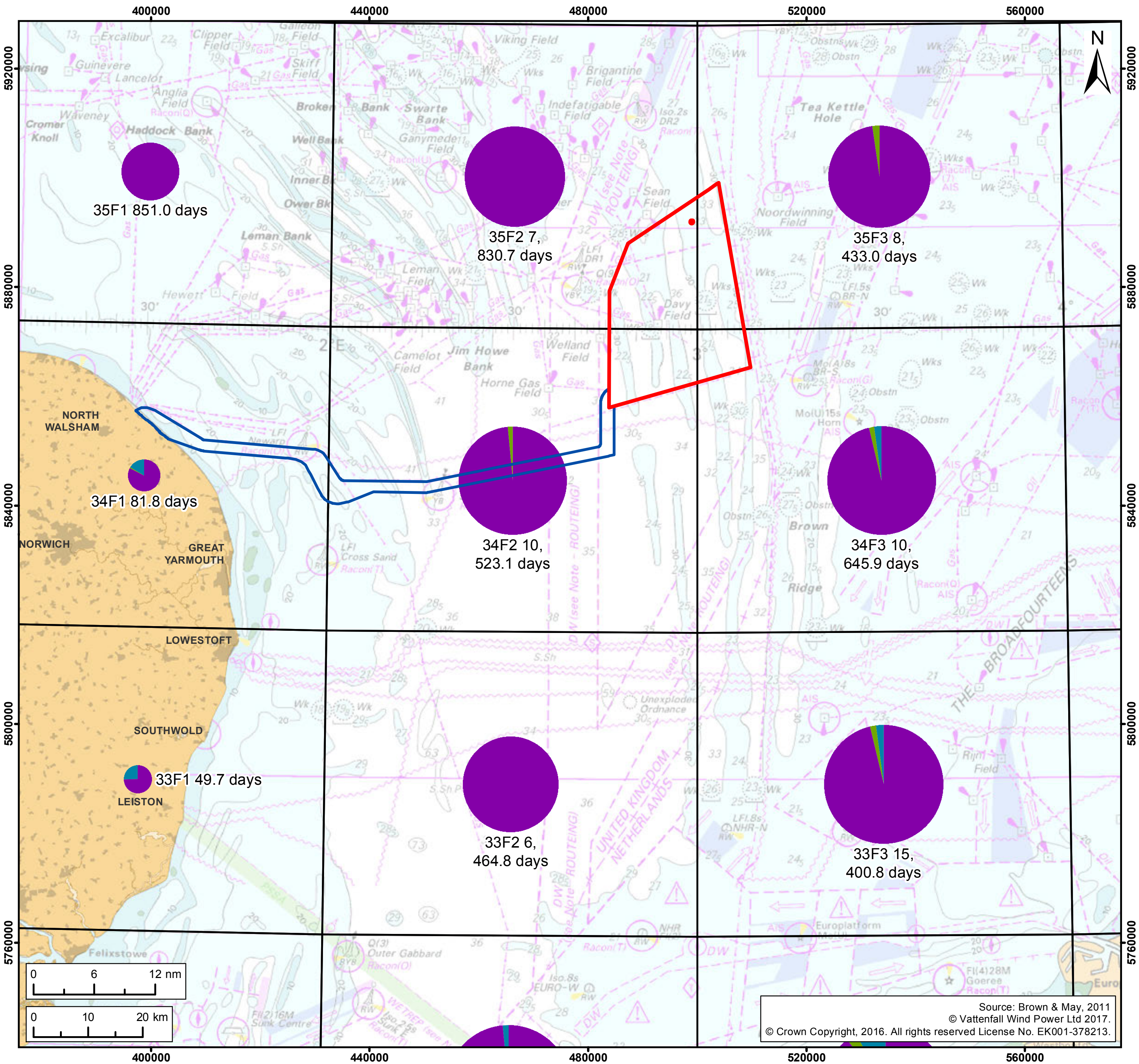

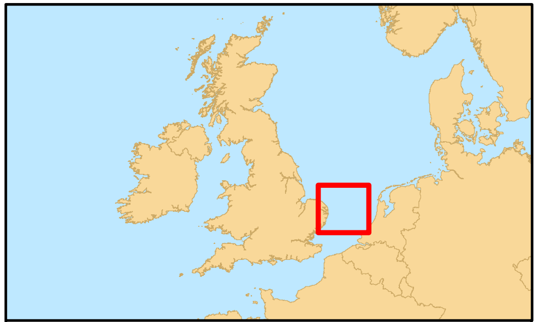

Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast
- ICES Rectangles

Dutch Annual Effort by Method (2001-2010)

- Beam Trawls
- Demersal Trawls
- Other Methods

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Dutch Annual Effort by Method (2001-2010)

Figure: 2.13 Drawing No: PB5640-102-017

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:1,000,000
01	01/02/17	JE	JM	A4	1:1,000,000

Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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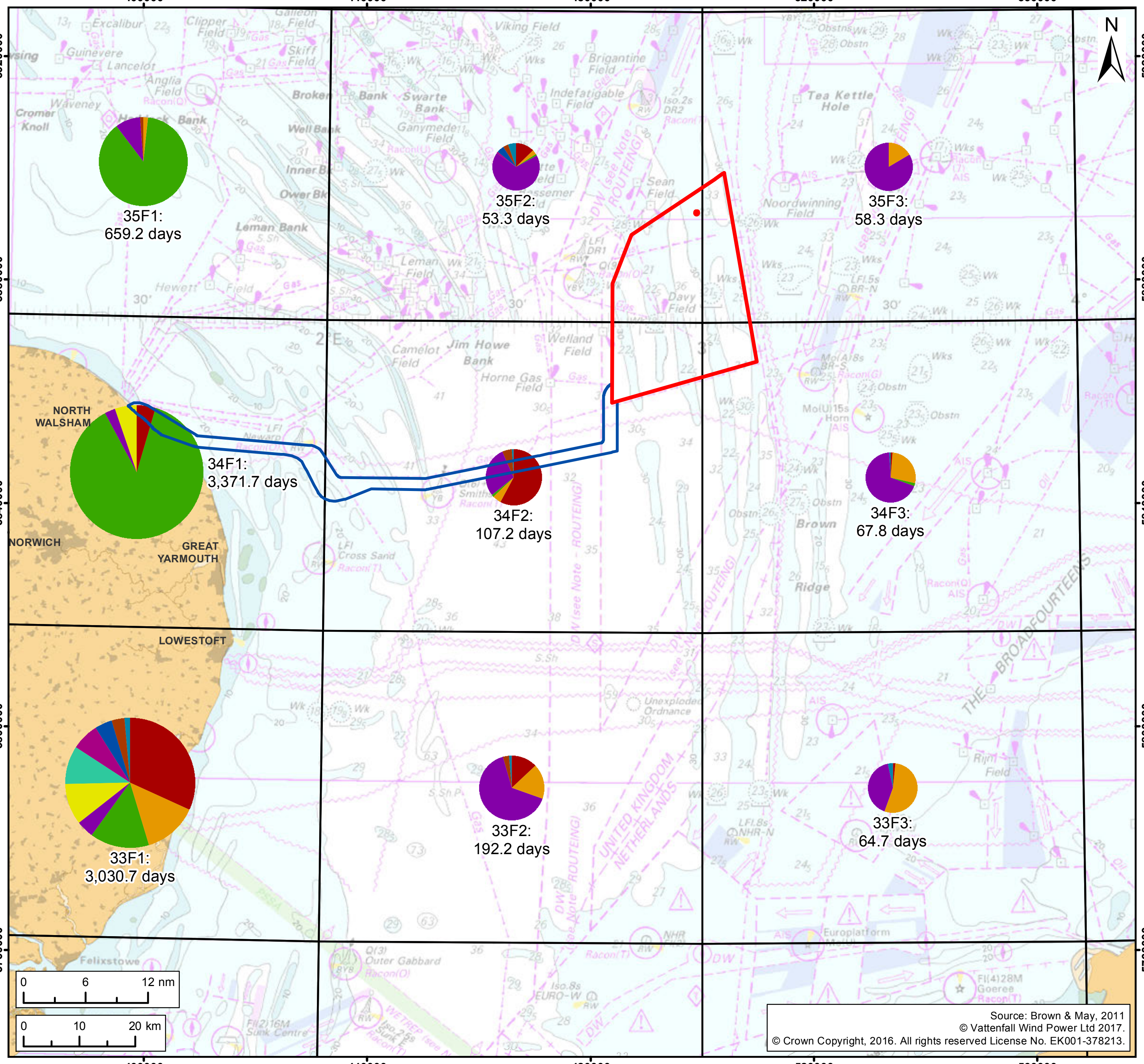

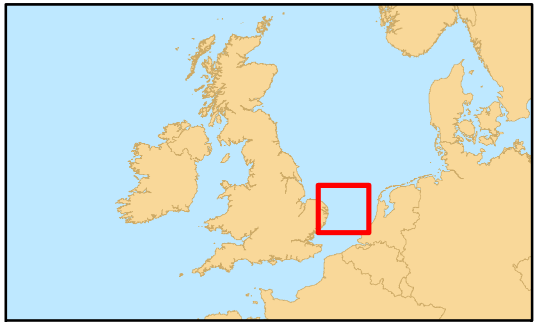

Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast
- ICES Rectangles

UK Annual Effort by Method (2001-2010)

- Longlines
- Gillnets
- Pots
- Beamtrawls
- Drift Nets
- Trammel Nets
- Otter Trawls (Bottom)
- Otter Twin Trawls
- Otter Trawls (Not Specified)
- Other Methods

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

UK Annual Effort by Method (2001-2010)

Figure: 2.14 Drawing No: PB5640-102-018

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:1,000,000
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Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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2.10.2 Potential impacts

2.10.2.1 Potential impacts during construction

608. **Impacts on commercially exploited species**: There is the potential for temporary displacement of sensitive fish species (Section 2.7) from the area of the construction works as a result of, for example, underwater noise associated with piling activities (finfish) or from physical disturbance of the seabed (which would be most likely to impact upon benthic and demersal fish and shellfish). This displacement could have an indirect, localised and temporary impact on the fishery operating in the area.

609. **Loss of or restricted access to traditional fishing grounds:** During the construction phase, it is generally standard practice to establish 500m safety zones around construction works to prevent incidents. During installation of the offshore export cables, fishermen would be advised to maintain a safe distance from the offshore cable laying vessel. This will be considered in the EIA and a realistic worst case scenario for safety zone establishment will be identified.

610. **Displacement of fishing activity:** Displacement during the construction period may lead to increased use of other areas (which may or may not already be traditionally used as fishing grounds) outside the Norfolk Boreas offshore project area.

611. **Increased collision risk:** Navigational safety issues will be covered by the Navigational Risk Assessment (NRA) as part of the impact assessment for shipping and navigation and will be discussed and agreed with relevant stakeholders, including appropriate commercial fisheries representatives.

612. **Increased steaming times:** The construction of Norfolk Boreas and the associated construction vessels (including safety zones) in the area will potentially exclude the passage of fishing boats in some areas. This has the potential to slightly increase steaming times to reach fishing grounds.

2.10.2.2 Potential impacts during operation

613. **Impacts on commercially exploited species:** Monitoring studies at two wind farms in the North Sea (Kentish Flats in the UK (Vattenfall, 2009) and Horns Rev in Denmark (DTU Aqua, 2011)) indicate minor or no change in abundance, distribution or behaviour of fish populations at the sites that could be attributed to these wind farms. Changes were recorded at Kentish Flats, however these were considered to be indistinguishable from natural variability. Other studies have indicated that shellfish colonise the foundations and scour protection; research has shown that the structures are used as successful nursery habitats for edible crab crabs and lobsters (RPS, 2015; Linley *et al.*, 2008) however to date, there is no conclusive evidence that shellfish populations have increased in the area surrounding the wind farms.

614. **Loss of or restricted access to traditional fishing grounds:** Due to the physical footprint of Norfolk Boreas infrastructure, some seabed which was previously able to be fished would be inaccessible. For jacket, GBS and monopile foundations this area is likely be very small and is expected to be restricted to the area of the foundations themselves. Should a floating foundation system be employed the spread and number of anchors and their associated mooring wires may further restrict the area within the windfarm which can be fished. This will be considered in more detail through consultation with stakeholders and presented within the EIA.

615. During maintenance works a temporary 500m safety zone may be required around certain activities. Further discussion will be undertaken with relevant stakeholders during the pre-application process to establish appropriate operating procedures and to address any outstanding concerns from the fishing industry. This will be considered in the EIA and a realistic worst case scenario for safety zone establishment will be identified.

616. **Displacement of fishing activity:** Whilst this potential impact will be considered within the EIA, there are not expected to be any significant effects of loss of fishing area during the operational phase and therefore minimal impacts are expected to alternative fishing grounds. Recent studies into the effects of wind farms on fishing practices such as the Gray *et al.,* (2016) will be used to inform the assessment of this impact.

617. Should a floating foundation be used the spread and number of anchors and their associated mooring wires may restrict the area within the windfarm which can be fished. This will be considered in more detail through consultation with stakeholders and presented within the EIA.

618. **Loss of or damage to fishing gear:** All cables would be buried or protected by rock placement or mattressing. It will be a requirement of the Marine Licence that any large items of equipment lost overboard during construction works which are potential snagging hazards are located and recovered.

619. **Increased collision risk:** Navigational safety issues will be covered by the NRA as part of the impact assessment for shipping and navigation (Section 2.11) and will be discussed and agreed with the relevant stakeholders.

620. **Increased steaming times:** During the operational phase, it is not anticipated that there would be significant restrictions on vessel access. For certain maintenance activities there may need to be restrictions in some areas (e.g. around temporary safety zones for O&M vessels). The impact on steaming times to reach fishing grounds will be assessed in the EIA but is expected to be minimal and short term.

2.10.2.3 Potential impacts during decommissioning

621. The potential impacts associated with decommissioning are likely to be similar to those during the construction phase. Foundations are likely to be removed at or below the seabed and cables may also be removed. A decommissioning plan will be developed and approved by the Regulatory Authorities to ensure that any hazards to fishing activities are identified and either removed or marked clearly on charts, which will mitigate the risk.

2.10.2.4 Potential cumulative impacts

622. **Interactions with other wind farms:** Cumulative impacts from the development of Norfolk Boreas and other wind farms within the former East Anglia Zone are possible and will be considered as part of the EIA where consultation with the fishing industry confirms that such interactions are a concern.

623. **Interactions with other activities:** Cumulative impacts upon commercial fisheries may occur between Norfolk Boreas and other activities or developments in the region. The following activities will be taken into account in the assessment:

- Aggregate extraction and dredging;
- Navigation and shipping;
- Existing and planned construction of sub-sea cables and pipelines;
- Potential port and harbour development;
- Oil and gas installations; and
- The designation of Marine Protected Areas.

2.10.2.5 Transboundary impacts

624. There is potential for transboundary impacts upon fisheries, and impacts on relevant European fisheries, including Dutch, Belgian and French vessels, will be considered.

2.10.2.6 Summary of potential impacts

Table 2.23 Summary of potential impacts relating to commercial fisheries

Potential impacts	Construction	Operation	Decommissioning
Impacts on commercially exploited species	✓	✓	✓
Loss of or restricted access to traditional fishing grounds	✓	✓	✓
Displacement of fishing activity	✓	✓	✓
Loss of or damage to fishing gear	x	✓	✓
Increased collision risk (to be covered by NRA)	✓	✓	✓

Potential impacts	Construction	Operation	Decommissioning
Increased steaming times	✓	✓	✓
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓

Scoped in (✓) and scoped out (X)

2.10.3 Mitigation

625. The Applicant has appointed a Fisheries Liaison Officer in line with the approach taken for East Anglia ONE and East Anglia THREE.

626. Mitigation measures and monitoring options would be discussed with local, national and international fishing bodies as appropriate. Mitigation would refer to relevant guidance such as:

- COWRIE options and opportunities for marine fisheries mitigation associated with wind farms (Blyth-Skyrme, 2010);
- MMO Review of environmental data associated with post-consent monitoring of licence conditions of offshore wind farms (MMO, 2014); and
- Fishing Liaison with Offshore Wind and Wet Renewables Group (FLOWW) Best Practice Guidance for Offshore Renewables Developments: Recommendations for Fisheries Liaison (FLOWW, 2014).

2.10.4 Approach to assessment and data gathering

627. Cefas guidance (Cefas, 2004a) recommends that there are two overarching issues that need consideration when assessing the impacts of an offshore wind farm on commercial fishing activities. The first is the possibility of the offshore wind farm affecting populations of fish and shellfish and therefore affecting their catchability; and secondly, the location of the wind turbines and other infrastructure causing a physical obstruction to normal fishing activity.

628. In line with recommended guidance, the EIA will provide evidence of the major commercial fish and shellfish species in the area, describing the fisheries, species and their seasonality. This will be done by complementing existing UK and foreign fleet landings and fishing effort data with the most up to date data obtained from the MMO and relevant organisations from other Member States. As recommended by the planning inspectorate's Norfolk Vanguard Scoping Opinion (The Planning Inspectorate, 2016b) landings and VMS data will be reviewed from the previous 10 years with specific analysis on the previous 5 years to give an accurate as possible picture of current fishing activity, where data are available.

629. Specific studies and information associated with other nearby offshore wind farms

will also be used to support the desk-based assessment, along with information collected through consultation with relevant authorities including the Eastern Inshore Fisheries Conservation Authority (EIFCA), relevant fisheries management organisations and information provided by the local fishing sector (including individual fishermen and commercial fishing associations).

630. Previous consultation was undertaken for the East Anglia ONE and East Anglia THREE EIAs and the ZEA process, with the relevant fishermen's organisations and with individual skippers in the UK, Holland, Belgium and France with a history of fishing the Zone.

631. With regard to Norfolk Boreas, local fisheries organisations and individual fishermen will be contacted at an early stage in the EIA process to update the information on the scale and seasonality of fishing activities in the area. Local port landings data will be obtained and used as context to discussions. This is particularly important for smaller scale largely inshore activities which will not be recorded by systems such as Vessel Monitoring Systems (VMS).

632. The impact of the construction, operation and decommissioning of Norfolk Boreas on the fishing industry will be assessed and discussed, drawing on knowledge and studies from existing wind farms and relevant data from East Anglia ONE and East Anglia THREE and Norfolk Vanguard. Where appropriate, mitigation measures will also be suggested as discussed above.

2.11 Shipping and navigation

2.11.1 Baseline

2.11.1.1 Data sources

633. The available data sources relevant to shipping and navigation which have been used to inform this section are provided in Table 2.24. A high level review has been undertaken for each of these sources as part of this scoping report. A more detailed and updated review of each will be undertaken (where appropriate) as part of the EIA and NRA process.

Table 2.24 Shipping and Navigation Data Sources

Data	Coverage	Date
Marine traffic survey Automatic Identification System (AIS) data collected from Met Mast.	Boreas Site Boundary and 10 nautical miles (nm) study area.	May 2016, November 2016

Data	Coverage	Date
Marine Accident Investigation Branch (MAIB) maritime incident data.	Boreas Site Boundary and 10nm study area. Offshore cable corridor.	2005 – 2015
Royal National Lifeboat Institute (RNLI) maritime incident data.	Boreas Site Boundary and 10nm study area. Offshore cable corridor.	2004 – 2014
Marine aggregates dredging data (licensed and active areas) from The Crown Estate.	Southern North Sea	2016
British Marine Aggregate Producers Association (BMAPA) dredger transit routes.	Southern North Sea	2016
Ministry of Defence exercise areas and explosive dumping grounds from Admiralty Charts.	Southern North Sea	2016
Existing locations of oil and gas platforms and other infrastructure such as pipelines and wells from Admiralty Charts.	Southern North Sea	2016
Anchorage Areas from Admiralty Charts.	Southern North Sea	2016
International Maritime Organisation (IMO) routeing measures from Admiralty Charts.	Southern North Sea	2016
Admiralty Sailing Directions (NP 54 / NP 28)	UK East Coast	NP 54: 2016 NP 28: 2013
UK Admiralty Charts issued by the United Kingdom Hydrographic Office.	UK	2016
Royal Yachting Association UK Coastal Atlas of Recreational Boating (2009) and geographical information systems shapefiles.	UK	2009
Fishing surveillance and satellite data (where available)	UK	Sightings surveillance: 2005 to 2009 Satellite: 2009

634. It is noted that for the purposes of the NRA, additional marine traffic survey data will be collected via a dedicated survey vessel, comprising AIS, radar and visual observation data.

635. The export cable corridor will be assessed using AIS data only. No surface structures will be located within the export cable corridor.

2.11.1.2 Baseline overview

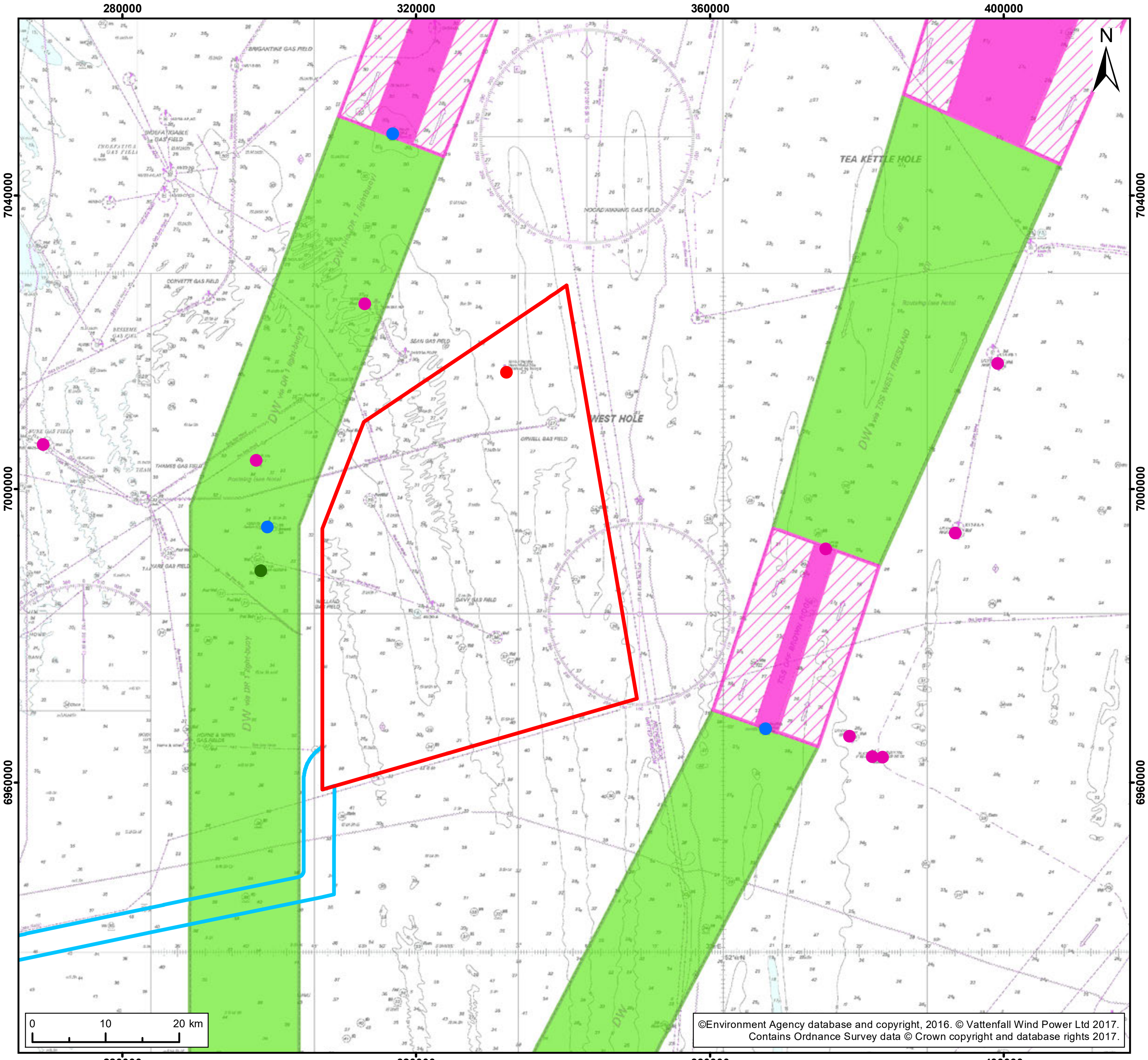
636. The region of the southern North Sea in which the Norfolk Boreas site is located is considered busy in terms of passing vessel traffic, in comparison to other areas

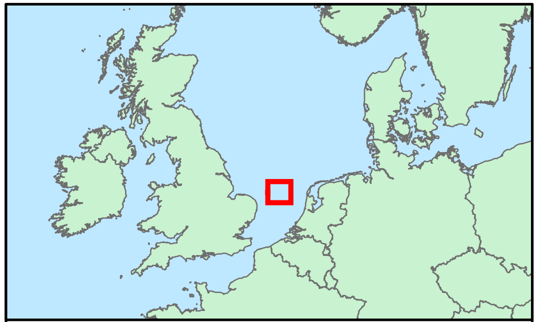
within the United Kingdom (UK) Renewable Energy Zone (REZ). The majority of this traffic is comprised of cargo vessels and tankers using the IMO routeing measures in the area, or on other regular commercial routes. Vessels associated with the oil and gas industry are also frequently present in the area, largely due to the associated installations in the southern North Sea. Other traffic transiting the region includes passenger (both commercial ferries and cruise liners), fishing, and recreational vessels.

2.11.1.3 Navigational features

637. The Norfolk Boreas site lies between IMO routeing measures. To the east, the West Friesland Traffic Separation Scheme (TSS) (17nm to the north-east of the site) and the Off Brown Ridge TSS (three to four nautical miles to the east of the site) are linked via a Deep Water Route (DWR). Similarly, the DR1 Light Buoy DWR passes one nautical mile to the west of the site, and links to the Off Botney Ground TSS, located approximately eight nautical miles north. It is noted that the provisional offshore cable corridor intersects the DR1 Light Buoy DWR. These routeing measures are illustrated in Figure 2.15.

638. There are a number of navigational aids (buoys) in the vicinity of the Norfolk Boreas site, either marking the IMO routeing measures, or associated with the oil and gas fields in the area. A Met Mast, owned and operated by EAOW, is also located within the site. This Met Mast records AIS data (see Table 2.24). The positions of the buoys and the Met Mast relative to the site are shown in Figure 2.15.





Legend

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Lit Buoy
- Lit Buoy with Racon
- Lit Buoy with Bell
- Met Mast

IMO Routeing

- DWR
- TSS - Traffic Lane
- TSS - Separation Zone

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

IMO Routeing and Buoyage relative to Norfolk Boreas

Figure: 2.15 Drawing No: PB5640-102-019

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	09/03/2017	DS	AF	A4	1:750,000

Co-ordinate System: WGS 1984 Web Mercator **EPSG:** 27700

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639. There are a number of gas fields within the vicinity of, or intersecting the Norfolk Boreas site. These include:

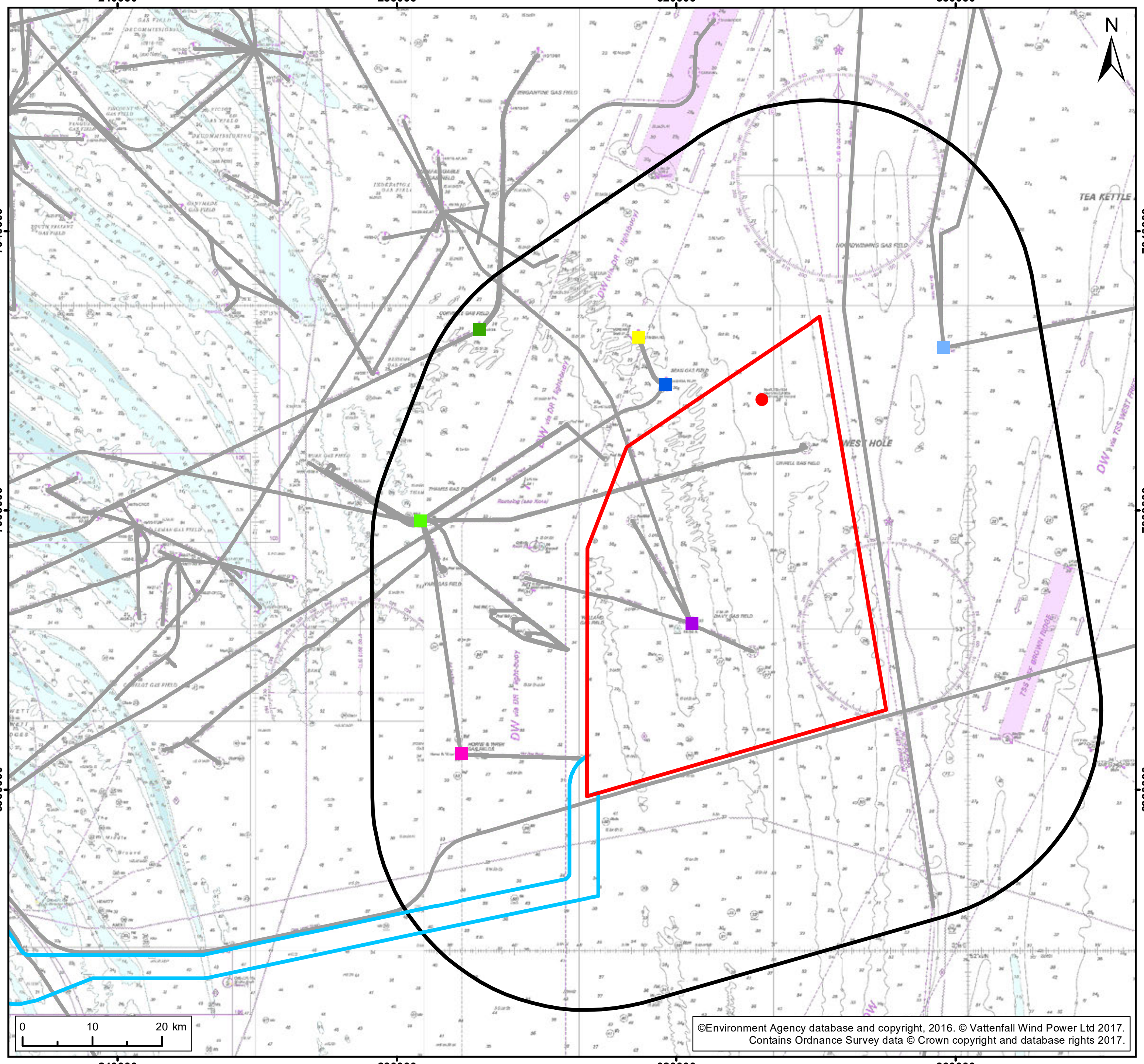
- The Davy Gas Field (two wells within the site linked to a normally unmanned platform, also within the site, it is expected that the Davy platform will be decommissioned and removed prior to the construction of Norfolk Boreas)
- The Orwell Gas Field (one well within the site, tied back to the Thames field, decommissioning is ongoing)
- The Welland Gas Field (inactive installations at this field have been decommissioned, including the removal of the surface platform)

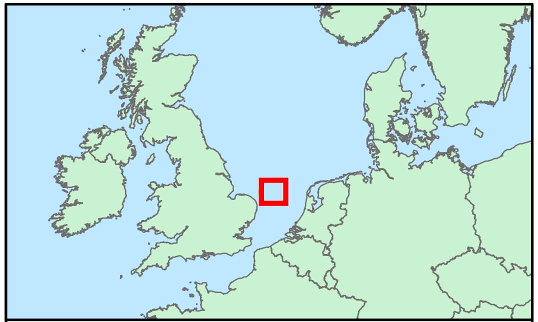
640. The K13-A platform is located approximately five nautical miles to the east of the site in Dutch waters. This installation is no longer associated with an active gas field, but still acts as a transit station for the WestGateTransport pipeline.

641. An illustration of the oil and gas infrastructure within 10nm of the Norfolk Boreas site is given in Figure 2.16.

642. There are no charted marine aggregate dredging areas, military practice areas, or anchorage areas within the considered study area. It is noted that vessels are permitted to anchor outwith designated anchorage areas assuming there are no relevant charted restrictions. This may include general planned anchoring, emergency anchoring (a drifting vessel anchoring to avoid collision/allision), or anchoring during adverse weather.

643. While there are no charted marine aggregate dredging areas within the study area, five BMAPA dredger routes intersect the Norfolk Boreas site, as shown in Figure 2.17.





Legend

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- 10nm Study Area UTM31N WGS84_region
- Met Mast

Oil & Gas Infrastructure

- Sean P
- Corvette
- Horne and Wren
- Davy A
- Sean RD
- Thames
- K13-A
- Pipeline

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Oil & Gas Infrastructure relative to Norfolk Boreas

Figure: 2.16 | Drawing No: PB5640-102-020

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	09/03/2017	DS	AF	A4	1:800,000

Co-ordinate System: WGS 1984 Web Mercator **EPSG:** 27700

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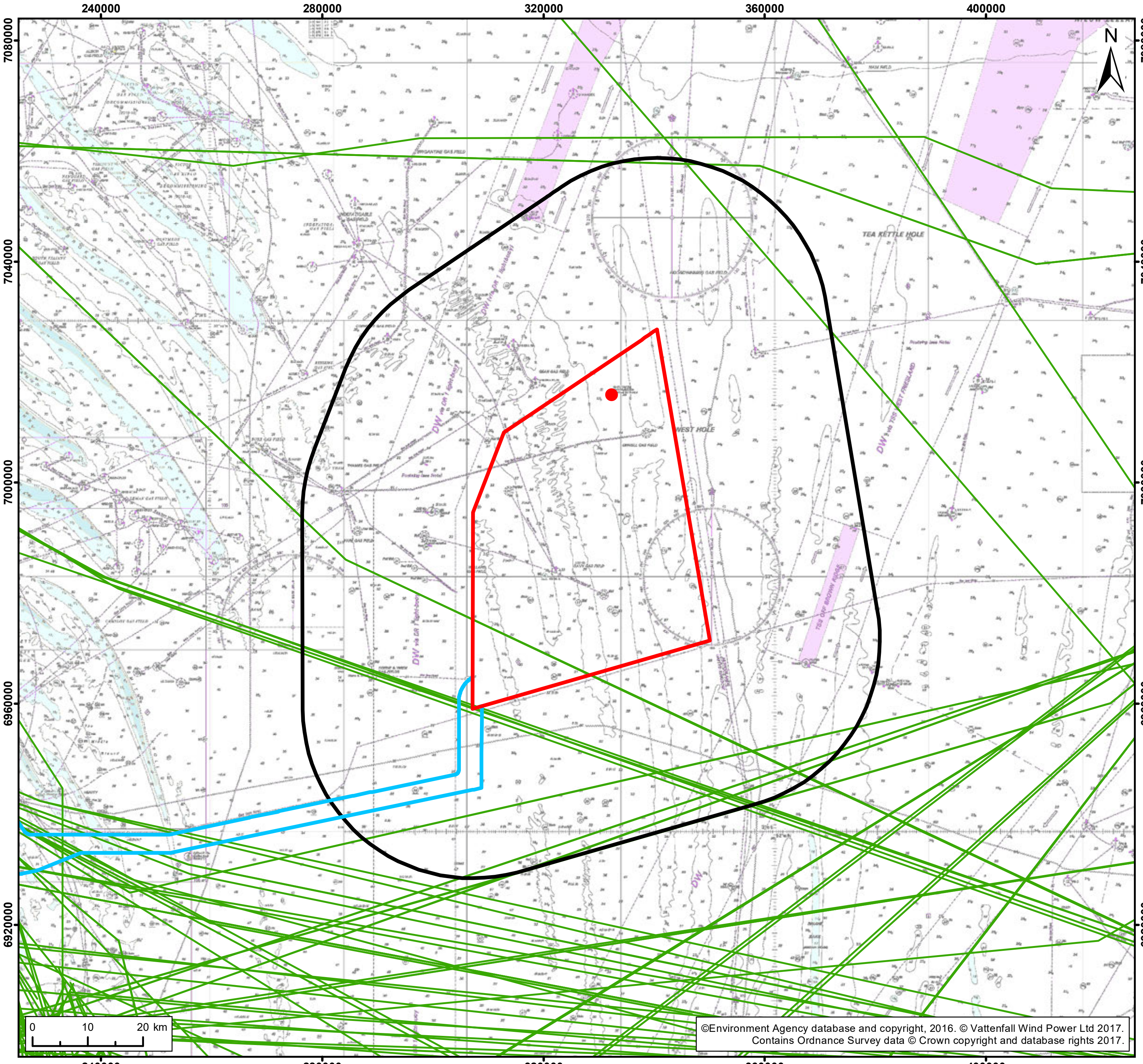

Legend

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- 10nm Study Area
- Met Mast
- BMAPA Routes

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title: BMAPA Routes relative to Norfolk Boreas

Figure: 2.17 Drawing No: PB5640-102-021

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	09/03/2017	DS	AF	A4	1:1,000,000

Co-ordinate System: WGS 1984 Web Mercator **EPSG:** 27700

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2.11.1.4 Commercial shipping

644. The area surrounding the Norfolk Boreas site is considered a busy area in terms of commercial shipping, largely due to the presence of the IMO Routeing Measures.

645. This is illustrated in Figure 2.18, which shows 28 days of AIS data for the Norfolk Boreas study area colour-coded by vessel type. Plate 2.1 gives the distribution of vessel traffic in the study area, based on the AIS. Any traffic considered temporary (vessels performing surveys, or performing temporary guard duties) has been excluded.

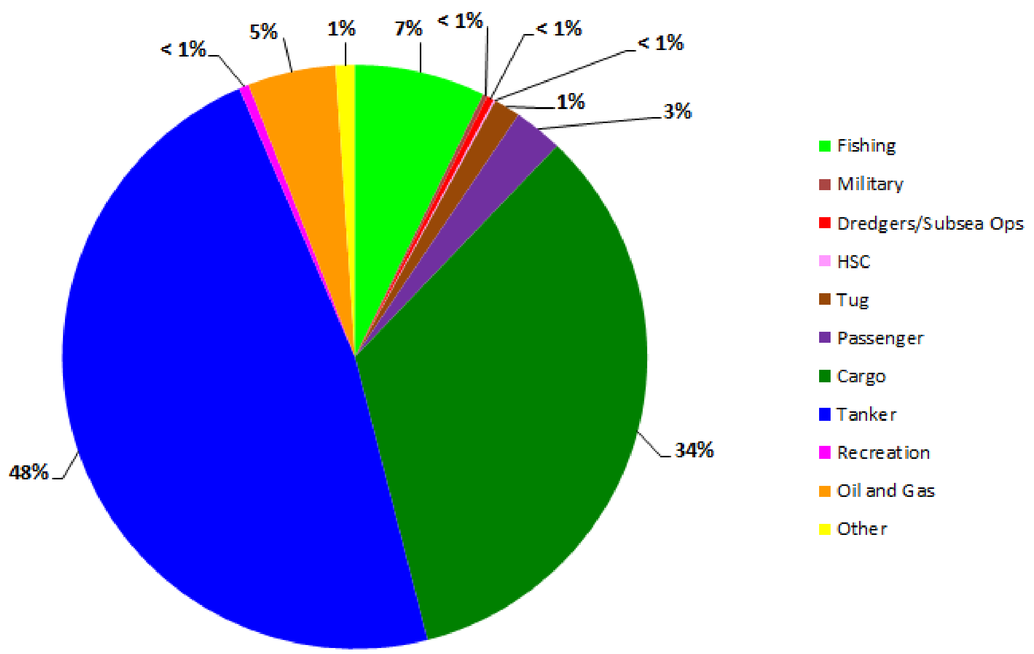


Plate 2.1 AIS Vessel type distribution (excluding temporary traffic)

646. Based on the AIS data, the majority of cargo vessels and tankers within the study area utilise the IMO routeing measures for transit. Therefore, as the routeing measures do not intersect the Norfolk Boreas site, the majority of cargo and tanker traffic currently passes outwith the site boundaries.

647. The majority of vessels using the Off Brown Ridge TSS (to the east of Norfolk Boreas) are tankers, mainly carrying crude oil or other chemicals. Bulk carriers, container carriers, and other general cargo vessels also occupy a notable proportion of the traffic. The vessels using the DWR to the west of the site (linked to the Off Botney TSS) show a similar traffic distribution, with the majority of vessels being crude and chemical tankers, bulk carriers, and other general cargo vessels. Although not a

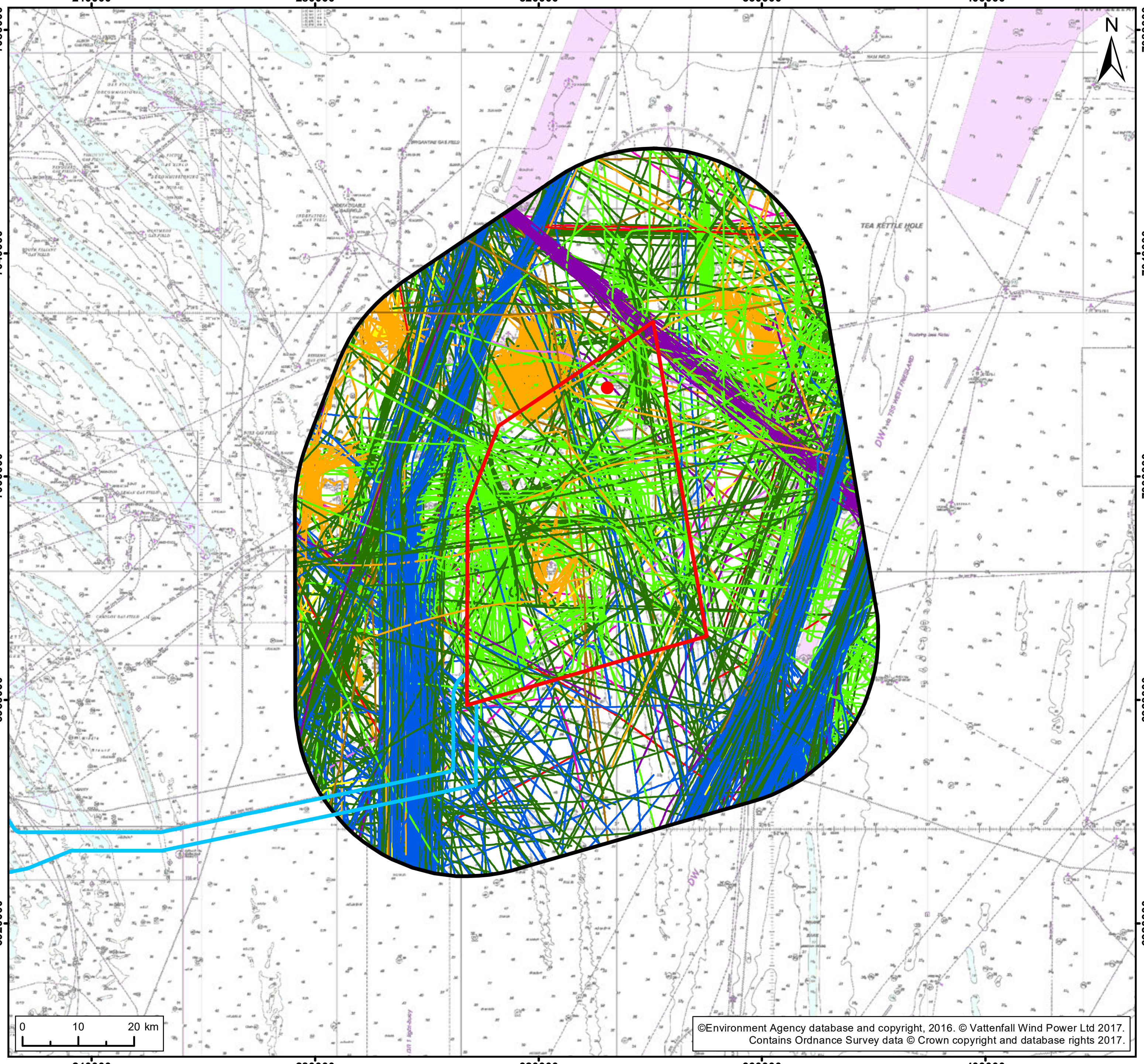
requirement for navigating within the DWR it is considered likely that a proportion of the vessels recorded will be constrained by their draught.

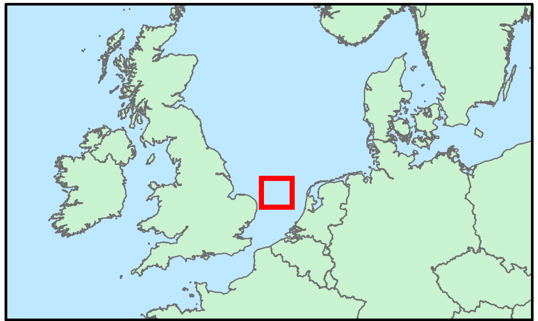
648. It is noted that merchant vessels on routes not associated with the IMO routeing measures were observed to intersect the site. The majority of vessels on these routes were travelling between the Netherlands and various UK ports, including ports in the Humber and Wash estuaries.

649. The commercial ferry route operating through the north-east corner of the Norfolk Boreas site is operated by DFDS Seaways and runs a timetabled ferry service between Newcastle and Ijmuiden (Amsterdam). Other passenger vessel traffic in the area is largely comprised of large cruise liners using the IMO Routeing Measures. The NRA will include a full vessel routeing analysis, which will identify all shipping routes which may be impacted by the Norfolk Boreas site.

650. Commercial vessels associated with the Oil and Gas industry were observed performing standby and supply services to the Davy, Sean, Thames and Corvette gas fields. Commercial Oil and Gas vessels were also recorded visiting the K13-A platform to the east of the site.

651. Two commercial vessels were observed at anchor within Dutch waters to the east of the Norfolk Boreas site (and west of the IMO Routeing associated with the Off Brown Ridge and West Friesland TSS). Vessels are unlikely to regularly anchor in the area due to the high density of passing traffic and pre-existing gas installations, however a wider anchoring assessment will be undertaken as part of the NRA process.





Legend

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- 10nm Study Area
- Met Mast

Vessel Type

- Fishing
- Military
- Dredger/Subsea
- HSC
- Tug
- Passenger
- Cargo
- Tanker
- Recreational
- Oil and Gas
- Other

Project: Norfolk Boreas

Report: Environmental Impact Assessment Scoping Report

Title: AIS Data 2016 - 28 Days (excluding temporary traffic)

Figure: 2.18 Drawing No: PB5640-102-022

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	09/03/2017	DS	AF	A4	1:1,000,000

Co-ordinate System: WGS 1984 Web Mercator **EPSG:** 27700

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2.11.1.5 Fishing vessels

652. Based on the 28 days of AIS data, there are moderate levels of fishing in the area surrounding the Norfolk Boreas site. The AIS tracks recorded from fishing vessels during the 28 days marine traffic survey periods are shown in Figure 2.19.

653. It should be noted that fishing vessels below 15m are not required to broadcast via AIS, however fishing activity from smaller vessels in this area is likely to be low given the distance from the nearest UK and mainland European ports.

654. A high level review of the AIS data suggests that the majority of fishing in the study area is from beam trawlers, with demersal trawlers, pelagic trawlers, and seiners also being recorded. The majority of fishing vessels in the study area were registered in the Netherlands, however vessels from the UK, France, Denmark, Germany, and Belgium were also recorded.

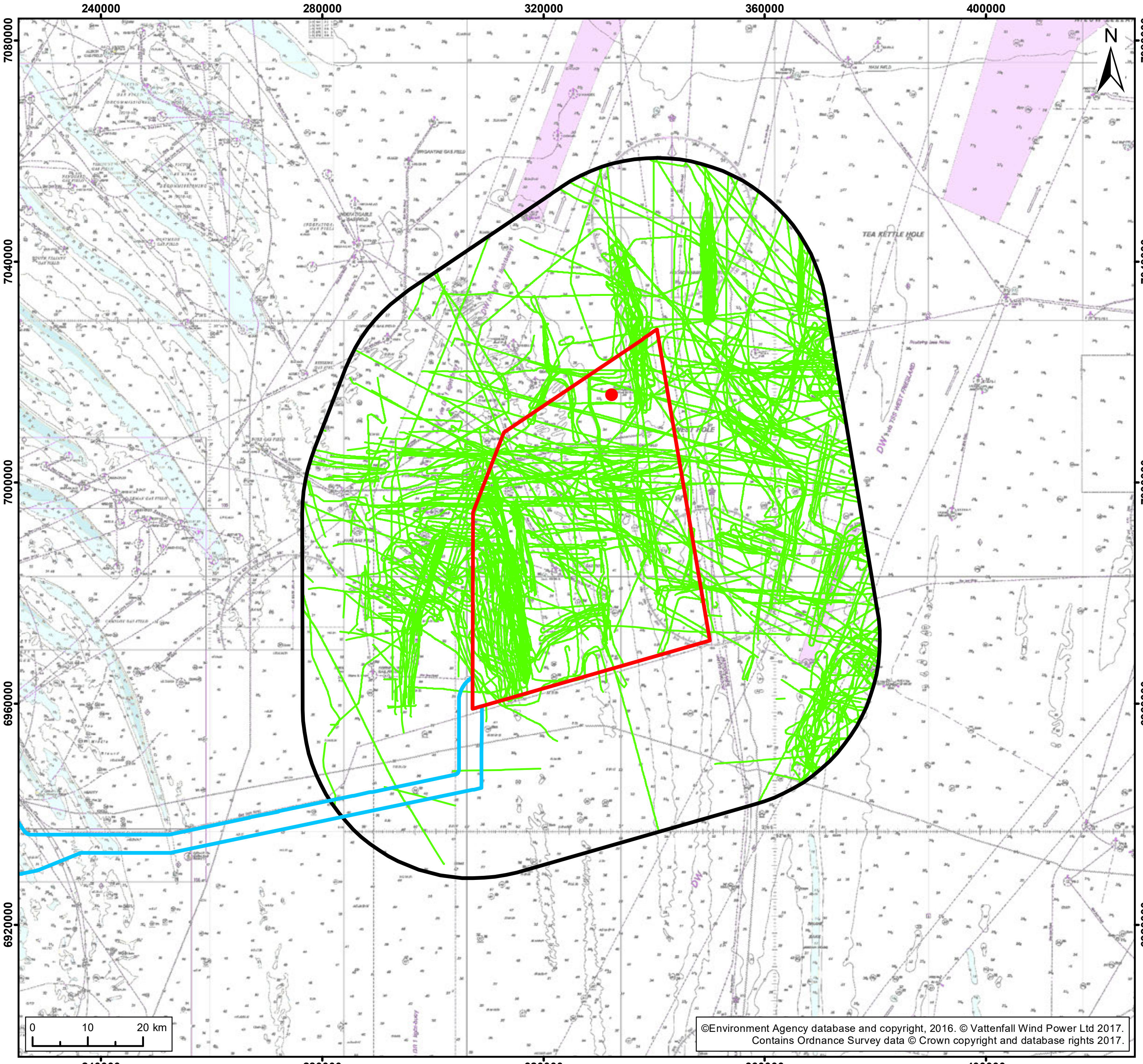
655. Additional fishing data collected via satellite (2009) and sightings surveillance (2005-2009) has also been reviewed as part of this scoping process. The surveillance data review showed similar results to the AIS analysis, with beam trawlers being the most common gear type in the study area, and the majority of vessels being registered in the Netherlands.

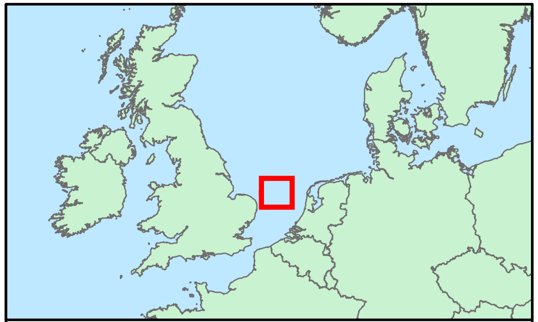
656. A detailed analysis to show the difference between vessels engaged in fishing and those in transit will be undertaken as part of the NRA.

2.11.1.6 Recreational vessels

657. The AIS tracks recorded from recreational vessels are presented in Figure 2.20, and Figure 2.21 shows RYA UK sailing areas and cruising routes (RYA, 2009) relative to the site.

658. Recreational vessels greater than 24m in length have been classified as passenger vessels (this is as per the Recreational Craft Regulations 2004 (Directives 94/25/EC and 2003/44/EC)) and are therefore not included in the recreational analysis below. It should be considered when viewing Figure 2.20 that AIS carriage is not a requirement for smaller recreational vessels, and it is therefore very likely that the AIS under-represents the overall recreational activity. However, due to the distance of the site from the nearest UK and European ports, there are expected to be low levels of activity from smaller recreational vessels in the area compared to other coastal marine development sites.





Legend

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- 10nm Study Area
- Met Mast

Vessel Type

- Fishing

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

AIS Fishing Vessels - 28 days

Figure: 2.19	Drawing No: PB5640-102-023				
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	09/03/2017	DS	AF	A4	1:1,000,000

Co-ordinate System: WGS 1984 Web Mercator **EPSG:** 27700

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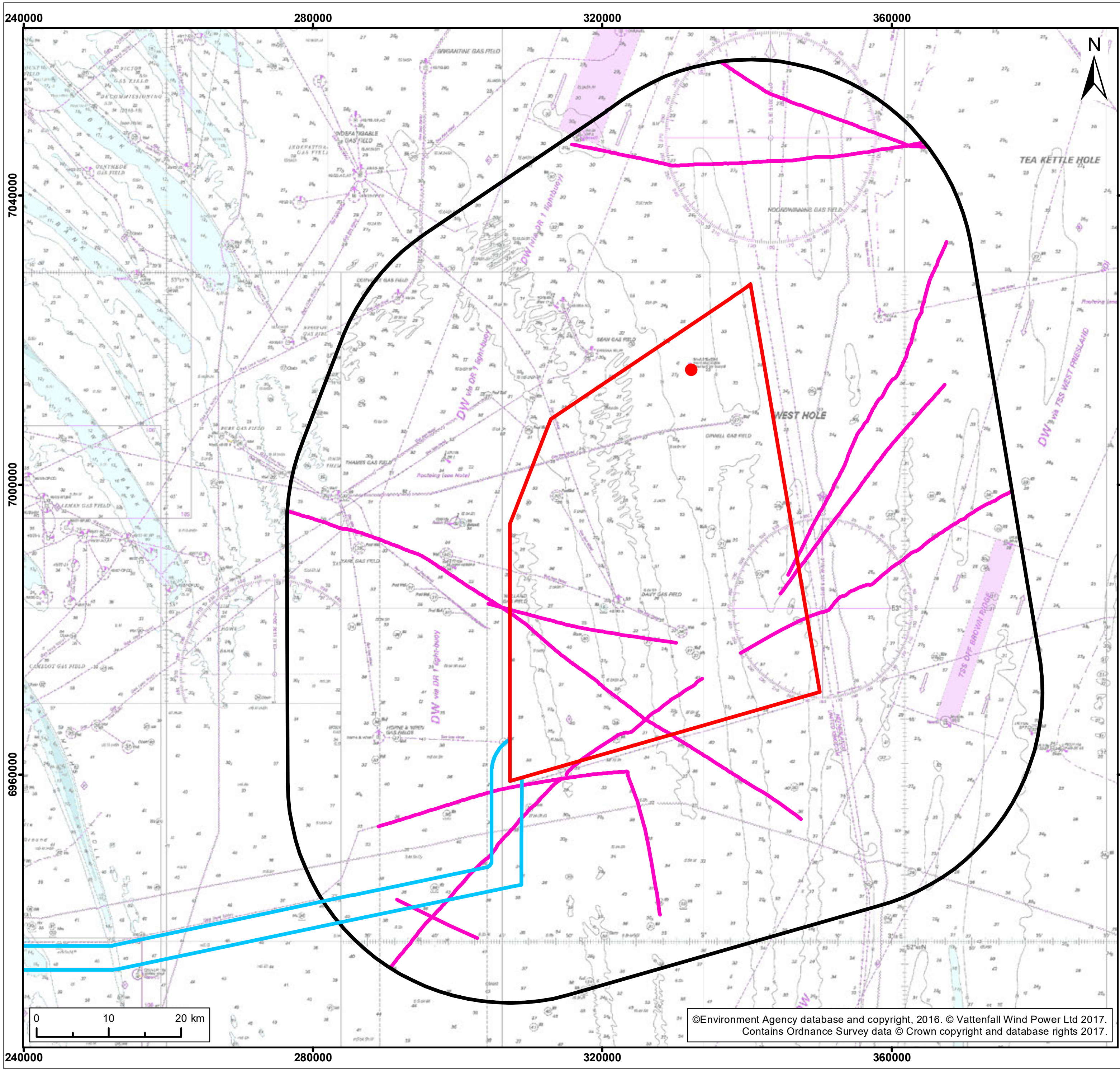

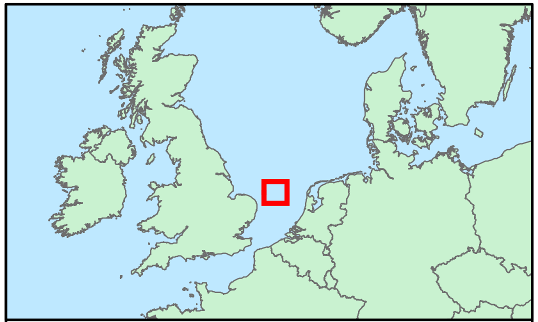

Legend

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- 10nm Study Area
- Met Mast

Vessel Type

- Recreational

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title: AIS Recreational Vessels 28 Days

Figure: 2.20 | Drawing No: PB5640-102-024

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	09/03/2017	DS	AF	A4	1:750,000

Co-ordinate System: WGS 1984 Web Mercator **EPSG:** 27700

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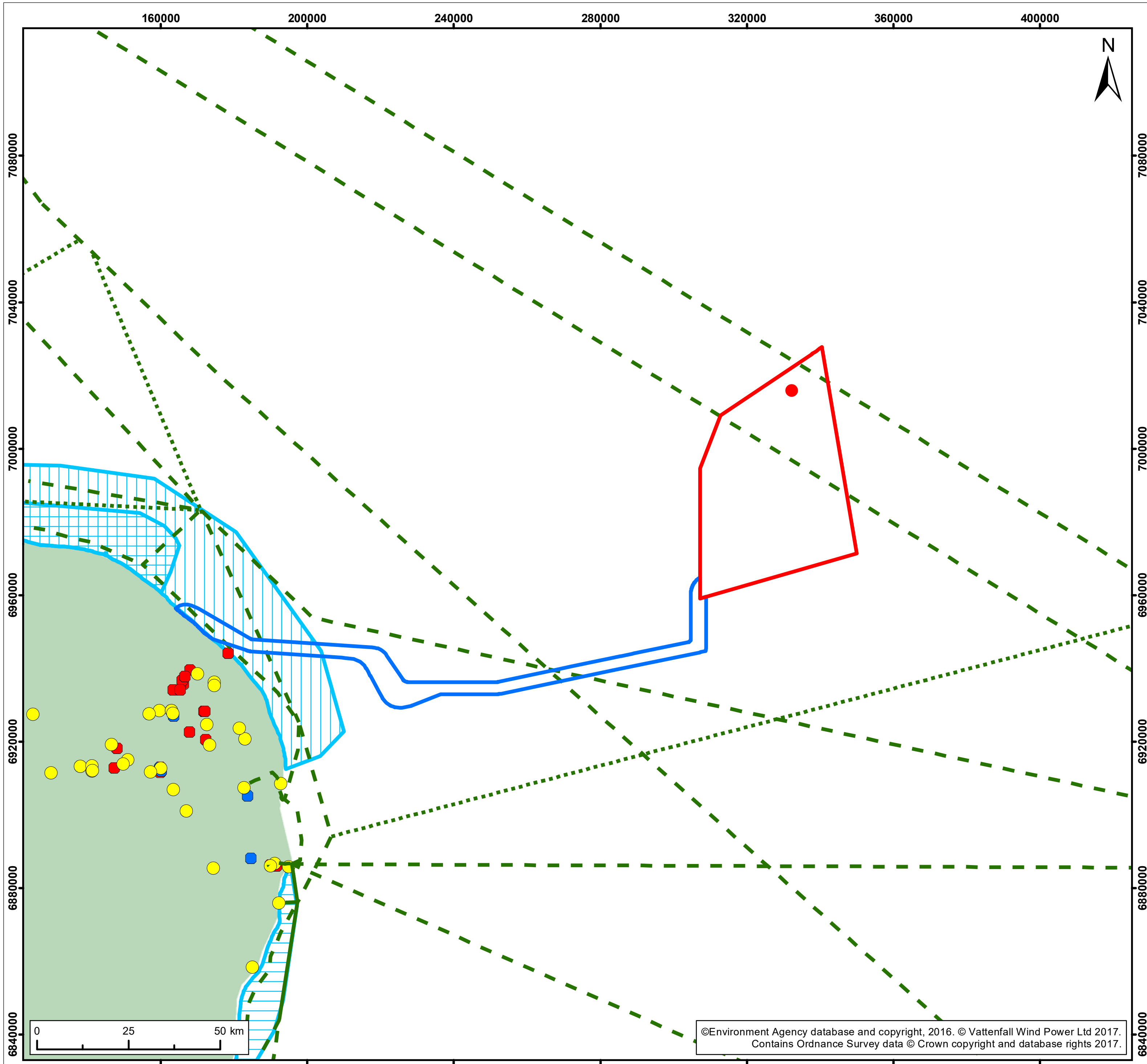

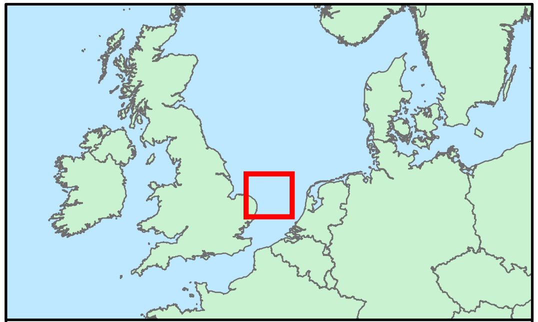

Legend

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast

RYA Cruising Route

- Light Use
- Medium Use
- Heavy Use

RYA Facilities

- Club
- Marina
- Training Centre

RYA Area

- Sailing Area
- Racing Area

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

RYA Coastal Atlas of Recreational Sailing

Figure: 2.21 Drawing No: PB5640-102-025

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	09/03/2017	DS	AF	A4	1:1,500,000

Co-ordinate System: WGS 1984 Web Mercator **EPSG:** 27700

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659. Two medium use cruising routes running between UK and the Netherlands intersect the Norfolk Boreas site. As the RYA sailing and racing areas are all coastal, there are none relevant to the site, however it is noted that the export cable corridor landfall is within the Greater Wash Sailing Area and that there are a number of races that operate between the UK and mainland Europe that may on occasion pass through the Norfolk Boreas site.

2.11.2 Potential impacts

660. The sections below summarise the potential impacts from the Norfolk Boreas project to shipping and navigation receptors identified within the baseline above. All impacts identified at this stage have been included, however it should be noted that the full baseline assessment undertaken as part of the NRA process may identify further impacts which were not able to be identified within this scoping report.

2.11.2.1 Potential impacts during construction

661. **Vessel routeing**: The review of the AIS data identified vessel routes intersecting the Norfolk Boreas site. These routes are likely to be displaced during construction due to the presence of buoyed construction areas (including 500m rolling safety zones around fixed structures where work is being undertaken), construction vessels and partially completed or pre commissioned structures.

662. The relevant routes are largely used by cargo vessels and tankers. Oil and gas vessel routes may also be affected. It is noted that as there is existing oil and gas infrastructure within (and surrounding) the site, access requirements may have to be agreed between the relevant parties.

663. The activity associated with the laying of the export cables would also displace vessel routes within the provisional offshore cable corridor for short periods of time.

664. **Displacement of third party Marine Activities**: Oil and gas vessels working in the vicinity of the Norfolk Boreas site may be displaced during the construction phase due to the presence of safety zones, and construction vessels. In particular, the AIS data identified vessel presence at the Davy platform within the site boundary, however it is noted that this platform is usually unmanned.

665. It is considered likely that the majority of oil and gas infrastructure currently located within the site will be decommissioned prior to Norfolk Boreas construction (section 2.14). However vessel access requirements may have to be agreed between the relevant parties operating in the surrounding area.

666. Fishing vessels (actively engaged in fishing) and recreational users within the site are also likely to be displaced.

667. Third party marine activities may also be displaced by cable laying activities within the provisional offshore cable corridor for short periods of time.

668. **Increased collision risk:** The displacement of transiting vessels from within the Norfolk Boreas site may lead to an increase in vessel-to-vessel collision risk with other passing traffic surrounding the site.

669. Experience from other developments shows that it is unlikely that vessels not associated with Norfolk Boreas would deliberately pass between on-going construction at the site, and would instead passage plan to avoid the site altogether. This displacement of vessels from within the site would reduce the surrounding sea room, and may lead to an increase in vessel-to-vessel encounters, which would increase the collision risk. In particular routeing within the IMO routeing measures may increase with vessels displaced from the Norfolk Boreas site.

670. Similarly, vessels deviating to avoid the cable laying activities may increase the vessel-to-vessel collision risk in and around the provisional offshore cable corridor.

671. There is also likely to be an increased collision risk from Norfolk Boreas construction vessels, and from those vessels involved in laying the export cables. Vessels associated with the construction would include large vessels restricted in their manoeuvrability (for example, heavy lift vessels, jack ups, or cable lay vessels). The vessels present on-site and within the provisional offshore cable corridor would create an additional collision risk to passing traffic, with the highest risk coming from the larger, less mobile vessels.

672. **Allision risk:** The physical presence of partially completed structures, or completed structures awaiting commissioning would create an increased allision risk to passing traffic, noting that there are pre-existing allision hazards within the site (namely the unmanned platform at the Davy Field, and the Met Mast).

673. There is also an increased risk of allision to any vessel not under command (NUC) within the Norfolk Boreas site boundary associated with emergency situations such as a machinery failure on-board. The risk of an NUC allision is highest where the site borders the IMO routeing measures, particularly the DWRs.

674. There is a particular risk to vessels actively engaged in fishing within the site, due to their increased exposure to the structures when compared to a passing vessel. It is noted that risks associated with fishing gear are considered in Section 2.10.

675. Certain types of foundation type (even when partially installed) proposed for Norfolk Boreas could also further increase or add frequency to allision risk. For example, floating foundations would pose an additional sub surface allision risk associated with the mooring lines, if used.

676. **Interaction with partially completed subsea cables:** Prior to completion of the Norfolk Boreas export and array cable installation, submarine cables may be unburied (or partially buried) on the seabed.

677. Any exposed cable creates a snagging risk to vessel anchors. This could lead to damage to the cables, or a low level risk to vessel stability. Gear snagging is considered in Section 2.10.

678. **Impacts on Emergency Response Resources:** Construction activities associated with the proposed project may diminish emergency response capability (including Search and Rescue (SAR) and pollution response) within the Norfolk Boreas site during construction. This would be due to an increase in incidents due to the windfarm; however these incidents are likely to be associated with Norfolk Boreas associated vessels and construction activities.

2.11.2.2 Potential impacts during operation

679. **Vessel routeing:** The review of the AIS data identified vessel routes intersecting the Norfolk Boreas site. These routes are likely to be displaced during the operational phase due to the wind turbine generators, and any other associated surface structures within the site. It should be noted that the affected routes are likely to have already been displaced during the construction phase.

680. The scale of this impact would depend on the number of structures installed, and their final positions within the site.

681. Routes used by large commercial vessels are likely to be the most affected, as such vessels would be expected to passage plan to avoid the site altogether. Smaller vessels (e.g., fishing or recreation) may still choose to transit through the site. It is assumed that access into the site from vessels requiring access to existing oil and gas infrastructure would be agreed by the relevant parties.

682. During periods of major maintenance in the operational phase, 500m safety zones may be employed around structures where work is being undertaken. These may cause further (temporary) displacement. Similarly, traffic may be displaced by vessels involved in cable maintenance.

683. **Displacement of third party marine activities:** Oil and gas vessels working in, and around the Norfolk Boreas site may be displaced by the presence of the wind farm structures. It is likely that all existing oil and gas infrastructure within the Norfolk Boreas site will be decommissioned by the time Norfolk Boreas is operational however if this is not the case access to existing oil and gas infrastructure may be required. Access agreements would be made between the relevant parties in this case.

684. Active fishing and recreational users may be displaced by the presence of the wind farm structures during the operational phase, however it is noted that smaller vessels are more likely to safely transit the area than larger commercial vessels.

685. During large scale maintenance activities, safety zones may be employed around the active work. These may cause more significant (albeit temporary) displacement to third party marine activities.

686. Third party marine activities may also be displaced by maintenance activities within the provisional offshore cable corridor for short periods of time.

687. **Increased collision risk:** The physical presence of the structures installed within the Norfolk Boreas site may displace oil and gas vessels, commercial shipping, fishing vessels and recreational vessels, leading to an increased vessel-to-vessel collision risk.

688. As part of the NRA process, the following (vessel-to-vessel) collision scenarios will be modelled:

- Base case without wind farm;
- Base case with wind farm;
- Future case without wind farm (assuming a 10% increase in traffic); and
- Future case with wind farm (assuming a 10% increase in traffic).

689. The future case increase may be altered from 10% during the NRA process if consultation feedback demonstrates that a change is considered necessary.

690. It is also noted that during periods of major maintenance, the presence of vessels working at the site or within the provisional offshore cable corridor creates an additional collision risk, particularly as it is likely that major maintenance would require large vessels restricted in manoeuvrability.

691. **Allision risk:** The physical presence of the completed wind farm structures would create an increased allision risk to passing traffic during the operational phase, noting that there are pre-existing allision hazards within the site (namely the unmanned platform at the Davy Field, and the met-mast).

692. There is also an increased risk of allision to any vessel NUC within the Norfolk Boreas site associated with emergency situations such as a machinery failure on-board. The risk of an NUC allision is highest where the site borders the IMO routeing measures, particularly the DWRs.

693. As during the construction phase, there is a particular risk to vessels actively engaged in fishing within the site, due to their increased exposure to the structures when

compared to a passing vessel. It is noted that risks associated with fishing gear will be considered within the commercial fisheries chapter.

694. Recreational vessels passing in the vicinity of the wind turbine generators would be exposed to a risk of blade / mast interaction which is dependent upon the clearance of the rotor blades in different tidal and sea conditions as well as the air draught of yachts using the area. This risk should be minimised through adequate clearance height (as per RYA requirements) and implementation of an emergency shutdown system of the rotor blades.

695. As part of the NRA process, the following (vessel-to-structure) allision scenarios will be modelled based on a realistic worst case layout:

- Base case with wind farm
- Future case with wind farm (assuming a 10% increase in traffic); and
- Vessels not under command.

696. Certain types of foundation type proposed for Norfolk Boreas could also further increase or add frequency to allision risk. For example, floating foundations would pose an additional sub surface allision risk associated with the mooring lines. A worst case foundation type will be considered within the NRA.

697. **Interference with marine navigational equipment:** The structures and cables installed within the site boundary may impact on the effectiveness of marine navigational equipment on-board passing traffic.

698. Large surface structures (e.g., the wind turbine generators) may produce radar interference effects on passing vessels, including vessels using the IMO Routeing Measures either side of the site. This may lead to an increased vessel-to-vessel collision risk, especially in periods of reduced visibility, when a vessel will rely on navigational equipment more than when conditions are favourable.

699. The EMF created by buried direct current cables has the potential to create interference on a vessel’s magnetic compass. This is expected to impact the most upon smaller recreational vessels, as some such vessels may lack more sophisticated navigational equipment on-board.

700. **Interaction with subsea cables:** Cables associated with Norfolk Boreas would be suitably protected, either via burial, or through other forms of external protection.

701. Any exposed cable would create a snagging risk to vessel anchors which could lead to damage to the cables, or a low level risk to vessel stability. This impact could be associated with both the export and array cables. Gear snagging is considered in Section 2.10.

702. Under keel clearance associated with protection methods used for non-buried cables may also pose a risk depending on the water depth and types of passing traffic.

703. **Impacts on emergency response resources:** Operational activities associated with Norfolk Boreas may diminish emergency response capability (including SAR and pollution response) within the southern North Sea area during construction. This would be due to an increase in incidents due to the windfarm; however these incidents are likely to be associated with Norfolk Boreas associated vessels.

704. Final layout design will also need to be considered as part of the NRA process to ensure that is does not impact the ability of SAR providers to undertake activities within the array area.

2.11.2.3 Potential impacts during decommissioning

705. **Vessel routeing:** The review undertaken on the AIS in the vicinity of the Norfolk Boreas site identified certain routes are likely to be displaced during the decommissioning phase due to the associated vessel presence, and the potential for safety zones. It is noted that the affected routes are likely to have already been displaced during the construction phase, and to some extent, the operational phase.

706. If any cable is required to be removed as part of the decommissioning process, the associated vessel presence may also cause route deviation within the provisional offshore cable corridor. It is noted that it is likely that the export and array cables would be left in situ.

707. **Displacement of third party marine activities:** During the decommissioning phase, it is likely that the associated vessel presence and the employment of safety zones would impact upon any third party marine activities occurring in, or near the Norfolk Boreas site. This could include oil and gas activities, active fishing, or recreational use.

708. It is noted that the Davy platform located within the site is extremely likely to have been decommissioned prior to the Norfolk Boreas decommissioning.

709. If any cable is required to be removed as part of the decommissioning process, the associated vessel presence could also displace third party marine activities within the provisional offshore cable corridor. It is noted that it is likely that the export and array cables would be left in situ.

710. **Increased collision risk:** The presence of vessels and safety zones associated with the decommissioning activities at Norfolk Boreas have the potential to displace vessel traffic, leading to an increase of vessel-to-vessel collision risk in the area surrounding the site.

711. The vessels associated with the decommissioning also create an additional collision risk for passing vessels, particularly as large vessels restricted in their manoeuvrability are likely to be required.

712. If any cable is required to be removed as part of the decommissioning process, the associated vessel presence may also displace traffic, increasing the vessel-to-vessel collision risk within and around the provisional offshore cable corridor. Cable removal would require the use of vessels which are restricted in their manoeuvrability, which would also pose an increased collision risk to passing traffic. It is noted that it is likely that the export and array cables would be left in situ.

713. **Allision risk:** Any partially decommissioned structures within the site would create an allision risk to passing traffic. The scale of this impact would depend on the extent to which the existing structures are dismantled; however it is assumed, as with other developments, that the structures would be removed to a point where they do not pose a risk to passing traffic.

714. **Interaction with partially decommissioned subsea cables:** Prior to completion of the decommissioning of the Norfolk Boreas cable network, submarine cables may be unburied (or partially buried) on the seabed. This impact could be associated with both the export and array cables. It is also likely that cables would be left in situ and would therefore need to monitored as any exposed cable could create a snagging risk to vessel anchors.

715. **Impacts on emergency response resources:** Decommissioning activities associated with Norfolk Boreas may diminish emergency response capability (including SAR and pollution response) within the southern North Sea area during the decommissioning phase. This would be due to an increase in incidents due to the windfarm; however these incidents are likely to be associated with Norfolk Boreas vessels.

2.11.2.4 Potential cumulative impacts

716. **Interaction with other wind farms:** When considered together with other wind farm developments (including those in the former East Anglia Zone (notably Norfolk Vanguard), other UK areas, and Europe), the Norfolk Boreas site has the potential to alter vessel routeing in the southern North Sea. An assessment of cumulative, in-combination, and transboundary shipping and navigation impacts will be carried out as part of the NRA process, which will be reported in the ES.

717. **Interaction with other marine activities:** In-combination effects will be considered within the NRA process for shipping and navigation receptors, including other oil and gas developments. It should be noted that fishing, recreational and marine aggregate dredging would be considered as part of the baseline assessment.

2.11.2.5 Transboundary Impact Assessment

718. Similarly to the cumulative impacts, the NRA and ES would consider transboundary offshore wind developments with regards to vessel routeing and international ports. Again it should be noted that fishing, recreation and marine aggregate dredging impacts, although having the potential to be internationally owned or located, would be considered as part of the baseline assessment.

2.11.2.6 Summary of potential impacts

Table 2.25 Summary of potential impacts relating to shipping and navigation

Potential impacts	Construction	Operation	Decommissioning
Vessel routeing	✓	✓	✓
Displacement of Third Party marine activities:	✓	✓	✓
Increased collision risk	✓	✓	✓
Allision risk	✓	✓	✓
Interference with marine navigational equipment	X	✓	X
Interaction with subsea cables	✓	✓	✓
Impacts on Emergency Response Resources	✓	✓	✓
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓

Scoped in (✓) and scoped out (X)

2.11.3 Mitigation

719. There are a range of mitigation measures that could be implemented to reduce the shipping and navigation impacts discussed above (and any further impacts identified as part of the NRA process). Potential measures that could be applied are listed below, as appropriate to the level and type of risk determined during the EIA:

- Compliance with MCA (Maritime and Coastguard Agency) Guidance Note 543 (M+F) (MGN 543 M+F) including site and turbine design;
- Appropriate and clear marking on Admiralty Charts;
- Promulgation of information and warnings through notices to mariners and other appropriate media;
- Continuous watch by multi-channel VHF, including Digital Selective Calling;
- Buoyed construction / decommissioning areas and safety zones of appropriate configuration, extent and application to specified vessels;
- Appropriate means to notify and provide evidence of the infringement of safety zones;

- Marine Traffic Control for project vessel during construction;
- Creation of an Emergency Response Co-operation Plan with the relevant Maritime Rescue Co-ordination Centre from construction phase onwards;
- Suitable array cable and export cable protection;
- Marking and lighting the site in accordance with General Lighthouse Authority requirements (which includes a system of routine inspection and maintenance of lights and marks);
- Wind turbine rotor blade tip clearance at a minimum 22m above Mean High Water Springs; and
- Vessel nomination as guard vessel during construction / decommissioning activities.

2.11.4 Approach to assessment and data gathering

2.11.4.1 Data sources

720. Where appropriate, the NRA will consider the data sources given in Table 2.24 within a study area covering 10nm around the Norfolk Boreas site. However, given that a deviation to a vessel route may have impact beyond a 10nm threshold, the cumulative and transboundary impact assessments may be considered over a wider geographical area.

721. The primary input to the NRA and ES will be up-to-date marine traffic survey data, including AIS, radar, and visual observations. This data will cover a minimum of 28 days, account for seasonal variations, and be collected within 24 months of submission. It is anticipated that this data will be collected via dedicated vessel surveys, with additional AIS data from the Met Mast and shore based receivers incorporated if appropriate.

722. AIS is required to be fitted aboard all vessels engaged on international voyages of 300 gross tonnage (GT) and upwards, cargo vessels of 500GT and upwards not engaged on international voyages and passenger vessels (carrying 12 or more passengers) irrespective of size built on or after 1st July 2002. It is also mandatory for fishing vessels over 15m to carry AIS. Vessels not required to carry AIS may still broadcast voluntarily via AIS Class A or B (a cost efficient version for non-mandatory vessels) and would also be recorded and assessed as part of the NRA and ES.

723. Vessels within the Norfolk Boreas site not broadcasting via AIS will be recorded where possible by radar and visual observation.

724. Consultation will be undertaken with relevant navigational or cumulative stakeholders, in order to obtain supplementary information. Parties consulted will include:

- Maritime and Coastguard Agency;
- MoD;
- Civil Aviation Authority;
- Trinity House;
- Chamber of Shipping;
- Royal National Lifeboat Institute;
- Royal Yachting Association;
- Cruising Association;
- Relevant port authorities (e.g., Great Yarmouth, Immingham);
- Regular vessel operators identified from the data sources;
- Local stakeholders (e.g., yacht clubs);
- National Federation of Fishermen's Organisation; and
- Transboundary or cumulative receptors identified as part of the assessment.

2.11.4.2 EIA methodology

725. The assessment methodology used in the NRA and ES will primarily be based on the following guidance:

- MCA MGN 543 (M+F) Offshore Renewable Energy Installations Guidance on UK Navigational Practice, Safety and Emergency Response Issues (MCA, 2016);
- MCA Methodology for Assessing the Marine Navigational Safety Risks of Offshore Renewable Energy Installations (MCA, 2015).

726. Other guidance considered during the assessment will include:

- IMO guidelines for Formal Safety Assessment (IMO, 2002);
- MCA Marine Guidance Note MGN 372 (M+F) (MGN 372 M+F) Offshore Renewable Energy Installations (OREIs) Guidance to Mariners Operating in the Vicinity of UK OREIs (MCA 2008);
- DECC Guidance Notes on Safety Zones (DECC, 2011c);
- Royal Yachting Association (RYA) – The RYA's Position on Offshore Energy Developments: Paper 1 – Wind Energy (RYA, 2015); and
- International Association of Lighthouse Authorities (IALA) – O-139 the Marking of Man-Made Offshore Structures (IALA, 2013).

727. The MCA require that their Methodology (MCA, 2015) is used to prepare an NRA, including an IMO Formal Safety Assessment (FSA). This methodology differs from the EIA, however the approaches are broadly similar. Both produce an assessment of the risks posed by a development to navigation, and present the mitigation required to minimise these risks.

728. The NRA would have a baseline data gathering phase broadly similar to the EIA, which would include marine traffic surveys, desk-based assessment and consultation to allow the identification of higher risk areas. This phase is then followed by the FSA, in line with the IMO FSA Process (IMO, 2002) and the DECC guidance (DECC, 2013).

729. The results of the baseline assessment will be used to identify the potential impacts arising from the construction, operation, and decommissioning of the Norfolk Boreas site relevant to shipping and navigation. Where a pathway exists through which an impact can be transmitted to a receptor, the overall “severity of consequence” is determined. This process requires a degree of subjectivity and professional judgement, therefore the assessment will incorporate the output of a hazard workshop involving national and local stakeholders relevant to shipping and navigation, and the lessons learnt from existing developments.

730. Following completion of the NRA, impacts that have a clear pathway of effect on receptors would be considered as part of the FSA process and would therefore be detailed within the ES.

731. The assessment of potential risks and impacts on shipping and navigation would also be made with specific reference to the relevant National Policy Statement (NPS). Those relevant to shipping and navigation are:

- Overarching NPS for Energy (EN-1) (July 2011); and
- NPS for Renewable Energy Infrastructure (EN-3) (July 2011).

732. The MCA Guidance MGN 543 highlights issues that need to be taken into consideration when assessing the impact on navigational safety from offshore renewable energy developments in the UK. Specific annexes of the guidance that address particular issues include:

- Annex 1: Site position, structures and safety zones;
- Annex 2: Developments, collision avoidance and communications;
- Annex 3: MCA’s wind farm shipping template for assessing wind farm boundary distances from shipping routes;
- Annex 4: Safety and mitigation measures recommended for OREI during construction, operation and decommissioning; and
- Annex 5: SAR and emergency response matters.

2.12 Offshore archaeology and cultural heritage

2.12.1 Baseline

2.12.1.1 Data sources

733. Information to support the scoping study (and the EIA) for Norfolk Boreas has primarily come from the ZEA for the former East Anglia Zone (EAOW, 2012a) and data sourced from OceanWise (OceanWise, 2017). Geophysical data was collected from the provisional offshore cable corridor during the Norfolk Vanguard offshore survey campaign in autumn 2016 and this data is currently being subjected to archaeological analysis by Wessex archaeology. However the analysis has not been completed in time to inform this Scoping report.

734. The ZEA Archaeological features were identified through a combination of interpretation of geotechnical and geophysical surveys, records held by national inventories and other secondary sources. The baseline data has been supplemented by records of wrecks and obstructions held by the United Kingdom Hydrographic Office (UKHO) obtained through OceanWise.

2.12.1.2 Features

735. Archaeological features include maritime sites (wrecks and wreckage from prehistory to the present), aviation sites and submerged prehistoric archaeological sites (Figure 2.22).

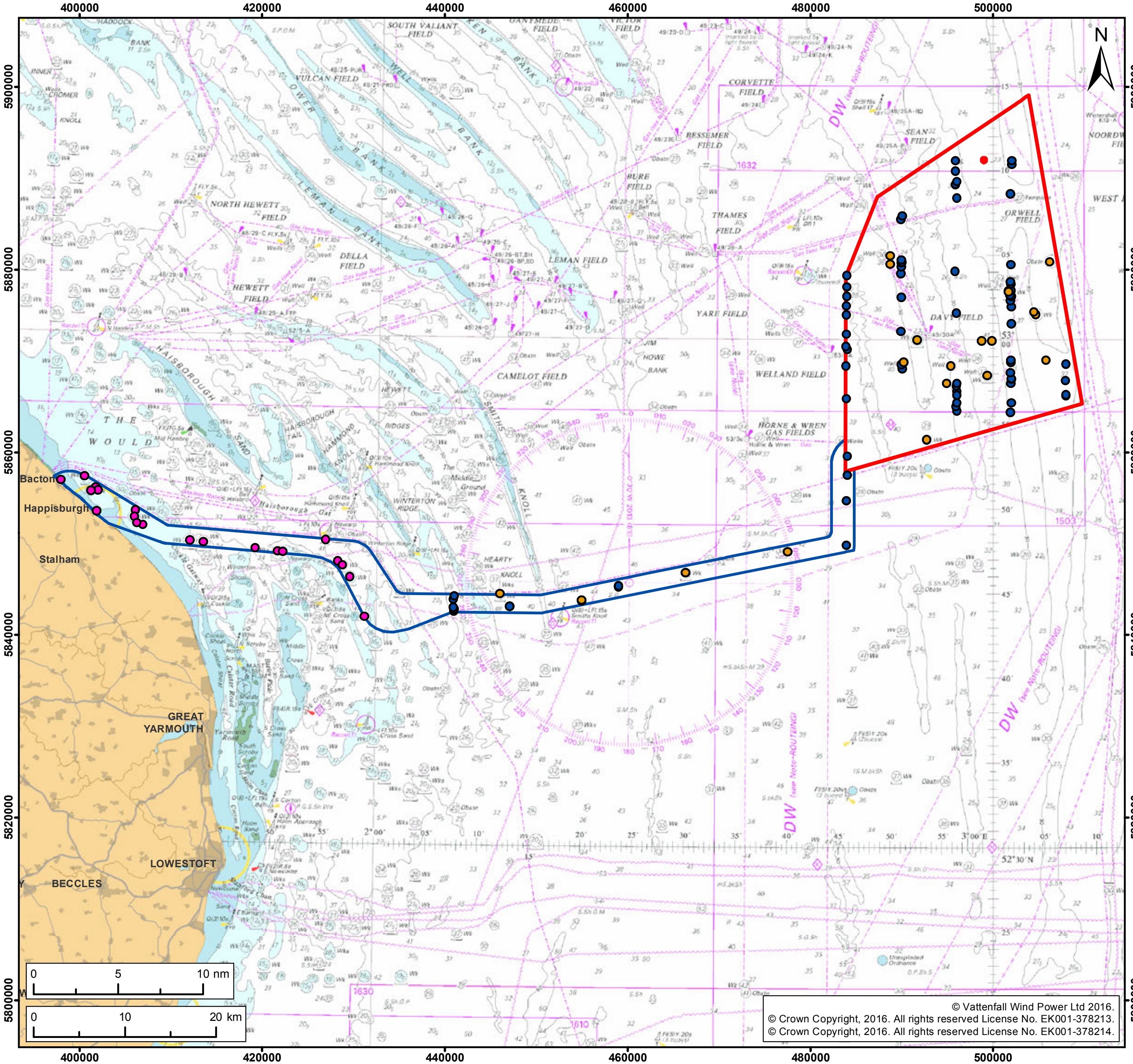
736. There are no designated sites or known prehistoric sites within the offshore project area. The baseline characterisation of the former East Anglia Zone has identified the presence of prehistoric landscape features and the potential for the presence of prehistoric sites and finds to be present (EAOW, 2012a).

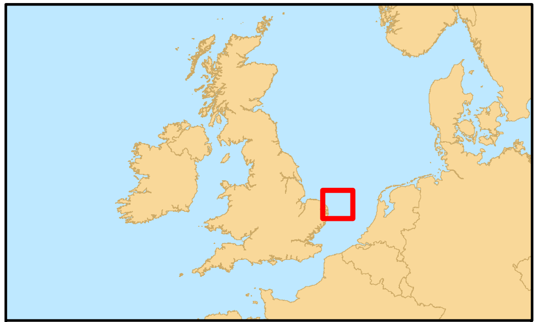
737. Within the Norfolk Boreas site there are 15 sites identified in the ZEA as historic records of possible archaeological interest. The locations of these records do not correspond to data lines assessed for the ZEA and as such have not yet been assessed using geophysical data. There are, however, 61 additional geophysical anomalies that have been seen in the ZEA data assessment (EAOW, 2012) and have been classified as being of uncertain origin and possible archaeological interest.

738. Within the provisional offshore cable corridor there are 4 sites identified in the ZEA as historic records of possible archaeological interest that are yet to be assessed using geophysical data and 11 additional geophysical anomalies. Beyond the boundary of the former East Anglia Zone area (and hence the ZEA baseline data coverage) there are 19 wrecks and one further obstruction recorded in the OceanWise data set.

739. In addition to these identified sites there is potential for further maritime or aviation sites to be present either on the seafloor or buried within seabed sediments.

740. To determine the total archaeological resource within the offshore project areas, geophysical data from site specific geophysical surveys and geotechnical site investigations will be reviewed alongside previously collected and other pertinent data sets.





Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast
- Additional Geophysical Anomoly (ZEA)[1]
- Historic record of possible archaeological interest with no corresponding geophysical anomaly (ZEA)[1]
- Wrecks and Obstruction [2]

[1] Wessex Archaeology, 2013.
[2] OceanWise, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Known Wrecks and Additional Geophysical Anomalies

Figure: 2.22 Drawing No: PB5640-102-026

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:600,000
01	21/02/17	JE	DT	A4	1:600,000

Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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2.12.2 Potential impacts

741. Impacts upon archaeological assets are by their nature different from those upon ecological or other human environmental receptors. Assets would either be damaged or destroyed during construction if there is a pathway for impact. This impact would be permanent and there would be no way to replace the resource, as such the impact would be of major significance.

742. Therefore for this topic, impacts would largely be prevented through appropriate layout of the wind farm infrastructure. Wherever possible, infrastructure would be sited such that it avoids possible conflict with archaeological assets. In any case, from the perspective of a safe functioning plant it is necessary to avoid archaeological assets (particularly those made of metal) that could damage equipment.

2.12.2.1 Potential impacts during construction

743. **Direct physical disturbance:** The installation of wind turbine foundations, potential scour protection and cables have the potential to cause direct disturbance and damage to known and undiscovered artefacts of marine archaeological significance. Dependent upon the design of installed features and method of installation, there may be a requirement for seabed preparation prior to installation which also has the potential to cause direct disturbance. Similar impacts may occur on surficial and shallow archaeology as a result of anchoring and jack-up activities associated with the construction works offshore and nearshore.

744. The Happisburgh landfall zone is particularly well known for its archaeological finds especially within Cromer Forest Bed Deposits. Potential impacts to known and unknown archaeological features are further discussed in Section 3.8 and the impacts at landfall will mainly be considered within the Onshore Archaeology and Cultural Heritage chapter of the EIA. However given the potential use of a long HDD (Section 1.5.6.4) impacts in the intertidal and shallow subtidal will be considered within the offshore Archaeology and cultural heritage chapter.

745. Archaeological review of site specific geophysical and geotechnical datasets will ensure that known archaeological assets are avoided as part of the design process, with the potential for Archaeological Exclusion Zones (AEZs) within the development area.

746. With regard to unknown assets (for example those discovered during pre-construction or construction activity), procedures will be developed in conjunction with stakeholders to produce suitable mitigation measures for these. Implementation of these mitigation measures which are employed as standard across the industry should reduce impacts to a level where they are not significant.

This would include adherence to the Offshore Renewables Protocol for Archaeological Discoveries (ORPAD) (The Crown Estate, 2014) which allows those working on a project to report unexpected discoveries throughout the project lifecycle.

747. **Indirect physical disturbance:** As marine archaeological assets have often survived as a result of a stable environment, changes to hydrodynamic and sedimentary process could trigger renewed degradation as a result of changes in physical, biological or chemical processes. Thus changes in sediment transport or localised scour caused by installation of the windfarm infrastructure could have direct and indirect impacts upon marine archaeological assets. Furthermore, if seabed levelling is required for foundation or cable installation, material may be deposited within the windfarm site. This could result in burial of archaeological features and changes to the sediment transport regime.

748. The archaeological assessment will therefore need to take into account seabed levelling and disposal of material and the results of physical processes modelling and assessment to determine the likelihood and significance of indirect impacts occurring.

749. As with direct impacts the offshore archaeology and cultural heritage, the EIA will consider the indirect impacts within the intertidal and shallow subtidal at the landfall location.

750. **Indirect disturbance of setting:** In assessing impacts to the historic environment it is also necessary to consider the setting of heritage assets defined as ‘the surroundings in which an asset is experienced’ (Historic England, 2015). Setting includes visual considerations and other environmental factors such as noise, dust and vibration, spatial associations, and consideration of the historic relationship between places.

751. As set out in the Section 1.2 the proposed project is located an approximate distance of 72km from the coast, therefore would not be viewed from the shore, it is also well beyond the 35km limit of visual significance identified in DTI guidance (DTI, 2005). It is therefore proposed that impacts to the setting of onshore heritage assets from the offshore wind farm should be scoped out from further consideration within the EIA. There would be potential for temporary impacts relating to the presence of vessels associated with the installation of offshore export cables close to the coast and activities at the landfall. These potential impacts would be assessed in respect of the setting of onshore heritage assets along the coast.

752. With respect to the setting of offshore heritage assets, potential impacts associated with visual considerations and factors such as noise, dust and vibration (i.e. how an asset is experienced) are of limited relevance for submerged assets. However, it is

important to consider setting in terms of spatial associations and the historic relationship between places and as part of the historic character of the seascape. For example, the Norfolk Vanguard scoping response from Historic England explained that there is a connection between the seabed area and the site of Second World War shipping casualties and that from further surveys it will be possible to elucidate such special features within a wider battlefield context and setting. More generally there are known intertidal and coastal archaeological sites of considerable importance within the project area, such as the footprints at Happisburgh (see Section 3.8 for further detail). The setting of these sites may be affected by temporary nearshore landfall works during construction. Therefore the setting of heritage assets for offshore archaeology will be scoped into the assessment.

753. The assessment will consider the capacity for the setting and character of the historic seascape to accommodate change associated with the construction of Norfolk Boreas. This will take account of the fact that as set out in Section 2.11, construction activities and additional vessel traffic would occur in the context of one of the busiest shipping channels between south-east England and mainland Europe and there is already an influence on the seascape from the existing features such as gas rigs and their service vessels within the site.

2.12.2.2 Potential impacts during operation

754. **Direct physical disturbance:** Direct impacts during operation could occur as a result of catenary mooring systems from floating foundations, where these are used, or due to routine maintenance activities, if these repeatedly disturb the seabed, however much of the areas either occupied by the floating foundations or maintenance vessels anchoring systems or jack up legs would already have been disturbed during construction there would be limited scope for further impact. Therefore any impacts are likely to be of lower magnitude than during construction. Exceptional maintenance activities have the potential to have a more significant impact on archaeological assets (for example if a cable needs to be replaced). However, given that known assets would have been avoided in the original layout, there would be limited potential for impacts from this source.

755. **Indirect physical disturbance:** Changes to hydrodynamic and sedimentary process during the operational phase could trigger renewed degradation as a result of changes in physical, biological or chemical processes. Thus changes in sediment transport or localised scour could have indirect impacts upon marine archaeological assets. The archaeological assessment will therefore need to take into account the results of physical processes modelling and assessment to determine the likelihood and significance of indirect impacts occurring.

756. **Indirect disturbance of setting:** It is proposed that the potential impacts of the offshore wind farm on the setting of onshore heritage assets should be scoped out from further consideration within the EIA. The distance from the shore to the offshore wind farm precludes visibility from coastal heritage assets. As set out above for construction, the setting of offshore heritage assets will be considered alongside a wider consideration of the capacity of the historic seascape character to accommodate change associated with the presence of Norfolk Boreas infrastructure.

2.12.2.3 Potential impacts during decommissioning

757. Impacts arising during the decommissioning are expected to be similar in nature but of a lesser magnitude than those experienced during the construction phase. There would be a temporary impact from the activities on site to remove structures, but this would be of relatively short duration. The establishment of the archaeological environment baseline and subsequent assessment of impacts will result in the production of a detailed map of features of archaeological significance. This will be further enhanced by the recording of currently unknown features during construction thus ensuring that these features could be avoided if they or not impacted upon further. This will facilitate the decommissioning works while minimising any impacts upon features of archaeological significance.

2.12.2.4 Potential cumulative impacts

758. Individual, known archaeological receptors within the Norfolk Boreas site would not be subject to significant direct impacts from other known plans or projects as they are discrete and there would be no physical overlap of different infrastructure. Norfolk Boreas would share a cable route with Norfolk Vanguard and sequential construction would be taking place, resulting in potential cumulative impacts, the offshore cable route has been chosen to avoid sites of archaeological interest and therefore these impacts should be limited. Given that indirect impacts (i.e. impacts from scour, catenary mooring systems, disposal or sediment transport changes) are likely to be highly localised and small scale (based upon physical process assessment and subsequent archaeological assessment undertaken for East Anglia ONE (EAOW, 2012b) and East Anglia THREE (EATL, 2015)) it is not considered likely that there are pathways for cumulative indirect impacts.

759. There is potential for cumulative impacts through the additive effect of small impacts across many projects, although to a great extent implementation of mitigation on each project should reduce this to impacts upon unknown assets. Each project will have an agreed Written Scheme of Investigation (WSI) which will cover the approach to unknown assets.

760. Although individual assets are discrete, taken together they could have collective

heritage value, therefore multiple impacts upon similar assets could have a cumulative additive impact. In addition there is potential for multiple developments to affect the larger-scale archaeological features such as palaeolandscapes and to affect the setting of heritage assets and historic landscapes/seascapes.

761. There is potential for significant cumulative effects at landfall as across the Norfolk Vanguard and Norfolk Boreas projects there would be up to 12 HDDs that could emerge within the intertidal zone. This will be assessed within the EIA.

2.12.2.5 Transboundary impact assessment

762. Transboundary impacts may occur where a planned activity results in an effect which crosses national boundaries. For offshore archaeology this could comprise:

- Wrecks or aircraft of non-British, European nationality subject to impact from development which may fall within the jurisdiction of another country;
- Indirect impacts to heritage assets in neighbouring sea areas if cumulative effects of changes to physical processes extend across borders; and
- Potential for developments, individually and cumulatively, to impact palaeo-landscapes and historic seascapes which may extend across borders.

763. These will be considered further in the EIA as appropriate.

2.12.2.6 Summary of potential impacts

Table 2.26 Summary of potential impacts relating to offshore archaeology and cultural heritage

Potential impacts	Construction	Operation	Decommissioning
Direct physical disturbance	✓	✓	✓
Indirect physical disturbance	✓	✓	✓
Indirect disturbance of setting (offshore)	✓	✓	✓
Indirect disturbance of setting (landfall)	✓	x	x
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓

Scoped in (✓) and scoped out (x)

2.12.3 Mitigation

764. Impacts to both known and potential archaeological receptors are addressed through the application of embedded mitigation. Known archaeology features of importance are generally avoided through the application of AEZs and subsequent micro-siting of infrastructure on the seabed.

765. Unavoidable impacts to potential receptors would be addressed through a series of agreed mitigation measures to deal with the discoveries once impacts have occurred

and been identified. These measures would be set out in the project WSI which would clarify the methodologies to address unavoidable impacts associated with the worst case scenario (project design envelope) in accordance with Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewables Projects (The Crown Estate, 2010).

766. Through the consenting process the WSI would be agreed as a point in time document as a means to ensure enforcement of the agreed mitigation measures through the DCO and DML. Specific methodological requirements and any required revisions (e.g. to the nature and extent of AEZs) would be addressed through Method Statements, as required, to underpin the delivery of the WSI.

2.12.4 Approach to assessment and data gathering

767. The offshore archaeology and cultural heritage assessment will address both marine areas and the intertidal area below MHWS. The onshore archaeology cultural heritage assessment (Section 3.8) will address terrestrial areas above MHWS.

768. During summer/autumn 2017 the Applicant will be undertaking geophysical and geotechnical surveys within the Norfolk Boreas site (data within the provisional offshore cable corridor having been acquired previously through the Norfolk Vanguard survey campaign). In order to ensure that the data produced as a result of this campaign will be capable of supporting archaeological interpretation, the Applicant consulted on, and agreed the approach with Historic England.

769. The site specific geophysical survey, including multibeam echo sounder, side scan sonar, magnetometer and sub bottom profiler data, will result in full geophysical coverage of the Norfolk Boreas site. Processing and interpretation of data will be carried out by Wessex Archaeology, a qualified and experienced archaeological contractor, and will be carried out in accordance with industry good practice as set out in available guidance such as Marine Geophysics Data Acquisition, Processing and Interpretation (Historic England, 2013). The results of the assessment will inform the archaeological desk-based assessment in support of the ES for Norfolk Vanguard.

770. Geotechnical site investigations comprise cone penetrometer tests (CPTs) and vibrocores within the Norfolk Boreas site. Geotechnical investigations within the provisional offshore cable corridor were undertaken as part of the Norfolk Vanguard survey campaign in 2016 and this data is currently being analysed for geoarchaeological interest. A desk-based review of which cores should receive further detailed analysis has been completed and further analysis is due for completion by Wessex Archaeology during quarter 2/3 of 2017.

771. Following the 2017 survey campaign the CPT and vibrocore logs will be subject to

review and further assessment and analysis of the cores, including sub-sampling, will be carried out if deposits with archaeological potential are identified. The results of the assessment, along with other relevant archaeological data and geophysical assessment, will inform the production of a sedimentary deposit model of the buried deposits and landscape features present within the study area. All geoarchaeological assessment will be carried out in accordance with Offshore Geotechnical Investigations and Historic Environmental Analysis – Guidance for the Renewable Energy Sector (Gribble and Leather, 2011).

772. In addition to these site specific investigations, an archaeological desk-based assessment will be undertaken which will be informed by a range of primary and secondary sources including:

- Records of wrecks and obstructions data from the UKHO (including 'dead' and salvaged wrecks that are no longer charted as navigational hazards);
- Records held by the National Record of the Historic Environment, including documented losses of vessels;
- Records held by the Norfolk Historic Environment Record; and
- Existing archaeological studies and published sources.

773. The Historic Seascape Character (HSC) of coastal and marine areas around England has been mapped through a series of projects funded by Historic England. The programme uses GIS to map data that can be queried to identify the key cultural processes that have shaped the historic seascape within a given area. Impacts to the historic seascape may occur where a proposed project or activity results in change to the historic character.

774. Norfolk Boreas falls within the study area for the HSC for East Yorkshire to Norfolk undertaken by Newcastle University in 2014. A review of the HSC for the area will be undertaken in order to identify the key cultural processes that have shaped the historic seascape and to inform the assessment of how that seascape may change with the construction of Norfolk Boreas.

775. The potential impacts from Norfolk Boreas will be assessed using standard methodologies and in accordance with available standards and guidance including:

- JNAPC Code of Practice for Seabed Development (Joint Nautical Archaeology Policy Committee and The Crown Estate, 2006);
- Historic Environment Guidance for the Offshore Renewable Energy Sector (Wessex Archaeology, 2007);
- Guidance for Assessment of Cumulative Impacts on the Historic Environment from Offshore Renewable Energy (Oxford Archaeology, 2008); and
- Chartered Institute for Archaeologists' Standard and Guidance for Historic

Environment Desk-Based Assessments (2014a) and Code of Conduct (2014b).

2.13 Aviation and Radar

776. This section covers civil and military aviation and radar by considering the proximity to and operations of civil airports, the types of radar operating around the East Anglia coast, Civil Aviation Agencies, helicopter operations and MoD operations.

777. The potential impacts arising from the proposed project on these activities are considered with a summary presented of the relevant UK guidance, methodologies and best practice that would be applied in undertaking the EIA.

2.13.1 Baseline

778. The airspace within / above and surrounding the Norfolk Boreas site is used both by civil and military aircraft.

2.13.1.1 Airports

779. The nearest UK airport to the Norfolk Boreas site is Norwich Airport, approximately 90km from the nearest western point of proposed project. Amsterdam Schiphol Airport is approximately 115km from the eastern boundary of Norfolk Boreas.

2.13.1.2 International Air Traffic Services

780. The world is divided into Flight Information Regions (FIR) defining Air Traffic Services (ATS) provision responsibility for aircraft. The boundary between the London FIR (under the regulation of the UK Civil Aviation Authority (CAA)) and Amsterdam FIR (under the regulation of the Dutch Aviation Authority (ILT)) runs to the south-east of Norfolk Boreas. Norfolk Boreas is wholly within the UK FIR.

2.13.1.3 En-route services

781. National Air Traffic Services En Route plc (NERL) provides en-route civil air traffic services within the London FIR, except where responsibility for air traffic services has been formally delegated to the service provider in the Netherlands, the Luchtverkeersleiding Nederland (LVNL). LVNL provides ATS in the Amsterdam FIR and there are cross-FIR boundary arrangements in the area of Norfolk Boreas.

782. The Norfolk Boreas site lies beneath a volume of airspace delegated to LVNL. In this delegated airspace (Flight Level 175 (17,500ft) to Flight Level 245 (24,500ft)), LVNL is responsible for providing ATS. Below and above the delegated airspace, NERL is responsible for providing ATS.

783. A National Air Traffic Services (NATS) Technical and Operational Assessment (TOPA) was completed by NATS during 2015 (NATS, 2015). Norfolk Boreas would be

theoretically detectable by the Cromer Primary Surveillance Radar (PSR) and cause false radar plots (clutter) to be produced, causing unacceptable interference to the PSR. Mitigation has been identified and parties are working closely together to ensure it is implemented prior to construction. In addition, the results of the TOPA indicated that no impact is anticipated on NATS navigational aids or radio communication infrastructure.

784. The Norfolk Boreas site lies beneath a volume of delegated airspace where en-route air traffic services are provided by LVNL. During the East Anglia Zone Appraisal Process, LNVL confirmed that none of the PSR systems used by LVNL have radar line of sight to Norfolk Boreas, nor would its North Sea Wide Area Multilateration and Automatic Dependent Surveillance–Broadcast systems be affected.

2.13.1.4 Military airfields

785. There are four Royal Air Force (RAF) stations located in the East Anglian region (Honington, Marham, Lakenheath and Mildenhall), and a single Army Air Corp base at Wattisham. Although all of these military bases are located more than 130km away from the Norfolk Boreas site, aircraft operating from any of these bases may transit through or within the airspace above the Norfolk Boreas site.

2.13.1.5 Air Defence Radar (ADR)

786. The nearest Air Defence Radar (ADR) to Norfolk Boreas is the TPS77 type ADR located at RAF Trimingham, North Norfolk. The majority of the Norfolk Boreas site would be within radar coverage and theoretically detectable by this ADR. The TPS77 ADR has an inherent resilience to wind turbine generators induced clutter through the use of pulse Doppler processing; however, where the inherent radar performance is not considered to be satisfactory for ADR purposes, the TPS77 has an enhanced signal processing capability which enables the implementation of a Non-Automatic Initiation Zone. A technical solution / mitigation would be agreed with the UK MoD prior to construction (as has been completed for the Greater Wash Wind Farms).

787. During the East Anglia Zone Appraisal Process, the Netherlands Ministerie van Defensie confirmed that turbines placed in the zone would not affect military operations for the Netherlands. This position will be re-confirmed as part of the EIA process.

2.13.1.6 Military training areas

788. The offshore project does not lie within, or underneath, any military training areas (including Air to Air Refuelling Areas).

2.13.1.7 Helicopter Main Routes (HMR)

789. There are a number of Helicopter Main Routes (HMRs) in the vicinity of the Norfolk Boreas site. HMRs 446 and KZ46 (a Dutch HMR) pass through the proposed project area crossing the Thames and Leman Bank offshore platforms. HMRs have no defined lateral dimensions, although CAA Civil Aviation Publication (CAP) 764 CAA Policy and Guidelines on Wind Turbines (CAA, 2016a) states that 2NM either side of the route centreline should ideally be kept obstacle free. However, it is not mandatory for helicopters to use established HMRs. When operating in good weather conditions, Visual Meteorological Conditions, helicopters may take a more direct route to their destination point.

2.13.1.8 Offshore oil and gas installations

790. In order to help achieve a safe operating environment, a consultation zone of 9nm radius (CAA, 2016a) exists around offshore helicopter installations. This consultation zone is not considered a prohibition on wind turbine generator development within a 9 nm radius of offshore operations but a trigger for consultation between the platform operators, the offshore helicopter operators, the operators of existing installations and wind developers to determine a solution that would maintain safe offshore helicopter operations. The eight platforms considered in which consultation will be completed are detailed in Table 2.27 below.

Table 2.27 Approximate Platform Coordinates (Degrees, Minutes, Seconds format)

Platform	Operator	Latitude	Longitude	Approx. Distance to Closest Boreas Boundary
Welland	Perenco UK	52 59 04N	002 44 07E	1NM / 1.85km
Davy	Perenco UK	53 00 16N	002 25 341E	Within Boundary
Sean R	Shell UK	53 13 31N	002 49 34E	2NM / 3.71km
Sean P	Shell UK	53 11 18N	002 51 37E	0.5NM / 0.9km
Thames A	Perenco UK	53 05 01N	002 32 44E	8NM / 14.8km
Corvette	Shell UK	53 13 52N	002 37 17E	8NM / 14.8km
Inde 23C	Perenco UK	53 18 24N	002 33 56E	9NM / 16.6km
Inde 23D	Perenco UK	53 18 06N	002 29 55E	9NM / 16.6km

791. The basic requirement of the 9 NM consultation zone is to provide airspace for the safe operation of helicopter instrument approaches in poor weather conditions where a low visibility approach profile is needed. In addition, the zone provides a safe area for helicopters to carry out a Missed Approach Procedure. The Norfolk

Boreas boundary would extend into 9NM consultation zones where established around the platforms listed in Table 2.27.

792. When on an operational mission, SAR aircraft are not constrained by the normal Rules of the Air, and operate in accordance with their Aircraft Operator Certificate, which allows them total flexibility to manoeuvre using pilot's best judgement.

793. An Emergency Response Co-operation Plan (ERCoP) will be compiled in conjunction with the Maritime and Coastguard Agency (MCA).

2.13.1.9 Meteorological office radar

794. In general terms, the interruption of a weather radar beam by any obstruction could result in a weather radar not being able to perform its intended purpose, namely to monitor precipitation. Even partial interruption of the radar beam has the potential to result in errors in the estimated precipitation levels.

795. The Statement of the European Union Meteorological Network Operational Programme for the Exchange of weather Radar information (OPERA) Group, on the cohabitation between weather radars and wind turbine generators indicates that the deployment of wind turbine generators within 5km of weather radar be prohibited. In addition, an impact study should be completed on wind turbine generators planned between 5km and 20km from UK Met Office radar.

796. The closest Met Office radar system is Old Buckenham located 20km south-west of Norwich. It is located a significant distance away from the Norfolk Boreas site and is highly unlikely to be affected, it is therefore proposed that impacts to weather radar should be scoped out from further consideration within the EIA.

2.13.2 Potential impacts

2.13.2.1 Potential impacts during construction

797. **Effects on aviation radar systems:** There would be no specific impact on aviation radar as a result of construction activities over and above that identified at operation, therefore potential impacts arising from the presence of wind turbine generators are considered in more detail under operational impacts.

798. **Risk of aviation collision:** In the construction phase, the presence and movement of certain construction vessels (e.g. tall cranes) may present an increased potential collision risk to low flying aircraft and helicopter flight operations in support of Oil and Gas (O&G) operations.

799. **Effect on HMRs and Offshore Platforms:** The helicopter operators may have concerns with the potential physical presence of the wind turbine generators as they are constructed near HMRs and Offshore Platforms.

2.13.2.2 Potential impacts during operation

800. **Effects on aviation radar systems:** Analysis completed by NATS (NATS, 2015) indicates that the NERL PSR at Cromer would detect the western edge of the Norfolk Boreas project (assuming a tip height of 225m) and create wind turbine generator induced clutter, presented on Air Traffic control (ATC) displays utilising the Cromer PSR. The MOD ADR at RAF Trimingham would theoretically have line of sight to the majority of the Norfolk Boreas wind turbine generators which, without suitable mitigation, would create operational effects to the ADR.

801. **Risk of aviation collision:** Wind turbine generators could be difficult to see from the air, particularly in poor meteorological conditions and at night, and could increase the collision risk to aircraft and helicopter flight operations.

802. **Effect on HMRs and Offshore Platforms:** The helicopter operators may have concerns with the potential physical presence of the wind turbine generators. Mitigation may take the form of re-routeing helicopters around the Wind Farm or constraining the minimum flight altitude of helicopters when operating on the HMR.

803. **Effect on Military Training Areas:** The Lakenheath North Aerial Tactics Area (ATA) is to the south-west of the Norfolk Boreas site and has a base height of Flight Level 60 (6,000ft) well above the 325m maximum wind turbine generator blade tip height, restricting any potential effects to those relating to aviation radar rather than physical obstruction.

2.13.2.3 Potential impacts during decommissioning

804. **Effects on aviation radar systems**: Any wind turbine generator within line of sight to current aviation radar infrastructure would have an impact on the system, unless a form of technical mitigation is utilised for its effect, until the sites are fully decommissioned.

805. **Risk of aviation collision:** The infrastructure required in the process of wind turbine generator decommissioning, in particular large crane structures, may present a physical obstruction and effect operations of low flying aircraft, helicopter flights in support of O&G operations and SAR operations. As discussed in Section 2.14 it is likely that much of the oil and gas infrastructure within the site will be decommissioned prior to the construction of Norfolk Boreas.

806. Any impacts from the operation of proposed project would be incrementally reduced to zero with the decommissioning of the Wind Farm.

2.13.2.4 Potential cumulative impacts

807. Cumulative impacts, especially to aviation radar, are anticipated between Norfolk Boreas and other offshore wind farms, in particular Norfolk Vanguard, and other aviation activities in the North Sea and would be further considered within the EIA.

2.13.2.5 Transboundary impacts

808. The Netherlands Authorities, during the East Anglia Zone Appraisal Process, have advised that they have no radar coverage (civil or military) over Norfolk Boreas.

2.13.2.6 Summary of potential impacts

809. Table 2.28 summarises the potential impacts.

Table 2.28 Summary of potential impacts relating to aviation and radar

Potential impacts	Construction	Operation	Decommissioning
Impact on Radar Systems	x	✓	x
Impact HMRs and Offshore Platforms	✓	✓	✓
Impact on Military Training Area	x	x	x
Increased collision risk	✓	✓	✓
Cumulative impacts	✓	✓	✓
Transboundary impacts	x	x	x

Scoped in (✓) and scoped out (x)

2.13.3 Mitigation

2.13.3.1 Aviation radar

810. Mitigation of the effects created to the NERL Cromer PSR would be achieved through technical and airspace management solutions around the Norfolk Boreas site.

811. Mitigation of ADR impacts would be achieved by implementation of technical solutions (as has been completed for the Greater Wash Wind Farms).

2.13.3.2 HMRs and offshore platforms

812. Mitigation may take the form of re-routing helicopters around the wind farm or constraining the minimum flight altitude of helicopters operating on the HMRs near the proposed project area.

813. Mitigation has thus been identified and subject to stakeholder agreement (NATS, CAA and the offshore helicopter operators) of the mitigation principles, the Applicant would ensure these are implemented prior to construction.

814. A collaborative approach between VWPL and Offshore Helicopter Aviation Stakeholders may realise a suitable compromise that would allow some development of wind turbine generators within the areas adjacent to the HMR route structure and offshore platforms.

815. Resolution on the issues of impact on HMRs and helicopter operations to offshore platforms is anticipated during VWPL's planned consultation process. As Norfolk Boreas lies in the vicinity of UK and Dutch HMRs, these would be a primary consideration of the EIA.

2.13.3.3 SAR operations

816. An ERCoP would be compiled in conjunction with the MCA and would be in place for the construction, operation and decommissioning phases of the proposed project. The ERCoP would detail specific marking and lighting of the wind turbine generators. The SAR helicopter bases would be supplied with an accurate Global Positioning System (GPS) position and development parameters of the proposed project.

2.13.3.4 Aviation lighting and marking

817. There would be a requirement for Aviation Obstruction Lighting on all or individual wind turbine generators. Consultation with the CAA, MCA (SAR input to the ERCoP) and MOD would be required to establish acceptable aviation obstruction lighting to meet requirements, in particular to ensure aviation lighting is clearly distinguishable from maritime lighting.

818. There is a CAA requirement in the UK for all structures over 300ft (91.4m) high to be charted on civil aviation maps and documentation (the MOD uses a lower threshold height). Consequently, the Applicant would be required to provide details of the development to the Defence Geographic Centre.

2.13.4 Approach to assessment and data gathering

819. The EIA process is likely to be supported by further desk-based studies that would identify and examine in greater detail, aviation, MCA and MOD receptors. Studies would be undertaken in parallel with consultation and meetings with specific stakeholders in order to provide a detailed understanding of potential impacts.

820. The Aviation Industry and the provision of Air Navigation Services (including radar services) are regulated through extensive legislation; however, the main mechanism

for regulating the relationship between aviation and offshore wind is through the consenting system and the guidance outlined below. The following documents, as a minimum, would be considered during the EIA process:

- CAA, CAP 764, Policy and Guidelines on Wind Turbines (CAA, 2016a);
- CAA, CAP 670, Air Traffic Services Safety Requirements (CAA, 2014a);
- CAA, CAP 393, The Air Navigation: Order 2016 and the Regulations (known as the Air Navigation Order (ANO) (CAA, 2016b);
- MOD Obstruction Lighting Guidance (MOD, 2014); and
- The Wind Energy, Defence and Civil Aviation Interests Working Group's 2002 Report on 'Wind Energy and Aviation Interests: Interim Guidelines' – this report details both military and independent airport operator issues and consultation procedures.

821. Other data sources and guidance considered as part of the desktop review of the baseline situation include the following:

- CAA, Visual Flight Rules Chart (CAA, 2016c);
- CAA, CAP 032, UK Integrated Aeronautical Information Package (UKIAIP). The UKIAIP is the main resource for information and flight procedures at all licensed UK airports as well as airspace, en-route procedures, charts and other air navigation information CAA, 2017);
- CAA, CAP 168, Licensing of Aerodromes (CAA, 2014b); and
- Military Aeronautical Information Publication (Mil AIP) (MOD, 2017).

822. To inform the EIA process, consultation may be required with the following agencies:

- UK CAA;
- Dutch Armed Forces;
- Dutch Aviation Authority;
- Norwich Airport;
- UK MCA (SAR and Lighting requirements);
- UK Meteorological Office;
- UK MOD;
- UK NATS / NERL; and
- Oil and Gas Industry (Helicopter and Platform operators).

823. It is expected that consultation would be an iterative process, allowing for any concerns that are raised to be considered in the wind turbine generator layout and optimisation process of Wind Farm design.

824. The Applicant will submit standard offshore wind farm enquiries to relevant aviation stakeholders including UK and Dutch authorities which allows for a standardised approach to provision of data and assessment by the regulators and statutory

consultees. A pre-planning assessment has been completed by NATS in which an unacceptable impact is predicted on the Cromer PSR. Discussion with NATS to establish appropriate technical mitigation for the effect of the proposed project on the Cromer PSR system is in progress. The MOD Trimingham ADR would theoretically detect the majority of the wind turbine generators of Norfolk Boreas and a technical solution would be provided to the MOD for acceptance.

2.14 Infrastructure and other users

2.14.1 Baseline

2.14.1.1 Offshore wind farm developments

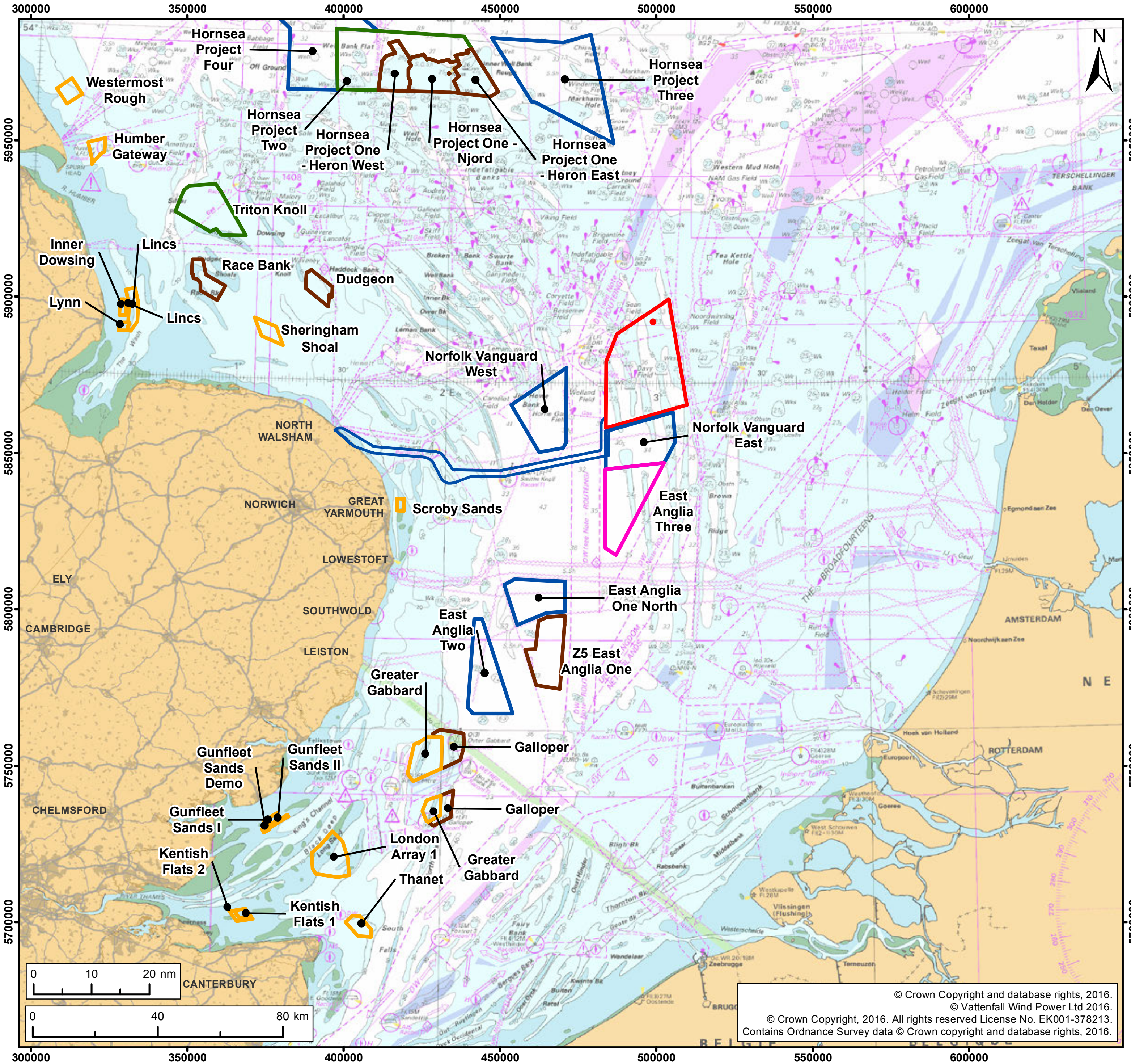
825. Figure 2.23 shows other UK offshore wind farm developments in the vicinity of offshore project area. Within the former East Anglia Zone, Norfolk Vanguard is to the west and the south of the Norfolk Boreas site. Further south within the former East Anglia Zone is the proposed East Anglia THREE project, the consented East Anglia ONE project and proposed future developments of East Anglia ONE North and East Anglia TWO.

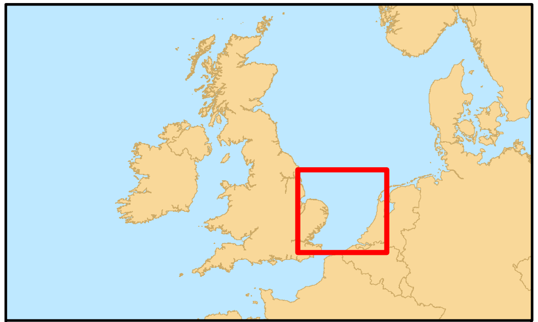
826. Aside from the other developments within the former East Anglia Zone, Norfolk Boreas is quite distant from other existing UK offshore wind farms, with the nearest being Scroby Sands Offshore Wind Farm, a Round 1 project of 60MW situated more than 68km away from Norfolk Boreas. Sheringham Shoal and Dudgeon are the next closest UK wind farm developments, at over 103km and 90km distance from Norfolk Boreas respectively.

827. The closest international wind farm developments are the Dutch Ijmuiden Development Zone, the Voorde Hollandse Kust Zoekgebieden development zone and the Breeveertien II offshore wind farms which are situated less than 19km 43.7km and 47km away from Norfolk Boreas respectively (Table 2.29).

Table 2.29 Nearest existing offshore wind developments to Norfolk Boreas

Offshore wind farm	Distance from Norfolk Boreas (km)
UK - Scroby Sands	68.3
UK - Sheringham Shoal	103.4
UK - Dudgeon	90.1
NL - Ijmuiden Development Zone	19
NL Voorde Hollandse Kust Zoekgebieden	43.7
NL - Breeveertien II	47.1





Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast

Wind Farm Status

- Active/In Operation
- Under Construction
- Consented
- Application Submitted
- Pre-planning

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title: Other UK Offshore Wind Farm Developments

Figure: 2.23 | Drawing No: PB5640-102-027

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02	20/03/17	JE	JM	A4	1:1,750,000
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Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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2.14.1.2 Oil and Gas pipelines and platforms

828. There is one active gas platform and five wells currently active within the Norfolk Boreas site as shown in Figure 2.24 (note the active surface structure in the Figure is also an active well). The Platform and four of the wells are operated by Perenco who are extracting from the Davy and Boyle fields. The active well in the north-east of the site is extracting from the Orwell field and is operated by Tullow PLC. There are five pipelines associated with the above infrastructure. The Applicant is in discussions with both Perenco and Tullow to understand how coexistence of the two industries can occur within the site; however it is currently understood that these assets will be decommissioned by 2023, i.e. prior to any proposed offshore construction for Norfolk Boreas.

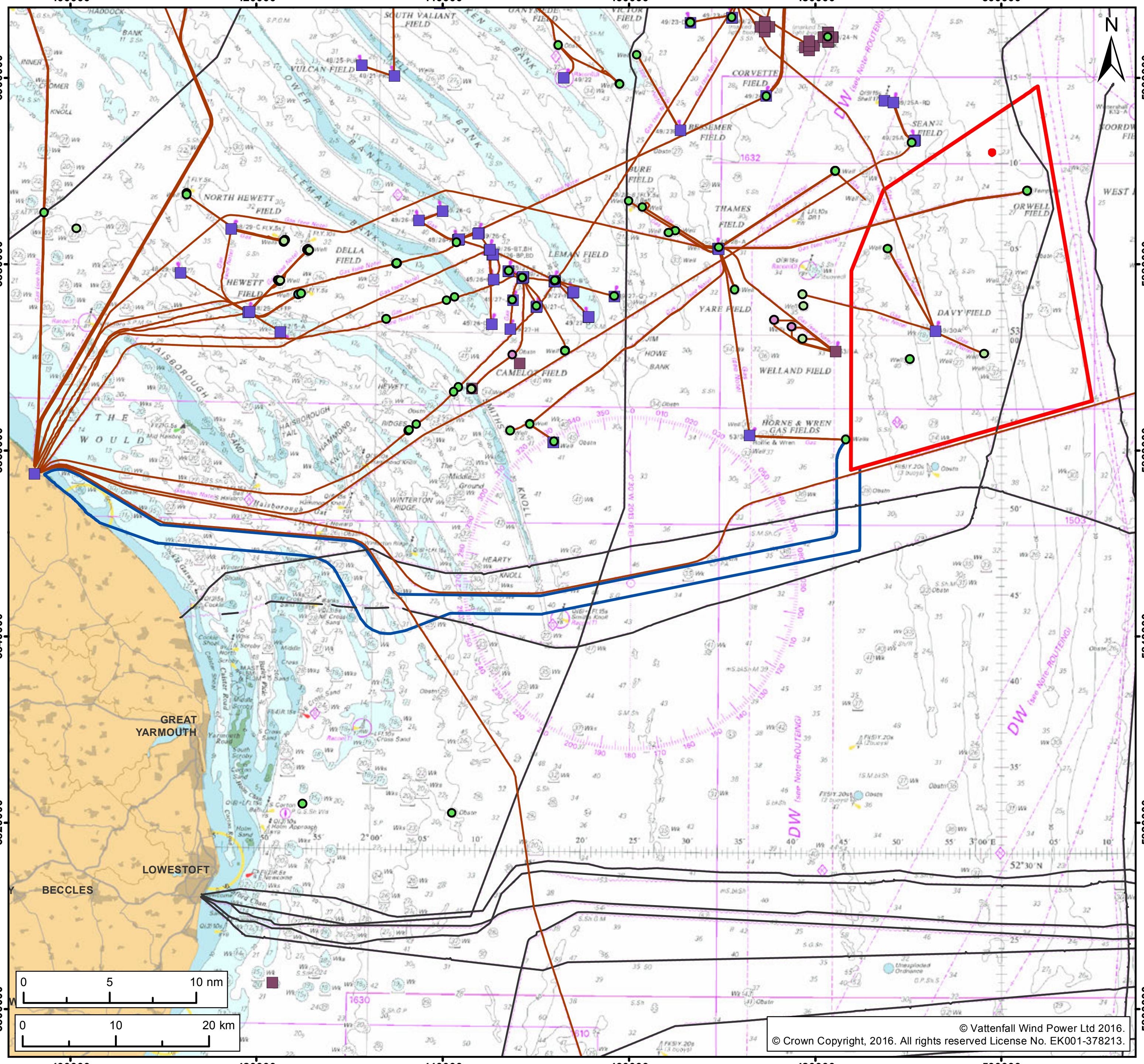
829. There are also two pipelines crossing the provisional offshore cable corridor. The Bacton-Zeebrugge interconnector bisects the provisional offshore cable corridor and runs northwest to southeast. The BBL Balgzand-Bacton gas pipeline runs east to west adjacent to the southern boundary of Norfolk Boreas site. Discussions with owners / operators will be undertaken as development progresses.

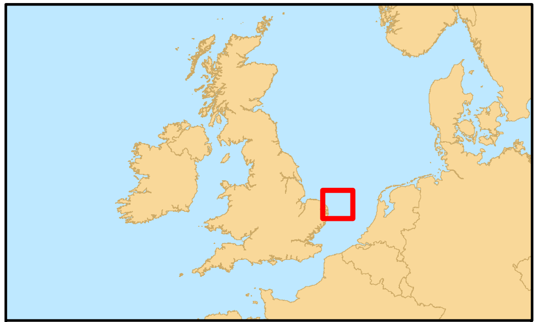
830. The provisional offshore cable corridor was designed to interact with as little oil and gas infrastructure as possible. There is one active subsurface structure near the provisional offshore cable corridor at the point at which it enters the Norfolk Boreas site and there are other subsurface and surface structures surrounding the red line boundary which are active, abandoned or removed (Figure 2.24).

831. The shipping and the aviation traffic associated with the oil and gas industry is discussed in Sections 2.11 and 2.13 respectively.

2.14.1.3 Oil and Gas licensing and exploration

832. There are a number of licensed blocks which have been awarded or provisionally awarded (under the 28th licencing round (Oil and Gas authority, 2017)) that are yet to be developed which overlap with the Norfolk Boreas site. Discussions with the owners of these licensed blocks are ongoing (where known) to understand results of early exploratory works and the resulting likelihood and extent of activity in these areas. Further blocks may be let within future licensing rounds. Licencing under the 29th round and the 2016 Offshore Supplementary Round is currently underway, however no blocks overlapping the Norfolk Boreas offshore project area were offered as part of these rounds.





Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast
- Pipeline[1]
- Subsea Cable[1]

Subsurface Infrastructure[2]

- Abandoned
- Active
- Not in use
- Precommission
- Removed

Surface Infrastructure[2]

- Abandoned
- Active
- Removed

[1] KisOrca, 2016. [2] Oil & Gas UK ltd., 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Other Offshore Infrastructure

Figure: 2.24 | Drawing No: PB5640-102-028

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:600,000
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Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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2.14.1.4 Sub-sea cables

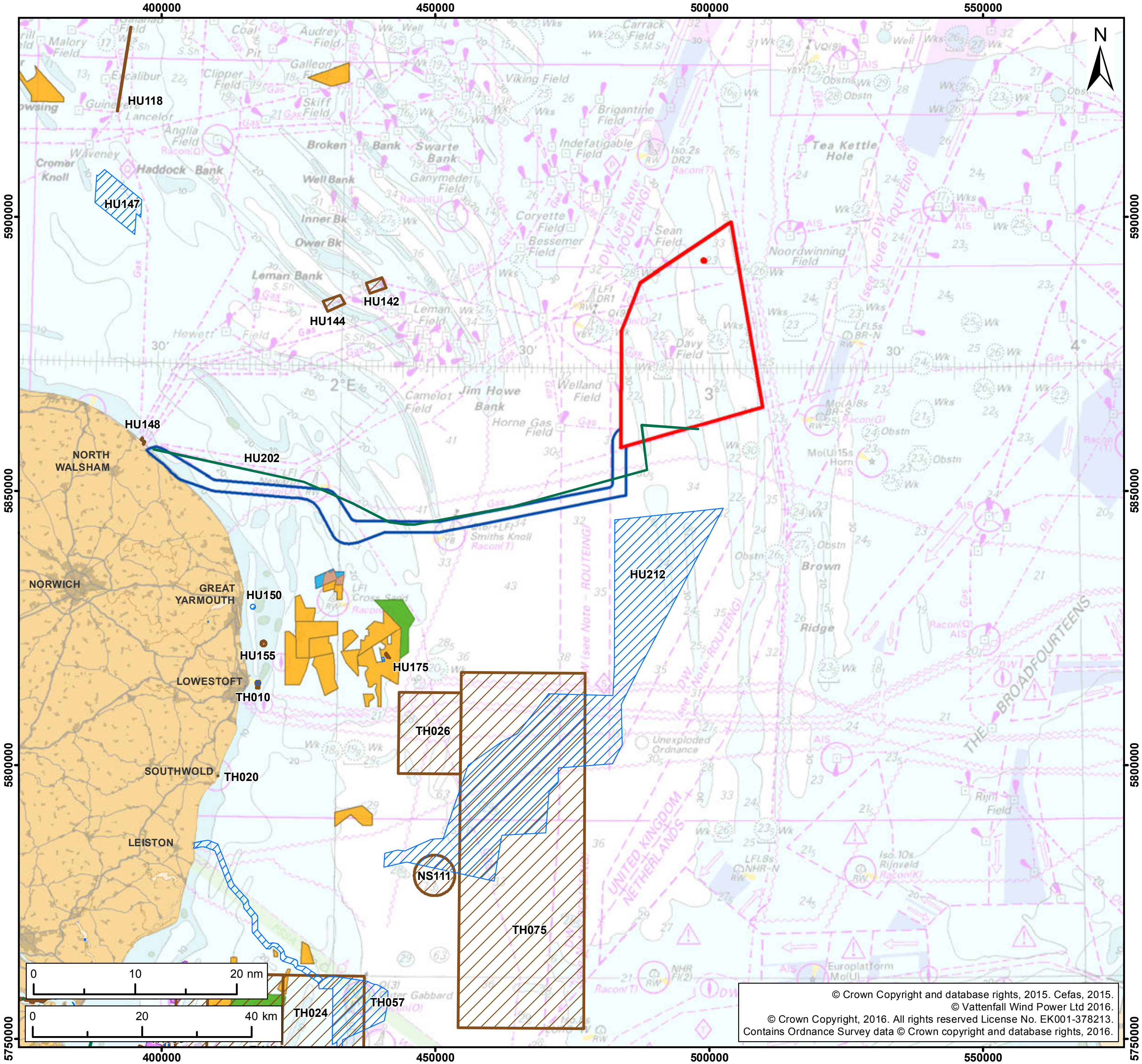
833. The southern North Sea has a significant number of cables; primarily telecommunication connections between the UK and continental Europe (see Figure 2.24). The UK-Netherlands 14 telecommunications cable runs from Winterton-on-Sea to Egmond in the Netherlands and intersects the provisional offshore cable corridor. The North Sea Com 1 fibre optic cable runs from Lowestoft north through the provisional offshore cable corridor. All other cables intersecting the Norfolk Boreas offshore project area are inactive.

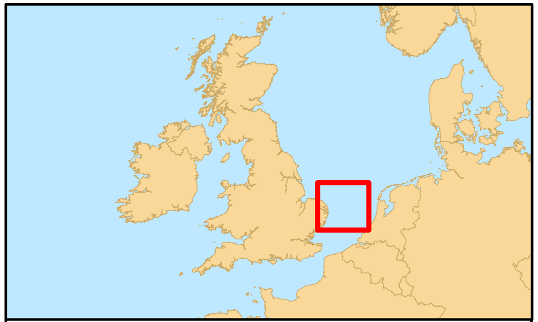
834. In addition, there are several disused cables that criss-cross the southern North Sea some dating from over 100 years ago, many of which are now lost and represent a risk to seabed activity. Modern charts only display cables decommissioned since 1987. Discussions with owners / operators of cables will be undertaken as development progresses.

2.14.1.5 Aggregate dredging

835. There are currently no aggregate dredging areas within offshore project area. There are a number of aggregate dredging licences approximately 45km west south-west of the Norfolk Boreas site; these are shown in Figure 2.25.

836. As previously discussed, there is a proposal to undertake aggregate dredging within the Haisborough, Hammond and Winterton SCI as a source for the Bacton sand engine coastal protection. This proposal is currently at scoping stage and dredging is proposed for 2017 however as consent is yet to be granted this may be delayed or not occur. Discussions with owners / operators of aggregate sites will be undertaken as development progresses.





Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast
- Aggregate Application Area
- Aggregate Exploration and Option Area
- Aggregate Licence Option Area
- Aggregate Option Area
- Aggregate Production Area

Disposal Site

- Closed
- Disused
- Open

Project: Norfolk Boreas

Report: Environmental Impact Assessment Scoping Report

Title: Aggregate Dredging and Marine Disposal Activity

Figure: 2.25 Drawing No: PB5640-102-029

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:1,000,000
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Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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2.14.1.6 Dumping/Disposal Sites

837. There is one disused marine disposal site HU202 that runs through the Norfolk Boreas site and the provisional offshore cable corridor. There are two closed marine disposal sites, HU146 and HU148 located just to the north of the Bacton landfall zone and two closed marine disposal sites approximately 35km west of the Norfolk Boreas site, as shown in Figure 2.25. Disposal site HU212 is located approximately 5km south of the provisional offshore cable corridor. This site would be used to dispose of marine sediment which has been dredged from the seabed during construction of the East Anglia THREE offshore windfarm. The DCO application for East Anglia THREE was submitted in 2015 and a decision is expected in June 2017.

838. A further large closed marine disposal site is TH075 which is located south of the Norfolk Boreas offshore project area.

2.14.1.7 Unexploded Ordnance (UXO)

839. The Southern North Sea has been a major area of naval and airborne warfare across a number of major wars, most notably WW1 and WW2. Consequently it is possible for UXO to be found in almost any area of the Southern North Sea(EAOW, 2012a). There are currently two MOD identified explosives dumping grounds to the west and south-west of the former East Anglia Zone. Magnetometer surveys have been completed across the provisional offshore cable corridor in 2016 and further surveys will be conducted across the Norfolk Boreas site in 2017 to identify potential UXO within the offshore project area.

2.14.1.8 Ministry of Defence (MoD) Activities

840. No PEXAs overlap with offshore project area. The closest PEXA is the Southern Military Defence Area with the closest distance to Norfolk Boreas site being 43.5km, and the distance to the closest point on the provisional cable corridor being 67.1km.

2.14.2 Potential impacts

2.14.2.1 Potential impacts during construction

841. **Potential interference with other wind farms:** As there is no spatial overlap of wind farm infrastructure within the sites at the present time, there is no pathway for interference with other developments and therefore it is proposed to scope this impact out of the EIA. Crossing of other wind farms' cables is discussed below. The export cables would be installed in the same cable corridor as Norfolk Vanguard export cables, however as both projects are being developed by Vattenfall any impacts can be managed.

842. **Potential interference with oil and gas operations:** There is potential for interactions between existing and future oil and gas activity and the Norfolk Boreas project. Through the site selection process the Applicant has sought maintain a redline boundary large enough to allow enough flexibility to avoid existing oil and gas infrastructure. Discussions with owners and operators of the infrastructure within and adjacent to the Norfolk Boreas site has indicated that the assets within the site will have been decommissioned by 2023, i.e. prior to construction of the wind farm. Discussions will continue to verify this. Due to the large area of seabed and the likely planned decommissioning it is anticipated at this stage that impacts would be minimal. Any conflicts with aviation activities, including helicopter operations associated with the oil and gas industry will be addressed as part of the Aviation and Radar assessment (see Section 2.13). Crossing of pipelines is discussed below.

843. The licensing of new areas for oil and gas exploration, and the associated exploratory works, is ongoing and this will be monitored by the Applicant.

844. **Physical impacts on subsea cables and pipelines:** Existing cables and pipelines within Norfolk Boreas would be avoided when siting the turbines and infrastructure. However array cables may be required to cross the existing pipelines and therefore crossing agreements with the operators of these will be sought. The provisional offshore cable corridor crosses three existing cables (Figure 2.24) and two pipelines; therefore the final cable route would inevitably require cable and pipelines crossings. Crossing agreements will therefore be prepared with the relevant owners of cables and pipelines and appropriate installation and protection measures developed.

845. **Impacts on aggregate dredging activities:** As there is no overlap of aggregate licence areas with the offshore project areas there are limited pathways for impacts upon aggregate dredging activities. If the project programme for the proposed dredging by the Bacton Gas Terminal changes overlaps with Norfolk Boreas construction this will be considered further, however this is considered highly unlikely given the current proposal to dredge in 2017 with Norfolk Boreas construction planned from 2025. Any vessel movement conflicts will be addressed as part of the shipping and navigation assessment (Section 2.11).

846. **Impacts on disposal sites:** Given that there is no overlap between Norfolk Boreas and disposal sites there is no pathway for impacts and therefore the Applicant proposes to scope this out of the EIA. The Warren Springs site (H202) is disused and therefore there is no pathway for Norfolk Boreas to impact upon users of this site. Consideration of any impacts on water and sediment quality due to any interactions between the Norfolk Boreas site and Warren springs is covered in Section 2.3,

specifically through the assessment of release of contaminated sediments.

847. **Initiation of UXO:** Operations such as piling or cable installation works could result in the initiation of abandoned UXO if it were present and live. The consequences of such an initiation would depend upon the size of the explosive and the distance of targets from the explosive. However this issue will be dealt with prior to construction through detailed geophysical survey and investigations. This is a health and safety risk which will be carefully mitigated rather than being an environmental issue. It is therefore proposed that these impacts should be scoped out from further consideration within the EIA.

848. **Impacts on MOD activities:** Due to the distance of the site from the nearest PEXA, no impacts on these MOD activities are expected as a result of the construction of Norfolk Boreas and therefore the Applicant proposes to scope this out of the EIA. Impacts on military aviation and radar are discussed in Section Aviation and Radar 2.13.

2.14.2.2 Potential impacts during operation

849. **Potential interference with other wind farm development:** As there is no spatial overlap of wind farm infrastructure at the present time, there is no pathway for interference with other developments and therefore the Applicant proposes to scope this out of the EIA. The export cables would be installed in the same cable corridor as Norfolk Vanguards' export cables, however as both projects are being developed by Vattenfall any impacts can be managed.

850. **Potential interference with oil and gas operations:** As stated above there is potential for interactions between existing and future oil and gas activity and the Norfolk Boreas site. Discussions with owners and operators of the infrastructure within the Norfolk Boreas site have advised that many of these assets will have been decommissioned by 2023, i.e. prior to construction of the wind farm. Further discussions will held to verify this. No impacts are therefore anticipated at this stage. Any conflicts with aviation activities, including helicopter operations associated with the oil and gas industry will be addressed as part of the Aviation and Radar assessment (see Section 2.13).

851. The licensing of new areas for oil and gas exploration, and the associated exploratory works, is ongoing and this will be monitored by the Applicant.

852. **Physical impacts on subsea cables and pipelines:** If cables require maintenance or replacement, standard industry techniques would be followed to ensure that other operators’ cables and pipelines are not impacted by maintenance works. As a result, the Applicant proposes to scope this impact out of the EIA.

853. **Impacts on aggregate dredging activities:** Based on known active and licensed areas, there is no spatial overlap of aggregate areas with the offshore project area and therefore there are limited pathways for impacts upon aggregate dredging activities. Consultation with dredging operators as part of the EIA should provide confirmation of this. Any vessel movement conflicts will be addressed as part of the shipping and navigation assessment (Section 2.11). Therefore the Applicant proposes to scope this out of the EIA.

854. **Impacts on disposal sites:** As there is no spatial overlap with offshore sediment disposal sites, no impacts are anticipated to users of disposal sites during the operational phase of Norfolk Boreas and so the Applicant proposes to scope this out of the EIA.

855. **Impacts on MOD activities:** Due to the distance of the site from the nearest PEXA, no impacts on MOD activities are expected as a result of the operation of Norfolk Boreas, therefore the Applicant proposes to scope this out of the EIA. Impacts on military aviation and radar are discussed in Section Aviation and Radar 2.13.

2.14.2.3 Potential impacts during decommissioning

856. Impacts upon infrastructure and other users during decommissioning are anticipated to be similar to those discussed during construction of the wind farm, with an incremental reduction of impact as individual wind turbines are removed from the site. Impacts with other activities throughout all phases of the life of Norfolk Boreas would be mitigated by planning and design. This impact is therefore considered unlikely to be significant.

2.14.2.4 Potential cumulative impacts

857. Given that the impacts of Norfolk Boreas on infrastructure and other users would be largely dependent upon physical overlap, non-significant or mitigated to no impact, it is unlikely that there would be pathways for cumulative or in-combination impacts.

2.14.2.5 Transboundary impacts

858. Transboundary impacts would not occur separately from the impacts discussed above as impacts are largely dependent upon physical overlap and no pathways exist for impacts beyond Norfolk Boreas.

2.14.2.6 Summary of potential impacts

Table 2.30 Summary of potential impacts relating to infrastructure and other users

Potential impacts	Construction	Operation	Decommissioning
Potential interference with other wind farms	x	x	x

Potential impacts	Construction	Operation	Decommissioning
development			
Potential interference with oil and gas operations	✓	x	x
Physical impacts on subsea cables and pipelines	✓	x	✓
Impacts on aggregate dredging activities	✓	x	✓
Impacts on disposal sites	x	x	x
Initiation of UXO	x	x	x
Impacts on MOD activities	x	x	x
Cumulative impacts	x	x	x
Transboundary impacts	x	x	x

Scoped in (✓) and scoped out (x)

2.14.3 Mitigation

859. Where conflicts between Norfolk Boreas and other infrastructure are identified, owners and operators would be consulted and legal agreements would be put in place as required.

2.14.4 Approach to assessment and data gathering

860. The Applicant will undertake consultation with all relevant developers, operators and marine users within the vicinity of the offshore protect area to ascertain any concerns relating to the project. Areas of concern will be identified and considered within the EIA. It is likely that any impacts would either be non-significant or able to be fully mitigated after consultation with the relevant parties as discussed above.

2.15 Offshore designated sites summary

2.15.1 Water Framework Directive (WFD)

2.15.1.1 Norfolk East WFD coastal water body

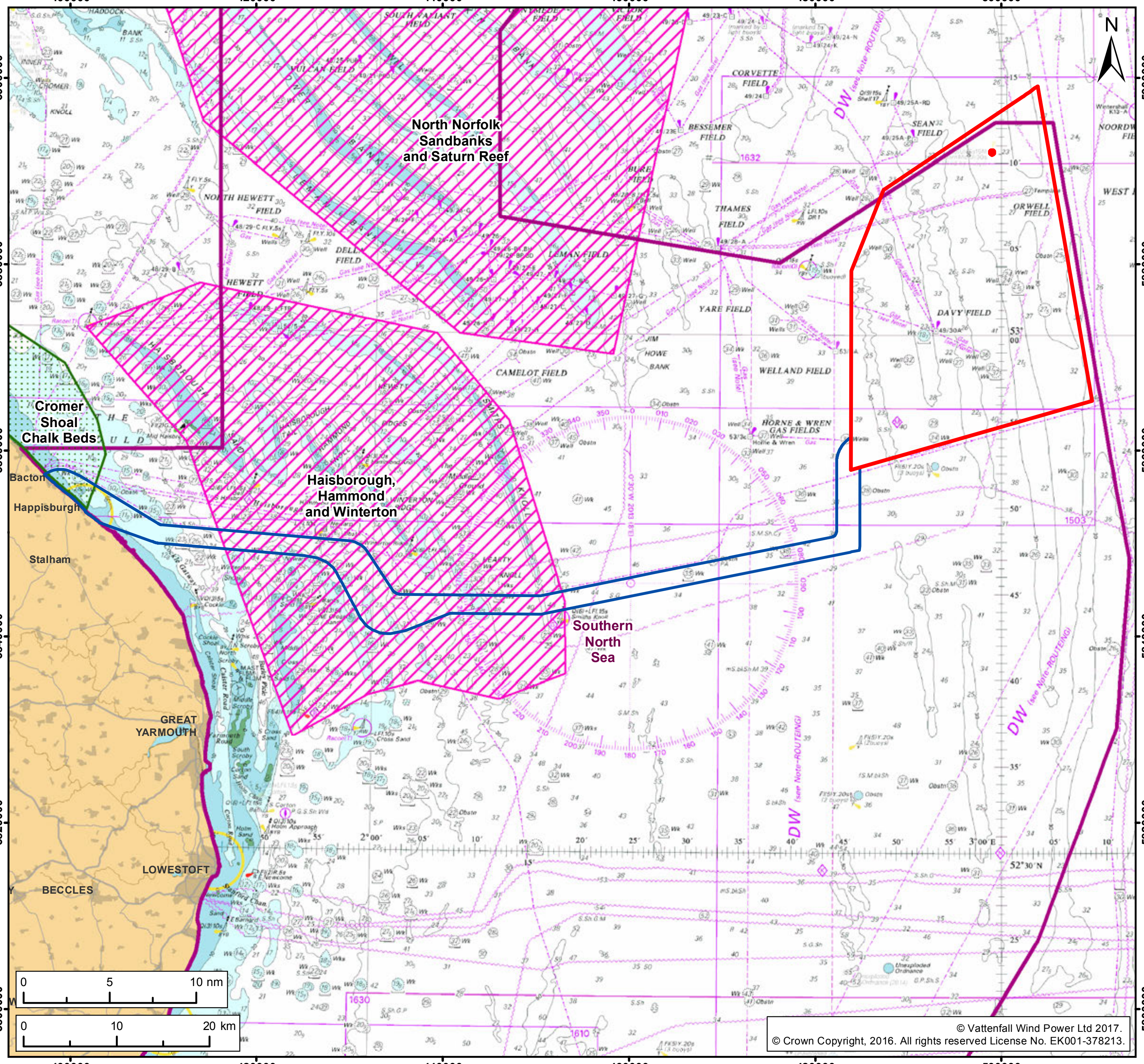
861. As discussed in Section 2.3, the provisional offshore cable corridor runs through the Norfolk East WFD coastal water body (GB650503520003), (see Figure 2.4). The North Norfolk WFD bathing waters are approximately 3.1km to the north of the Bacton landfall zone at Mundesley and 3.9km south of the Happisburgh landfall zone at Sea Palling. Mundesley and Sea Palling bathing waters have been classified as having excellent bathing water quality every year since 2013 and 2012, respectively (Environment Agency, 2016a and 2016b).

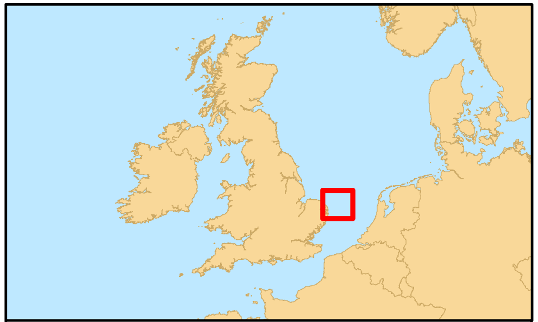
2.15.2 Natura 2000 sites

862. This section provides an overview of Natura 2000 sites identified and designated

under the Habitats Directive and Birds Directive (see Section 1.4.4). During the Habitats Regulations Assessment (HRA) Screening for Norfolk Boreas, a detailed review of Natura 2000 sites will be undertaken in consultation with key stakeholders through the EPP. This will include sites which have potential connectivity with the Norfolk Boreas project (i.e. those designated for mobile species which may use the offshore project area).

863. The offshore project area lies mostly within the Southern North Sea cSAC (Figure 2.26). The offshore cable corridor passes through the Haisborough Hammond and Winterton SCI (Figure 2.26), the Greater Wash Marine pSPA (Figure 2.27) and the Cromer Shoal Chalk Beds MCZ (Figure 2.26). The potential impacts on EPS (Annex IV of the Habitats Directive) using the area will also be assessed within the ES and HRA.





Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast

Offshore Designated Sites

- Marine Conservation Zone (MCZ)[1]
- Candidate Special Area of Conservation (cSAC)[1]
- Site of Community Importance (SAC/SCI)[1]

[1] Natural England, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Special Areas of Conservation and Marine Conservation Zones in Proximity to Norfolk Boreas

Figure: 2.26 Drawing No: PB5640-102-030

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03	20/03/17	JE	JM	A4	1:600,000
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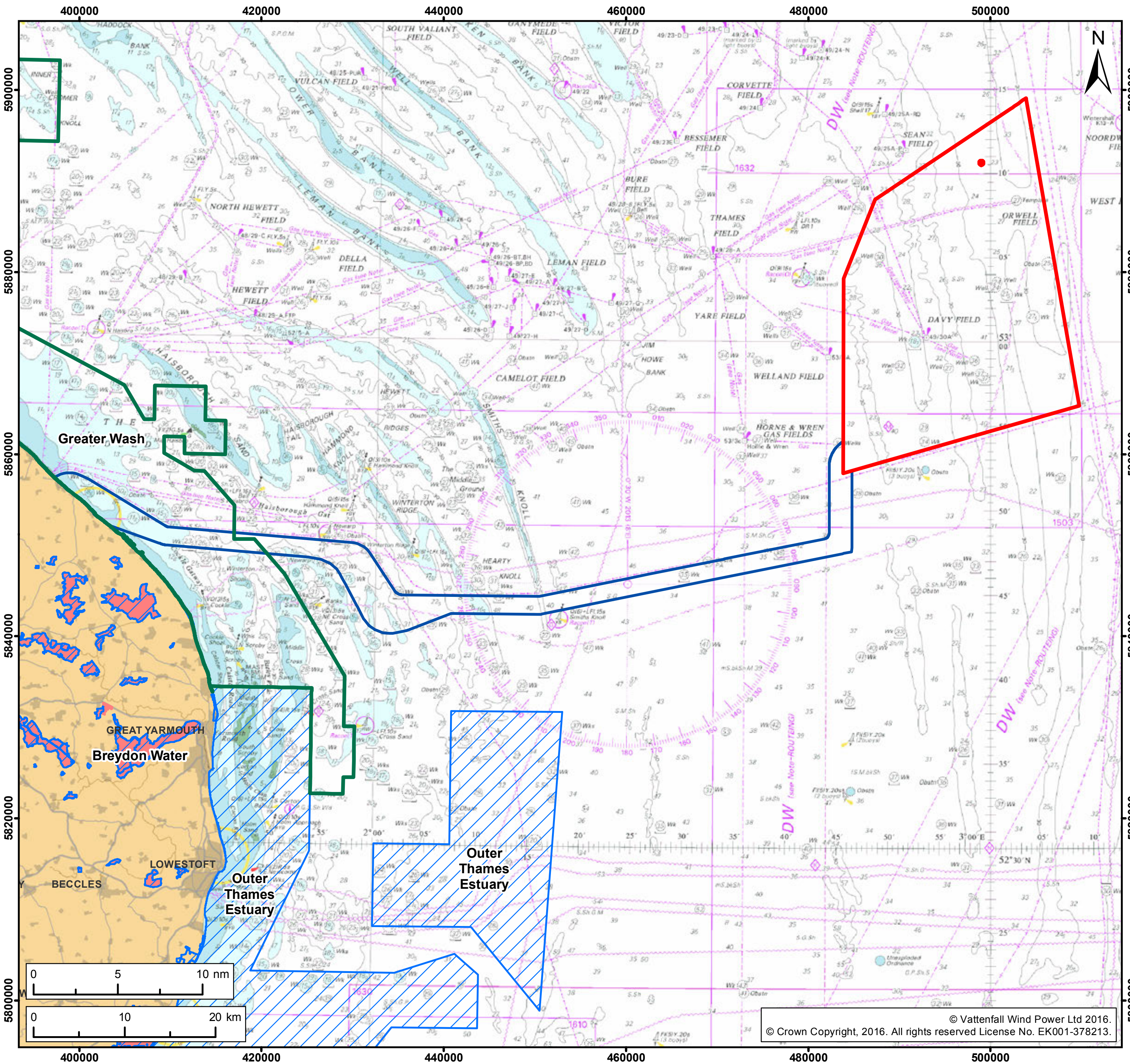

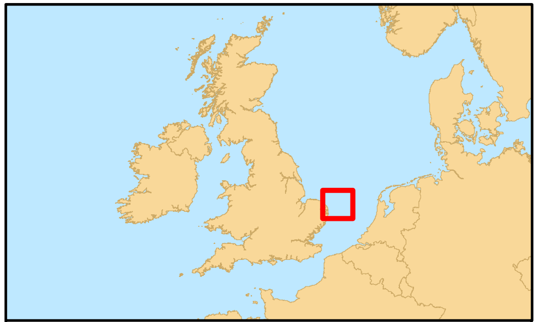

Legend:

- Norfolk Boreas Site
- Provisional Offshore Cable Corridor
- Met Mast
- Special Protection Areas (SPA)[1]
- Potential Special Protection Area (pSPA)[1]
- Ramsar[1]

[1] Natural England, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Special Protection Areas and Ramsar sites in Proximity to Norfolk Boreas

Figure: 2.27 Drawing No: PB5640-102-031

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02	20/03/17	JE	JM	A4	1:600,000
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Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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2.15.2.1 Haisborough, Hammond and Winterton SCI

864. Sites of Community Importance are sites that have been adopted by the European Commission but not yet formally designated by the UK government as an SAC. In 2011 the Haisborough, Hammond and Winterton SCI was ratified by the EC. The site contains two Annex I habitats, 'Sandbanks slightly covered by sea water all the time' and 'Reef' in the form of *Sabellaria spinulosa* biogenic reefs (Section 2.6). The sandbanks are of historical geological interest with bank systems originating from around ~7000 years BP (JNCC, 2017a). The impact assessment for Norfolk Boreas will therefore consider any potential impacts to the form and function of sandbanks within the Marine Geology, Oceanography and Physical Processes EIA and impacts to *S.spinulosa* reef as part of the benthic ecology EIA and the HRA.

2.15.2.2 Southern North Sea cSAC

865. The Southern North Sea site has been accepted by the European Commission as a Candidate SAC (cSAC) for harbour porpoise. JNCC undertook consultation on the site in 2015, which has been identified as being within the top 10% of persistently high density areas for harbour porpoise in UK waters (JNCC, 2017b). JNCC (2017b) state that the harbour porpoise within the site cannot be considered in isolation as they are a wide-ranging species. The impact assessment for Norfolk Boreas will therefore be based on the harbour porpoise North Sea MU reference population (IAMMWG, 2015) unless further information becomes available.

2.15.2.3 Greater Wash Marine pSPA

866. The Greater Wash pSPA has been identified from Bridlington Bay in the north to approximately Great Yarmouth in the south (Natural England, 2015) which overlaps with the provisional offshore cable corridor. A consultation on the pSPA concluded in January 2017 (Defra 2017), at the time of writing (April 2017) the results of this consultation have not been published.

867. The Greater Wash Marine pSPA encompasses the following ornithology features:

- Foraging areas of little tern *Sternula albifrons* from the following colonies;
    - The Humber Estuary;
    - Gibraltar Point;
    - The Wash;
    - North Norfolk Coast; and
    - Great Yarmouth and North Denes SPA colonies.
- Foraging areas of sandwich tern *Thalasseus sandvicensis* at;
    - The Wash and North Norfolk Coast SPA colonies;

- Foraging areas of common tern *Sterna hirundo* at;
    - North Norfolk Coast and Breydon Water SPA colonies;
- Areas of importance for non-breeding common scoter protected under the North Norfolk Coast SPA (JNCC, 2016a);
- Areas of importance for non-breeding red-throated diver; and
- Areas of importance for non-breeding little gull.

2.15.3 Marine Conservation Zones (MCZ)

2.15.3.1 Cromer Shoal Chalk Beds MCZ

868. In January 2016, Cromer Shoal Chalk Beds became a MCZ. The designated features within the Cromer Shoal Chalk Beds MCZ are:

- Moderate energy infralittoral rock;
- High energy infralittoral rock;
- Moderate energy circalittoral rock;
- High energy circalittoral rock;
- subtidal chalk;
- Subtidal coarse sediment;
- Subtidal mixed sediments;
- Subtidal sand;
- peat and clay exposures; and
- North Norfolk Coast (subtidal) – geological feature.

869. Mapping of these features (Defra, 2016) indicates the nearshore area of the MCZ which could overlap with the provisional offshore cable corridor may include subtidal chalk as well as subtidal coarse and mixed sediment. Initial results from the Norfolk benthic surveys of the provisional offshore cable corridor also support this, although this data is being analysed further.

2.15.4 Approach to assessment

870. The assessment of impacts to Natura 2000 sites (SPAs, SACs and SCIs) will be included within the HRA (Section 1.4.4) and considered within the relevant chapters of the EIA (mainly Benthic and Intertidal Ecology, Marine Geology, Oceanography and Physical Processes and Offshore Ornithology). Impacts to MCZs and WFD designations will be considered within the relevant chapters of the EIA (mainly Benthic and Intertidal Ecology, Marine Geology, Oceanography and Physical Processes and Marine Water and Sediment Quality). The approach to the assessment of impacts to designated sites will be agreed with the relevant stakeholders through the EPP.

2.16 Offshore inter-relationships

871. The EIA will identify inter-relationships which are likely to result from the construction, operation and decommissioning of Norfolk Boreas. The inter-relationships relevant to the offshore environment are outlined in Table 2.31.

Table 2.31 Offshore inter-relationships

Offshore Topic	Inter-relationships
Marine Geology, Oceanography and Physical Processes	Would have effects on: • Benthic and Intertidal Ecology • Marine Water and Sediment Quality • Fish and Shellfish Ecology
Marine Water and Sediment Quality	Is affected by: • Marine Geology, Oceanography and Physical Processes
Offshore Air Quality	N/A
Offshore Airborne noise	N/A
Benthic and Intertidal Ecology	Would be affected by: • Marine Geology, Oceanography and Physical Processes would have effects on: • Fish Ecology
Fish and Shellfish Ecology	Would be affected by: • Marine Water and Sediment Quality • Benthic and Intertidal Ecology Will have effects on: • Commercial Fisheries • Marine mammals
Marine mammals	Would be affected by: • Marine Water and Sediment Quality • Fish Ecology • Shipping and Navigation
Offshore Ornithology	Would be affected by: • Fish Ecology
Commercial Fisheries	Would be affected by: • Fish ecology • Shipping and Navigation
Shipping and Navigation	Would have effects on: • Marine Mammals • Commercial Fisheries
Offshore Archaeology and Cultural Heritage	Would be affected by: • Marine Geology, Oceanography and Physical Processes
Aviation and Radar	N/A
Infrastructure and Other Users	N/A

872. The inter-relationships between receptors (shown in Table 2.31) are incorporated within the impacts identified in Sections 2.2 to 776, for example:

- Deterioration in water quality due to increased suspended sediment concentrations (Section 2.3);
- Impacts on benthic ecology as a result of increased suspended sediments (Section 2.6);
- Impacts on fish ecology as a result of increased suspended sediments and smothering (Section 2.7);

873. The inter-relationship in terms of the combination of all potential impacts on each receptor will also be considered where appropriate. In accordance with the Planning Inspectorate (2012a), this will not necessarily result in an increase in impact significance, particularly where an impact may counteract another. For example with regard to collision, an animal cannot be struck by a vessel if it has been displaced from an area by underwater noise.

874. The approach to offshore inter-relationships will be discussed with relevant stakeholders during the EPP.

2.17 Cumulative and Transboundary Impacts Summary

875. Offshore cumulative and transboundary impacts will be considered as part of the EIA process. The assessment will consider the potential cumulative impacts of Norfolk Boreas with other proposed wind farms in the former East Anglia Zone which enter the consenting process during the period of the Norfolk Boreas EIA. At the time of writing these are likely to include (Figure 2.23):

- SPR's East Anglia ONE(consented);
- SPR's East Anglia THREE (in determination);
- Norfolk Vanguard Ltd's Norfolk Vanguard (Request for Scoping Opinion submitted in October 2016, Scoping Opinion received 11th November 2016);
- SPR's East Anglia ONE North (not yet submitted a request for Scoping Opinion); and
- SPR's East Anglia TWO (not yet submitted a request for Scoping Opinion).

876. The CIA will also include other offshore wind farms, where appropriate. The extent of UK and international plans and projects to be screened into the CIA and transboundary assessment will take into account the relevant range and reference population of each receptor. The Dutch offshore wind developments will be considered in this context. Any project with the potential to result in impacts that may act cumulatively with Norfolk Boreas will be identified during consultation as part of the EPP and following a review of available information.

877. The assessment will consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Boreas in the context of other developments that are existing, consented or at application stage.

878. Table 2.32 collates the scoping of onshore cumulative impacts discussed in Sections 2.2 to 2.14.

Table 2.32 Summary of potential offshore cumulative and transboundary impacts

Potential impacts	Construction	Operation	Decommissioning
Marine geology, oceanography and physical processes cumulative impacts	✓	✓	✓
Marine geology, oceanography and physical processes transboundary impacts	x	x	x
Marine water and sediment quality cumulative impacts	✓	✓	✓
Marine water and sediment quality transboundary impacts	x	x	x
Offshore air quality cumulative impacts	x	x	x
Offshore air quality transboundary impacts	x	x	x
Offshore airborne noise cumulative impacts	x	x	x
Offshore airborne noise transboundary impacts	x	x	x
Benthic and intertidal ecology cumulative impacts	✓	✓	✓
Benthic and intertidal ecology transboundary impacts	x	x	x
Fish and shellfish ecology cumulative impacts	✓	✓	✓
Fish and shellfish ecology transboundary impacts	✓	✓	✓
Marine mammal ecology cumulative impacts	✓	✓	✓
Marine mammal ecology transboundary impacts	✓	✓	✓
Offshore ornithology cumulative impacts	✓	✓	✓
Offshore ornithology transboundary impacts	✓	✓	✓
Commercial fisheries cumulative impacts	✓	✓	✓
Commercial fisheries transboundary impacts	✓	✓	✓
Shipping cumulative impacts	✓	✓	✓
Shipping transboundary impacts	✓	✓	✓
Offshore archaeology and cultural heritage cumulative impacts	✓	✓	✓
Offshore archaeology and cultural heritage transboundary impacts	✓	✓	✓
Aviation and radar cumulative impacts	✓	✓	✓
Aviation and radar transboundary impacts	✓	✓	x
Infrastructure and other users cumulative impacts	x	x	x
Infrastructure and other users transboundary impacts	x	x	x

Scoped in (✓) and scoped out (x)

3 PART 3: ONSHORE

3.1 Introduction

879. The onshore project design has been jointly developed for both Norfolk Vanguard and Norfolk Boreas through a process of constraints mapping, informed by desk based research, and consultation. This process has therefore been informed by the Scoping Process and Evidence Plan Process (EPP) for Norfolk Vanguard and the following chapters are informed by the Scoping Opinion and the EPP Method Statements for Norfolk Vanguard.

3.1.1 Worst case scenario for onshore infrastructure

880. Worst case scenarios will be developed and agreed through the EPP for Norfolk Boreas and updated for the PEIR.

881. Details of the current project description are provided in Section 1.5. The potential impacts discussed below are based on a worst case scenario that all works for Norfolk Boreas are completed during the construction of Norfolk Boreas (Scenario 2). Under this scenario, impacts would potentially occur for the following:

- HDD at landfall;
- Trenchless techniques (including HDD and micro-siting) at sensitive locations;
- Construction of cable relay station (if required);
- Construction of the onshore project substation;
- Trenching along the onshore cable corridor, installation of ducts and pull through of cables;
- Creation of jointing pits;
- Creation of temporary haul road;
- Creation of mobilisation zones;
- Extension to the National Grid substation;
- Modification of the overhead power lines; and
- Planting and landscaping schemes.

882. Should the Norfolk Vanguard project include works for Norfolk Boreas (Scenario 1), the potential construction impacts for the majority of receptors would be less than the worst case scenario presented here. The ES will contain an assessment of impacts against both scenarios for all receptors.

3.1.2 Definition of the onshore scoping area

883. The Norfolk Boreas, onshore scoping area (Section 1.1.4) includes the footprint of all onshore infrastructure as well as an area 250m around temporary infrastructure and 500m around permanent infrastructure, to allow for receptor identification and the

undertaking of environmental surveys. In line with best practice and standard guidelines, the following chapters may identify and describe a different scoping area relevant to their particular potential impacts.

3.1.3 Data sharing between Norfolk Vanguard and Norfolk Boreas

884. As much of the footprint of the onshore construction works is shared between Norfolk Boreas and its sister project Norfolk Vanguard, much of the data gathering and surveys undertaken for Norfolk Vanguard will be directly relevant to Norfolk Boreas and will therefore be shared across the two projects.

3.1.4 Suggested questions

885. The following questions are suggested for consideration while reviewing each onshore section and providing responses for inclusion in the Scoping Opinion:

We have taken account of the Norfolk Vanguard Scoping Opinion within this scoping report, however if you have any further responses to the questions below we would be very grateful to receive them.

Q1. Please can you tell us about further data sources that could be reviewed as part of the site characterisation for each topic?

Q2. Please tell us your views on about any other relevant potential impacts for each topic?

Q3. Please tell us whether you believe that that the data collected in 2017 as described in this section will be relevant and suitable to the Norfolk Boreas EIA.

Q4. Do you agree with the potential impacts that have been scoped out for each topic? If not, please provide details.

Q5. Have the relevant potential cumulative impacts been identified? If not, please provide details

Q6. Do you agree the proposed approach to assessing each impact is appropriate? If not, please provide details.

Q7. Is there any further guidance relating to each topic that we should be aware of? If so, please provide details.

Q8. Do you agree with the proposed extent of the study area for the individual topic? If not, please provide details.

Q9. Please tell us your comments for each topic regarding the search areas and sectors for the following project infrastructure:

- ***Landfall zones (Figure 1.3)***
- ***Onshore project substation zone (Figure 1.4),***
- ***Current onshore cable corridor (Figure 1.2);***
- ***Cable relay station zones (Figure 1.3): and***
- ***National Grid substation extension and overhead line modification zone (Figure 1.4).***

3.2 Ground conditions and contamination

3.2.1 Baseline

3.2.1.1 Data sources

886. The data sources used to inform this ground conditions and contamination baseline are shown in Table 3.1 below.

Table 3.1 Ground Condition Data sources

Source no.	Data	Source	Date
1	Geology	British Geological Survey (BGS)	2017
2	Hydrogeology: groundwater vulnerability, groundwater Source Protection Zones (SPZs), abstractions	The Environment Agency	2017
	Landfills		
3	Water Framework Directive (WFD) Classification	The Environment Agency	2017
4	Mineral Safeguard Areas	Norfolk County Council	2017

887. The information sources used to inform the EIA ground conditions and contamination baseline shall include those shown in Table 3.1 above. In addition, information within the Kelling to Lowestoft Ness Shoreline Management Plan (AECOM 2012) will be considered.

888. Cross referencing will be made to other relevant Sections including 3.4 and 3.5.

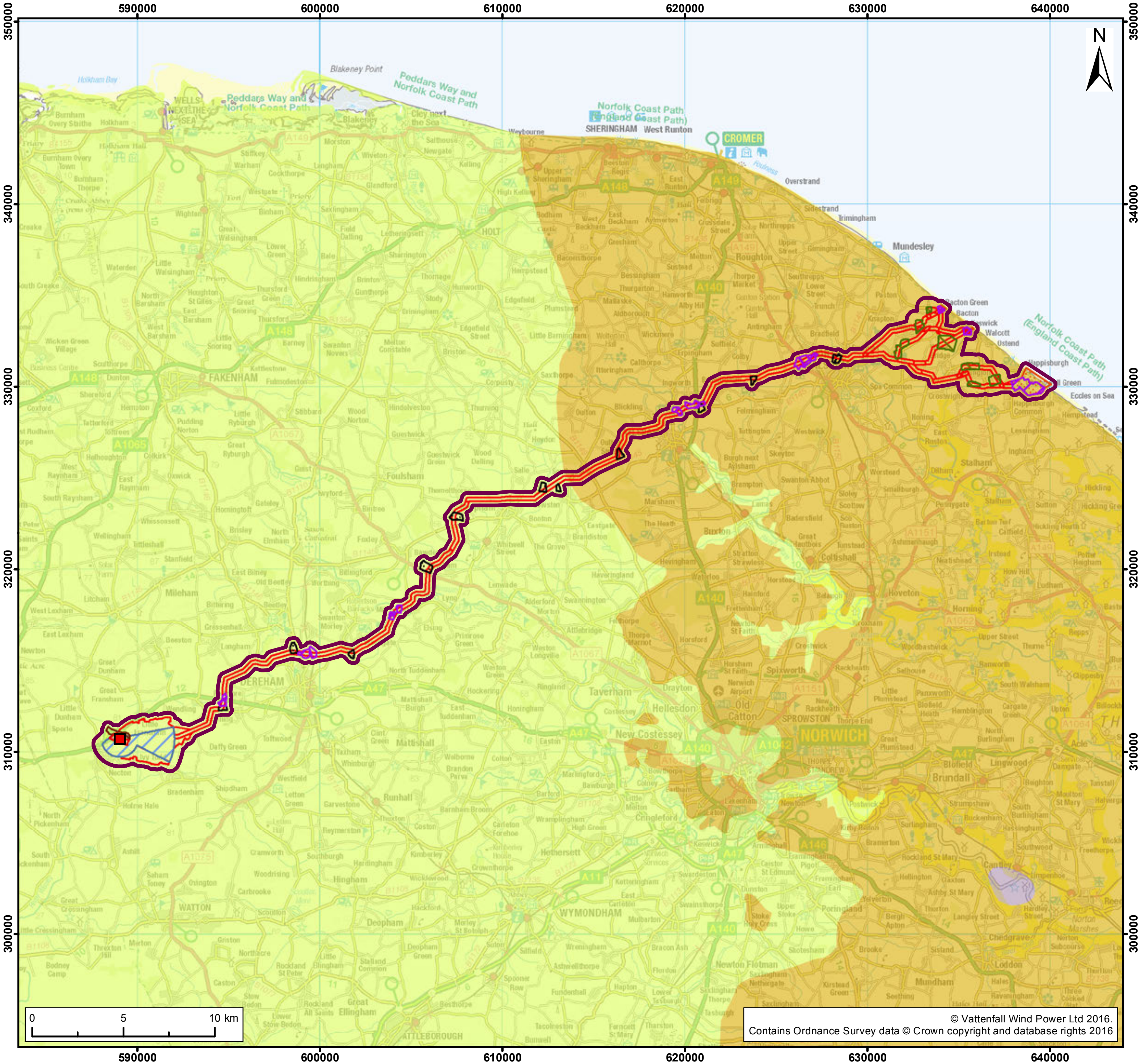
889. Any additional data sets will be identified through feedback from stakeholders following this Scoping Request.

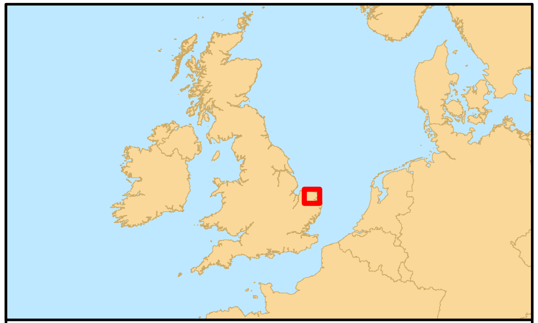
890. The proposed study area for this assessment extends 500m from the all onshore works areas and 1km from cable relay stations and sub-stations.

3.2.1.2 Solid and Superficial Geology

891. The solid geology beneath the proposed onshore works area compromises White Chalk and Crag Group deposits which dip gently to the south east (Figure 3.1). In the east of the study area, Neogene and Quaternary marine sands and gravels (Crag) overlie the Chalk.

892. The bedrock is overlain by superficial deposits throughout the study area, comprising predominantly of glacial till dating from the Anglian glaciation, interspersed with sheets of glacial sands and gravels (Figure 3.2).





Legend:

- Onshore Scoping Area
- Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
- Cable Relay Station Zone
- Landfall Zone

Bedrock Geology[1]

- Neogene to Quaternary Rocks (Undifferentiated) - Gravel, Sand, Silt and Clay
- White Chalk Subgroup - Chalk
- Thames Group - Clay, Silt, Sand and Gravel

[1] British Geological Survey, 2016.

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Title:

Bedrock Geology

Figure: 3.1 Drawing No: PB5640-102-033

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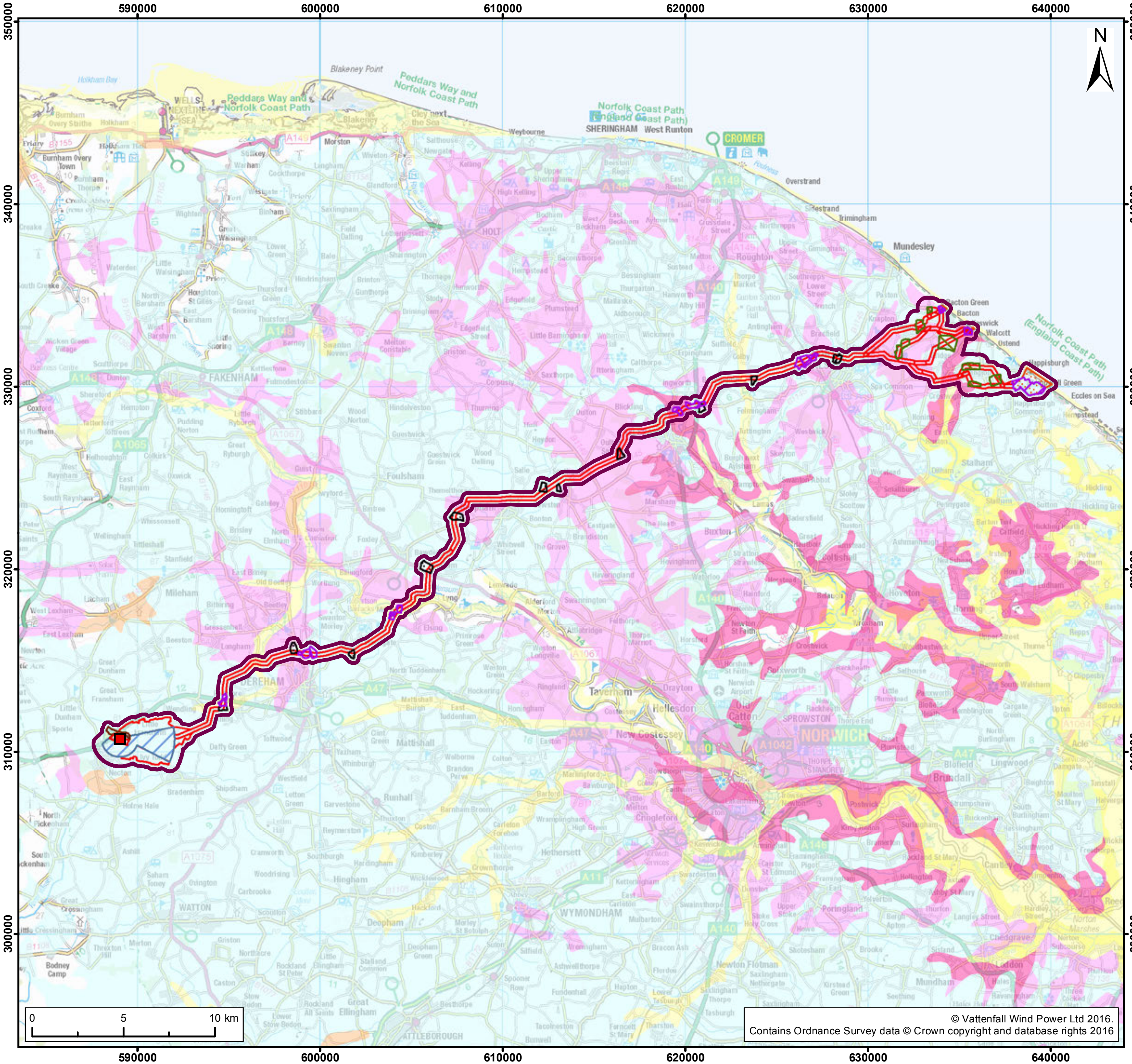

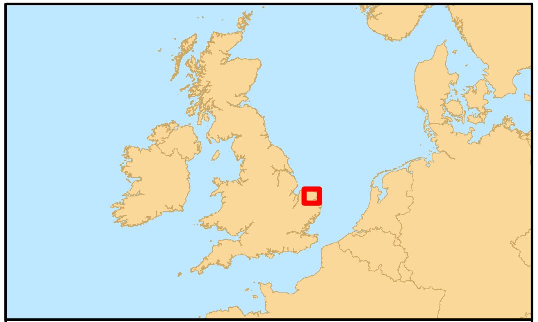

Legend:

- Onshore Scoping Area
- Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
- Cable Relay Station Zone
- Landfall Zone

Superficial Geology[1]

- Till - Diamicton
- Glacial Sand and Gravel
- Crag group - Sand and Gravel
- Alluvium - Clay, Silt and Sand
- River Terrace deposits - Undifferentiated Sand and Gravel
- Brickearth - Silt

[1] British Geological Survey, 2016.

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Superficial Geology

Figure: 3.2 Drawing No: PB5640-102-034

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3.2.1.3 Mineral Safeguarding Areas

893. A Mineral Safeguarding Area is an area designated by a Minerals Planning Authority which covers known deposits of minerals which should be kept safeguarded from unnecessary sterilisation by non-mineral development.

894. There are several Mineral Safeguarding Areas within the proposed onshore works area. These are mostly sands and gravels associated with river valleys.

3.2.1.4 Hydrogeology

895. Regionally, the principal groundwater body covering the majority of the area of the proposed onshore works area is the Broadland Rivers Chalk & Crag. The Chalk & Crag aquifers are classified as Principal Aquifers and a number of groundwater Source Protection Zones (SPZs) are identified within the area. The Norfolk Boreas onshore works search area includes several SPZs (Figure 3.3) including four inner (Zone 1) SPZs, located in the vicinity of Bradenham, Hoe, Cawston and North Walsham.

896. The proposed onshore works search area is underlain by four groundwater bodies, as defined under the Water Framework Directive:

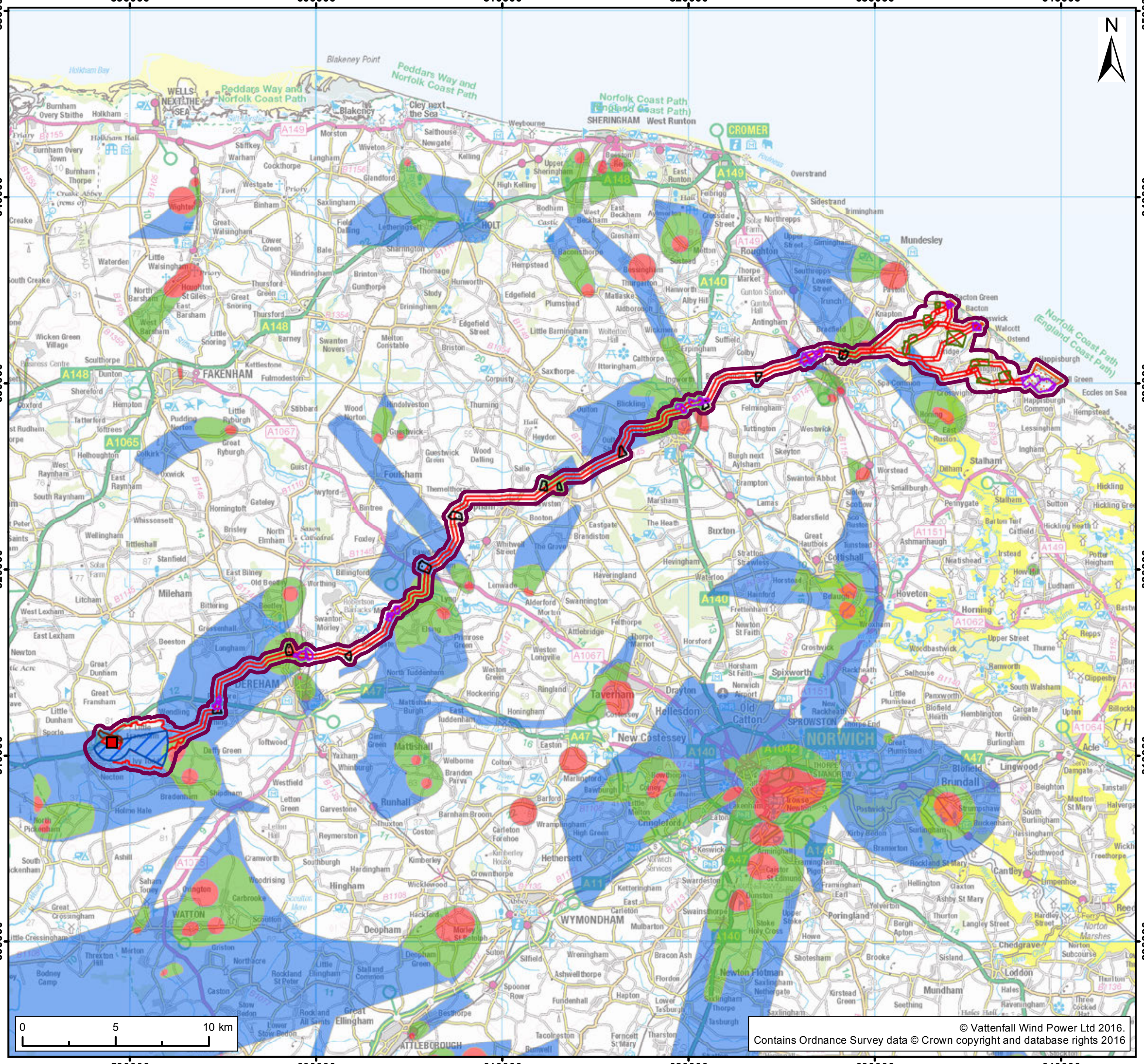
- Broadland Rivers Chalk and Crag (GB40501G400300).
- Cam and Ely Ouse Chalk (GB40501G400500).
- North Norfolk Chalk (GB40501G400100).
- North West Norfolk Chalk (GB40501G400200).

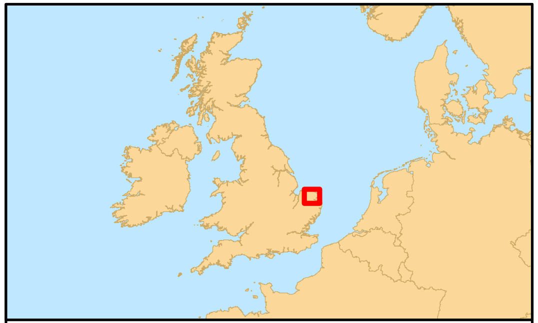
897. The status of these water bodies is discussed in more detail in Section 3.4.

3.2.1.5 Land quality

898. The majority of the proposed onshore scoping area is largely agricultural in land use. There is some potential for both diffuse and point sources of pollution from current and past agricultural activities to have affected soil and groundwater quality.

899. Settlements within the onshore scoping area include the towns of North Walsham, Aylsham, Dereham and Reepham and both roads and railway lines cross though this area. There is potential for ground contamination to be present as a result of historical activities in these areas, particularly in association with the Bacton Gas Terminal, historic and active landfill sites, railway land and highways (Figure 3.4).





Legend:

- Onshore Scoping Area
- Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
- Cable Relay Station Zone
- Landfall Zone

Source Protection Zone[1]

- 1
- 2
- 3

Environment Agency, 2016.

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Title:

Source Protection Zones

Figure: 3.3 Drawing No: PB5640-102-035

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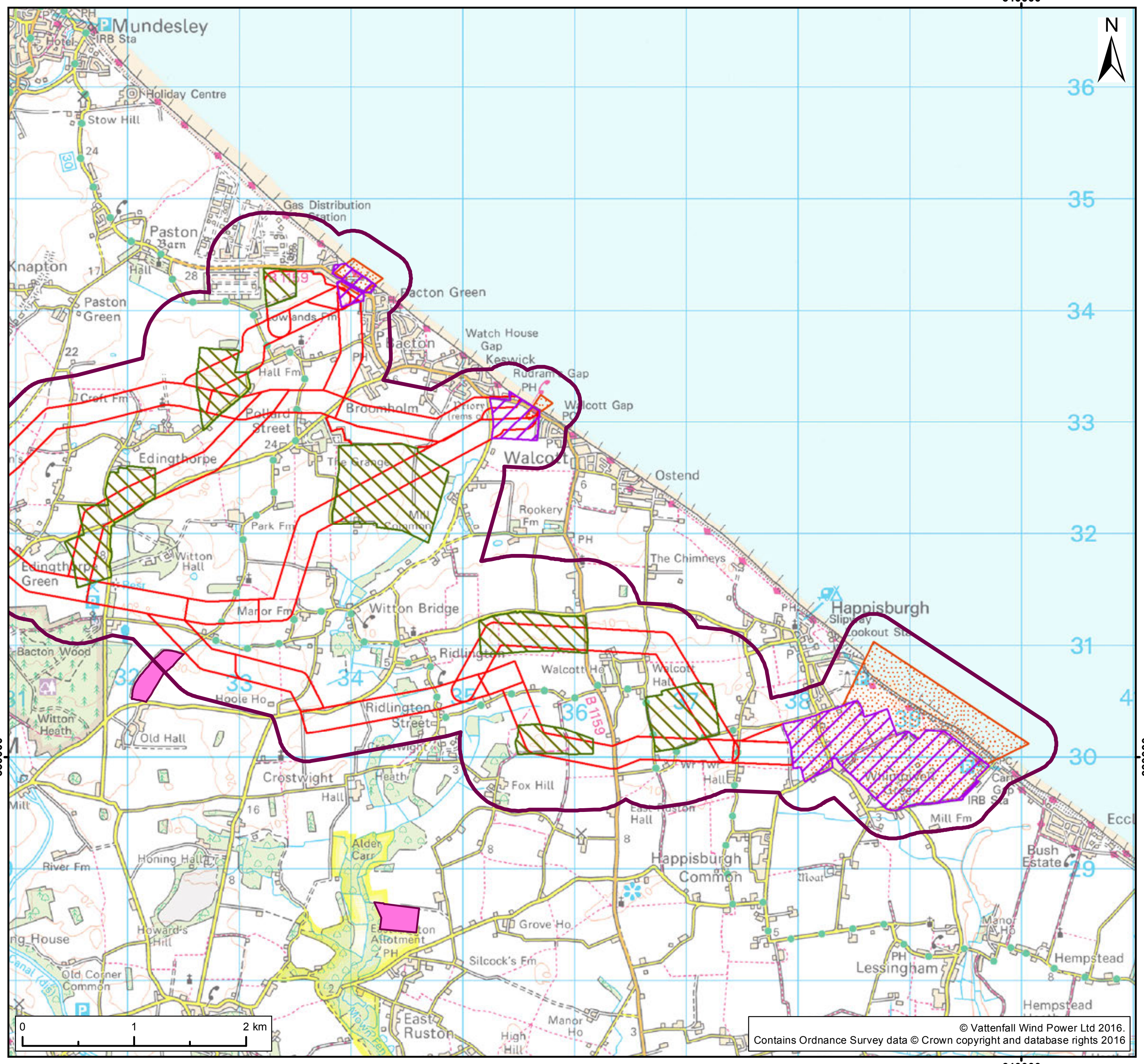

Legend:

- Onshore Scoping Area
- Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Cable Relay Station Zone
- Landfall Zone
- Historic Landfill Site
- Authorised Landfill Site

Environment Agency, 2016.

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Landfills

Figure: 3.4a | Drawing No: PB5640-102-036

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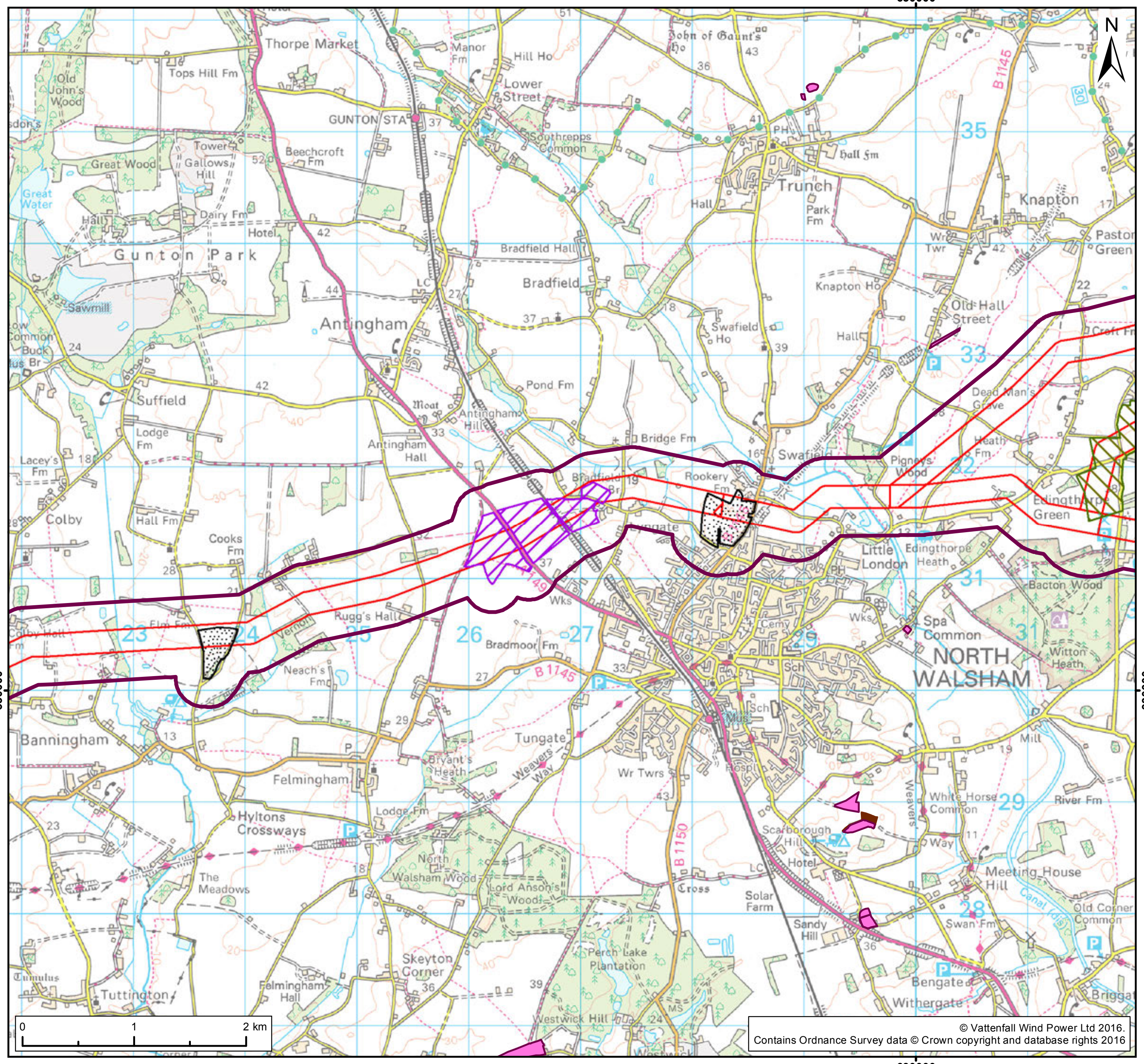

Legend:

- Onshore Scoping Area
- Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
- Cable Relay Station Zone
- Historic Landfill Site
- Authorised Landfill Site

Environment Agency, 2016.

Project: Norfolk Boreas

Report: Environmental Impact Assessment Scoping Report

Title: Landfills

Figure: 3.4b   Drawing No: PB5640-102-036

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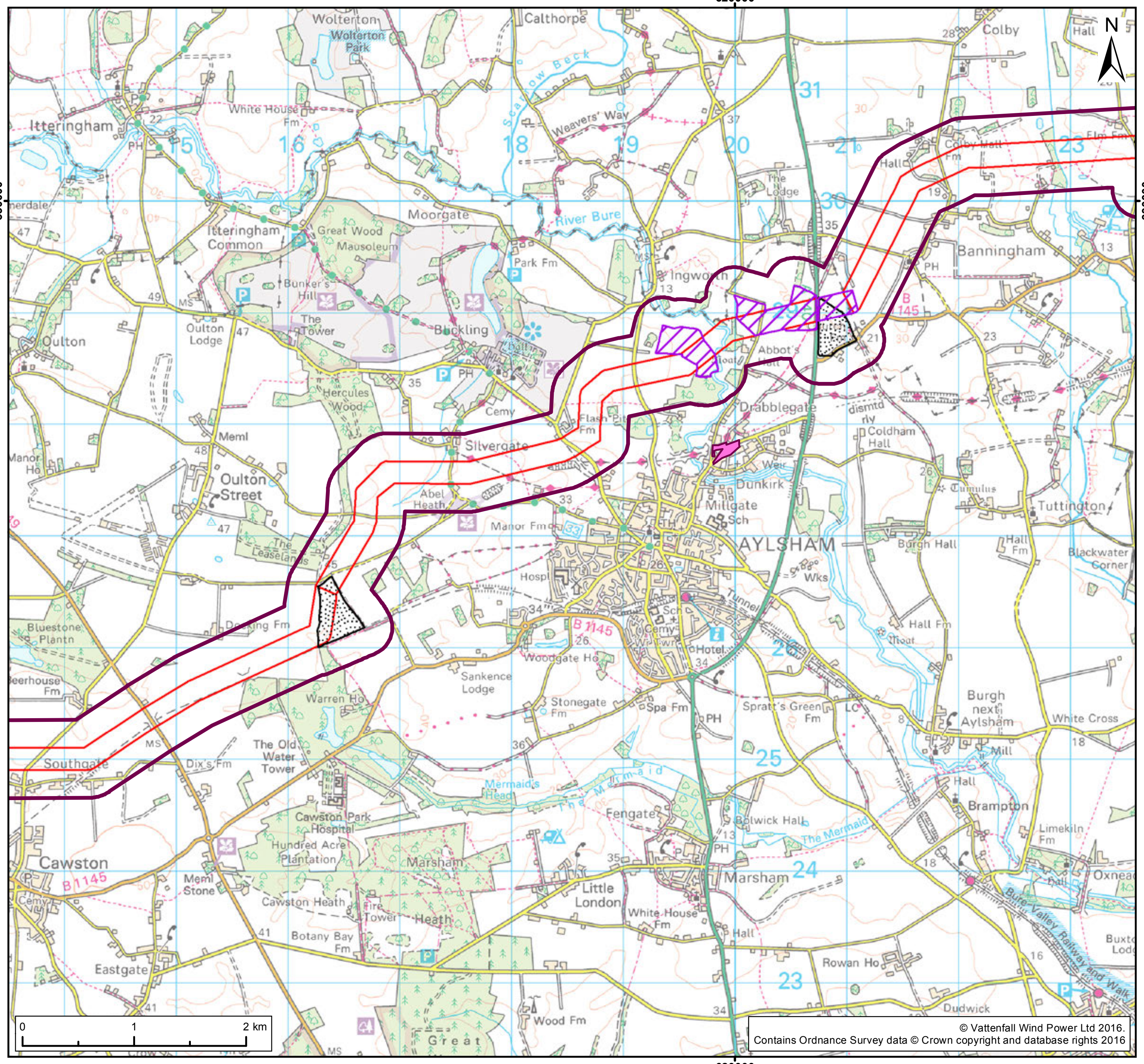

Legend:

- Onshore Scoping Area
- Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
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- Authorised Landfill Site

Environment Agency, 2016.

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Landfills

Figure: 3.4c | Drawing No: PB5640-102-036

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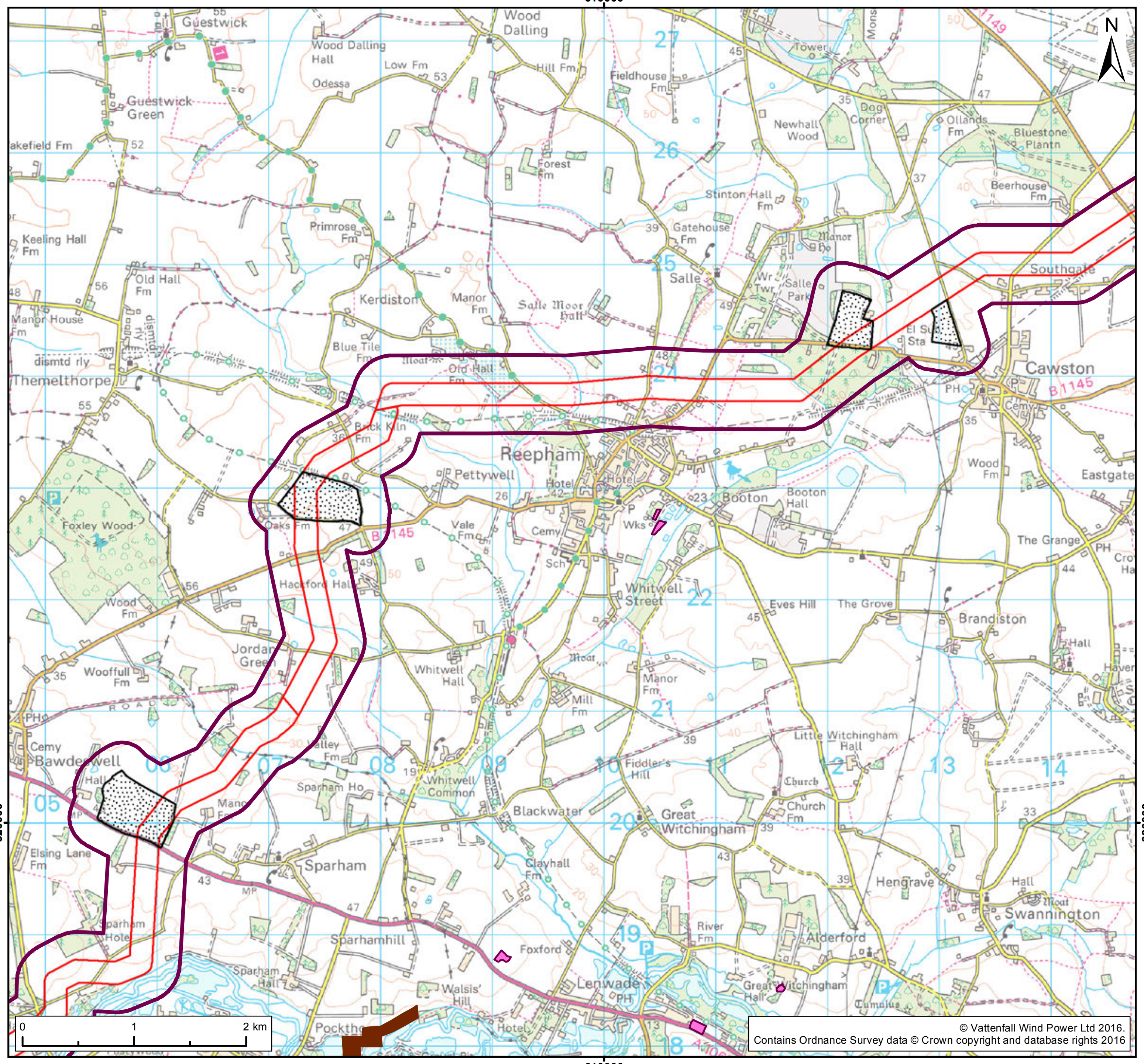

Legend:

Onshore Scoping Area

Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

Onshore Cable Corridor

Mobilisation Zone

Historic Landfill Site

Authorised Landfill Site

Environment Agency, 2016.

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Landfills

Figure: 3.4d Drawing No: PB5640-102-036

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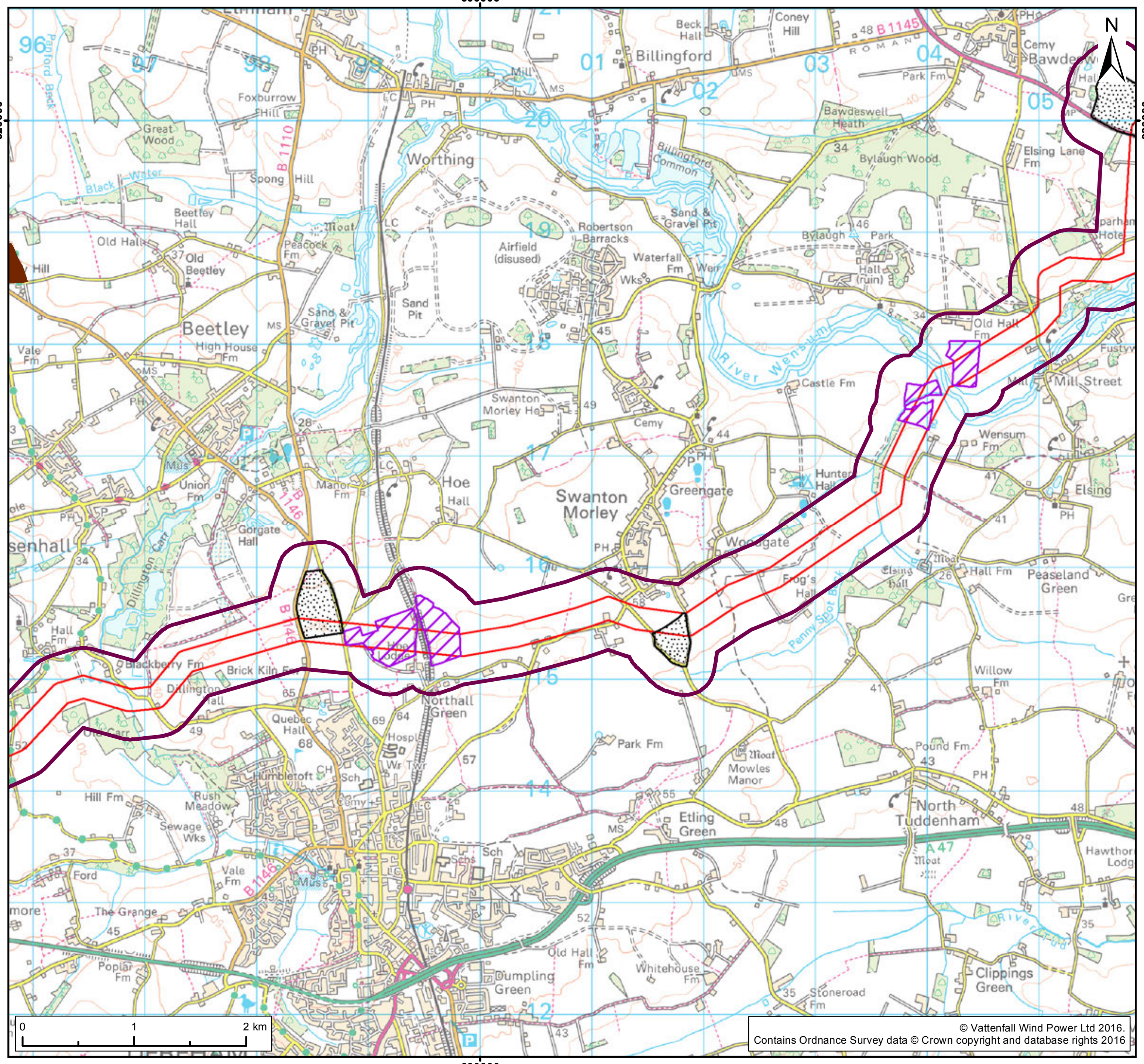

Legend:

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Norfolk Boreas Onshore Infrastructure

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- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
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Environment Agency, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Landfills

Figure: 3.4e Drawing No: PB5640-102-036

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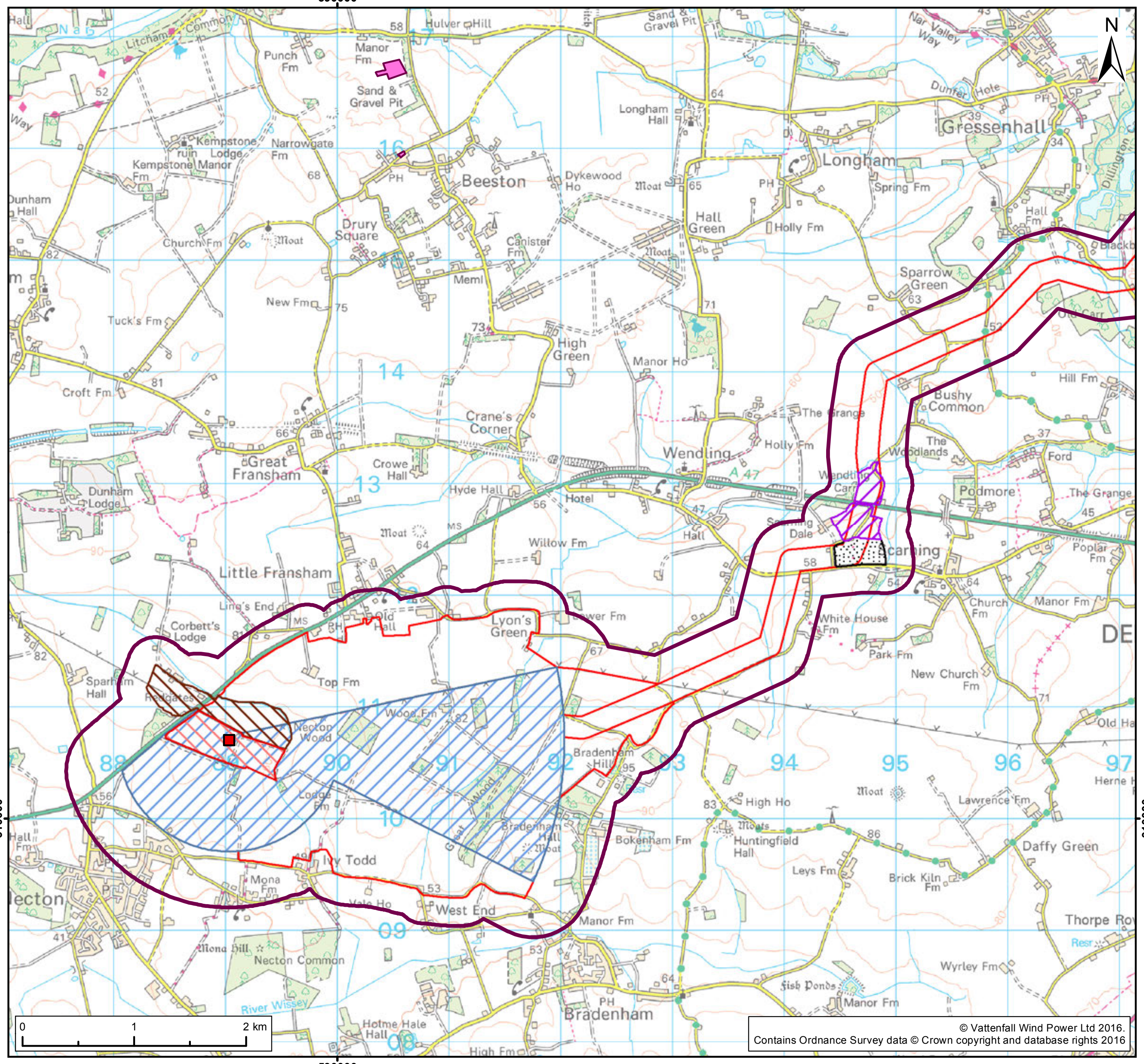

Legend:

- Onshore Scoping Area
- Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
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Environment Agency, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

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Landfills

Figure: 3.4f | Drawing No: PB5640-102-036

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3.2.1.6 Designated geological sites

900. Happisburgh Cliffs Site of Special Scientific Interest (SSSI) is designated specifically for its geological interest (Figure 3.11). The cliffs are an important site for dating the Pleistocene succession in East Anglia, and are particularly important for several main features:

- Cliff exposures which uniquely show three glacial deposits.
- The Anglian-aged Cromer Tills, with intercalated water-deposited sediments.
- The underlying Cromer Forest-bed Formation, which is exposed at the foreshore and supports excellent development of pre-Pastonian and Pastonian deposits.

3.2.2 Potential impacts

901. Full details of the project description are provided in Section 1.5.

3.2.2.1 Potential impacts during construction

902. During construction activities, the following impacts may occur:

903. **Contaminant mobilisation from earthworks during construction:** The excavation of the cable trench, earthworks for substation construction and the excavation and stockpiling of soils has the potential to mobilise existing ground contamination (if present), which could result in unacceptable human health risks to construction workers and pollution risks to controlled waters (surface water and groundwater). The identified Inner Groundwater SPZs are particularly sensitive in this regard.

904. Physical impacts on groundwater resources (i.e. on groundwater level) will be discussed in the Water Resources and Flood Risk chapter of the ES and cross referenced to this chapter as appropriate.

905. **Alteration to coastline, including coastal geological designated sites:** The proposed landfall works have the potential to impact upon coastal processes, and could therefore affect rates of erosion in a dynamic coastal area. These activities therefore have the potential to affect geological designated sites and/or existing coastal defence works. Impacts on Happisburgh Cliffs SSSI will be discussed in the Marine Geology, Oceanography and Physical Processes chapter of the ES and cross referenced to this chapter as appropriate.

906. **Sterilisation of mineral resources and waste generation:** The proposed landfall works cross numerous mineral safeguard areas and would prevent future extraction of sand and gravel resources within the cable easement and the duct excavations would generate a significant volume of surplus waste material, not required for backfill. It is unlikely to be cost-effective to extract sand and gravel resources prior to

construction because this would extend the area of excavation and necessitate the importation of backfill material. It is likely that there would be opportunities to reduce waste by re-using suitable material as aggregate during the construction phase.

3.2.2.2 Potential impacts during operation

907. There are unlikely to be any significant impacts from the operation of Norfolk Boreas. Operation and maintenance activities would follow standard procedures therefore minimising any potential impacts. Non-routine maintenance would be subject to robust and effective planning and risk assessment procedures. It is therefore proposed that these impacts should be scoped out from further consideration within the EIA.

3.2.2.3 Potential impacts during decommissioning

908. No decision has been made regarding the final decommissioning policy for the substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. It is likely that the substation and cable relay station equipment would be removed and reused or recycled. It is expected the onshore cables would be removed from ducts and recycled, with the transition pits and cable ducts left in situ.

909. The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator.

910. It is anticipated that the decommissioning impacts would be similar in nature to those of construction.

3.2.2.4 Potential cumulative impacts

911. The approach to assessing cumulative impacts is detailed in Section 3.13.

912. Cumulative impacts may arise in relation to the mobilisation of contaminants, alterations to the coastline and sterilisation of mineral resources.

913. Further consideration will be given to these potential cumulative scenarios as part of the EIA in combination with other projects, particularly in respect to the combined Norfolk Vanguard and Norfolk Boreas scenarios, and the cable route for the proposed Hornsea Project 3.

3.2.2.5 Summary of potential impacts

Table 3.2 Summary of impacts relating to ground conditions and contamination

Potential impacts	Construction	Operation	Decommissioning
Contaminant mobilisation from earthworks during construction	✓	x	✓
Alteration to coast line, including coastal geological designated sites	✓	x	✓
Sterilisation of mineral resources and waste generation	✓	x	✓
Cumulative impacts	✓	x	✓

Scoped in (✓) and scoped out (X)

3.2.3 Mitigation

914. At this stage, no additional mitigation measures are expected to be needed beyond those embedded in the design of Norfolk Boreas.

915. Embedded mitigation is expected to include the following:

- Avoidance of impact through site selection (e.g. avoidance of areas with contamination risk and sensitive receptors);
- Avoidance of impact through engineering techniques (e.g. trenchless techniques at sensitive points). It is noted that although trenchless techniques are a recognised method of working at sensitive locations, there may be residual risks to the environment and these will still be addressed in the ES; and
- Development of and compliance with a CoCP to ensure all appropriate Pollution Prevention Guidelines and good practice guidelines are followed. A draft CoCP will be submitted as part of the DCO.

3.2.4 Approach to assessment and data gathering

916. The approach to assessment and data gathering outlined below is informed by methodology discussed with regulators during the EPP for Norfolk Vanguard.

3.2.4.1 Ground contamination

917. The assessment of ground contamination impacts will consider human health and controlled waters (surface water and groundwater resources). The assessment will follow the Source-Pathway-Receptor approach, which identifies potential pollutant linkages that may result in unacceptable risks to receptors from ground contamination. For a risk to exist, the following elements must be present:

- Source: A potentially polluting activity or existing ground contamination.

- Pathway: A route or means by which a receptor could be exposed to or affected by contamination.
- Receptor: Something that could be adversely affected by contamination.

918. The ES baseline will comprise a description of the current ground conditions and potential receptors. The impact assessment will compare the baseline to a conceptual site model (CSM) describing feasible pollutant linkages associated with the construction phase of Norfolk Boreas (It is proposed that impacts from the operation and maintenance phase should be scoped out from further consideration within the EIA).

919. The impact assessment will be based on the findings of a land quality Preliminary Risk Assessment (PRA), undertaken in general accordance with following UK guidance (and associated documents):

- Environment Agency Groundwater Protection: Principles and Practice, Version 1.1 (Environment Agency, 2013); and
- Environment Agency Model Procedures for the Management of Land Contamination (Contaminated Land Report (CLR) 11) (DFRA and Environment Agency, 2004).

920. The PRA is a desk-based study that may lead, if required, to intrusive investigation, further risk assessment, options appraisal, remedial design, implementation planning and completion reporting.

921. The PRA will identify potential risks within the study area. Should potentially unacceptable risks be identified, that cannot be mitigated through the use of appropriate personal protective equipment and adherence to a CoCP, targeted soil or groundwater sampling may be undertaken prior to construction works commencing. The ground investigation data would inform a generic quantitative risk assessment (GQRA) that would either confirm that risks to human health and controlled waters are low; or, inform the design of risk mitigation measures. These could include: further ground investigation to refine the risk assessment; remediation of contaminated ground; or, changes to the proposed construction methodology, cable route alignment or scheme design.

3.2.4.2 Mineral resources

922. It has been agreed with Norfolk County Council that the Mineral Planning Authority (MPA) guidance[22] for assessing the impacts of non-mineral development is not appropriate for Norfolk Vanguard onshore works because it would not be cost effective or practical to pre-excavate from MSAs. Instead, a short assessment will be

[22] Guidance Note on the Mineral Safeguarding Process for aggregates – Sand & Gravel and Carstone. Norfolk County Council, November 2014.

produced within the EIA topic chapter, identifying potential volumes of excavated mineral material and focussing on the practicalities of re-using surplus material, with aim of minimising waste and maximising sustainable use and re-use of resources. It is proposed that a similar approach be taken within the Norfolk Boreas EIA.

923. The assessment will identify existing and proposed mineral and waste sites, and safeguard areas, from the published Minerals and Waste Development Plan Documents (Norfolk County Council, 2017a). The route ould be microsited where possible to avoid specific mineral and waste sites identified in the adopted Development Plan Document. The potential volume of reusable spoil will be estimated from MSA mapping, based on the worst-case scenario for the permanent cable easement and any available ground investigation data.

924. The principles for re-use of excavated material will be set out in a materials management plan (MMP) to be followed during construction, which would also deal with excavated waste management.

3.2.4.3 Waste

925. A waste assessment will be provided as an appendix to the Ground Conditions and Contamination chapter of the ES. The appendix would provide details of the waste arisings and good practice management measures in how waste would be considered as part of the project.

926. In addition, the following reports would be provided:

- A waste hierarchy assessment report; and
- A Site Waste Management Plan.

3.3 Air Quality

3.3.1 Baseline

3.3.1.1 Data sources

927. The data sources used to inform the air quality baseline are listed in Table 3.3

Table 3.3 Air Quality Data sources

Source no.	Data	Source	Date
1	Interactive Air Quality Management Area Boundaries map	Defra	2016
2	Local Air Quality Management (LAQM) reports	North Norfolk District Council, Broadland District Council, Breckland Council, and Norwich City Council.	2013 2105 2016 2015

928. Monitoring data were also obtained from the following Local Authority websites for use in this scoping report:

- North Norfolk District Council (NNDC);
- Broadland District Council (BDC);
- Breckland Council (BC); and,
- Norwich City Council.

929. A study area encompassing the Construction Phase Road Traffic Emissions Study Area for traffic related impacts (which will be refined during the EIA process) and a 350m buffer around the onshore scoping area for sensitive receptors (Figure 3.5) has been defined.

930. The maximum extent of the road traffic study area covers an additional four Local Authorities:

- Great Yarmouth District Council (GYDC);
- South Norfolk District Council (SNDC);
- Waveney District Council (WDC); and,
- Kings Lynn and West Norfolk District Council (KLWNDC).

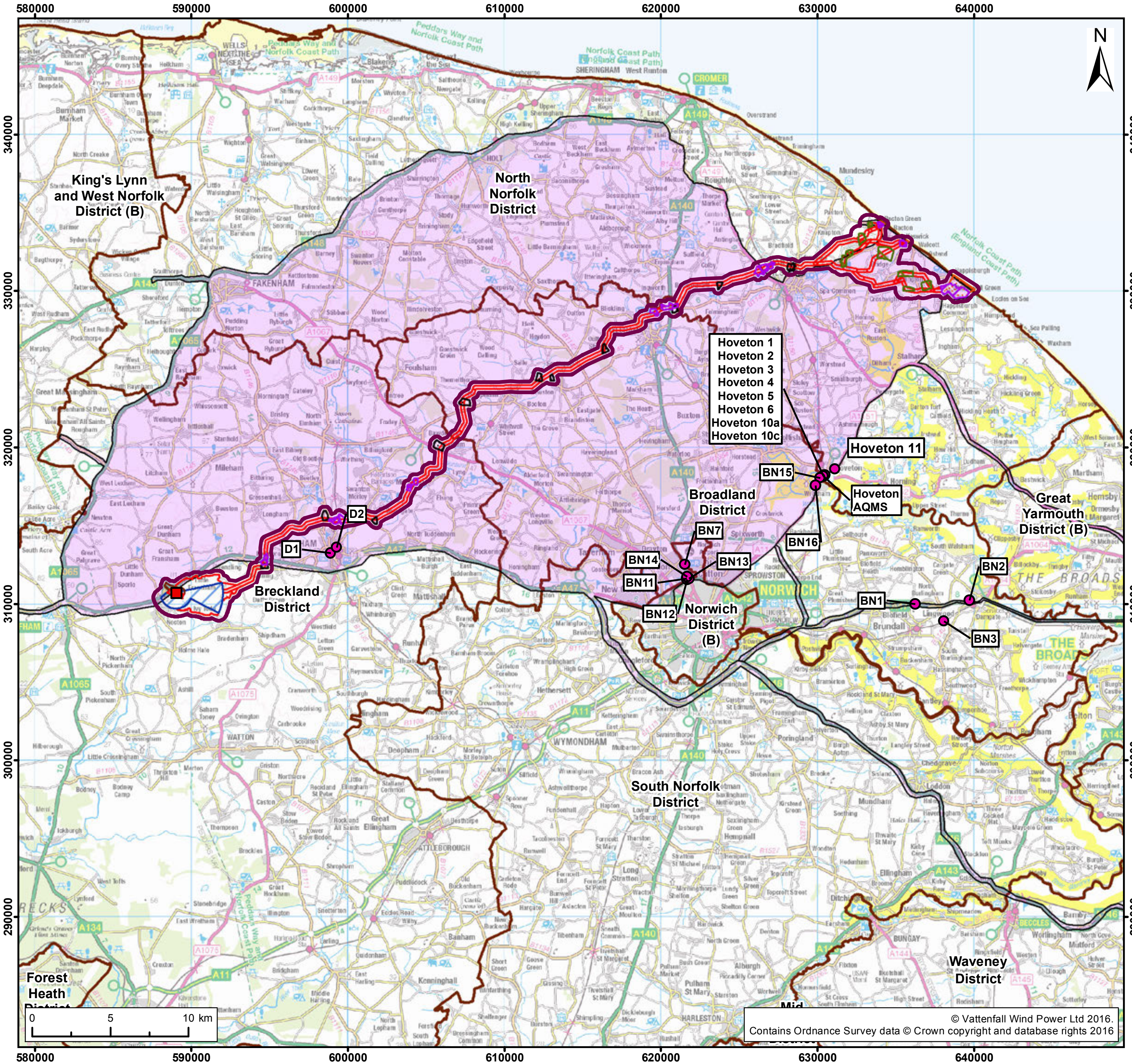
931. Existing baseline monitoring data will be obtained if detailed assessment is required within these Local Authority areas. The monitoring locations identified with the study area are detailed in Figure 3.5. Any available additional data sets will be identified through feedback from stakeholders following this Scoping Request.

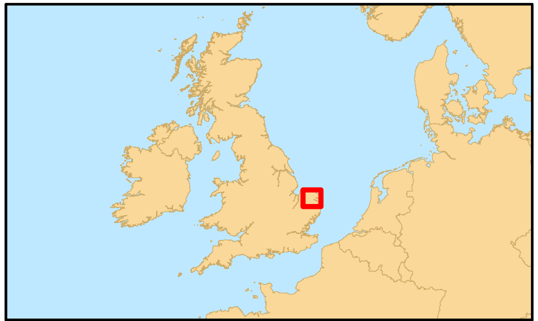
3.3.1.2 Baseline

932. The onshore scoping area is located within the North Norfolk, Broadland and Breckland District Council administrative areas of Norfolk. An initial review of baseline air quality conditions indicated that there are no designated Air Quality Management Areas (AQMA) within the defined onshore scoping area. The closest AQMA is the Norwich City Centre AQMA which is located approximately 17 km from the closest point of the considered onshore scoping area.

Desk based review

933. A desk-based review was undertaken to determine the air quality baseline within the study area.





Legend:

- Onshore Scoping Area
- Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
- Cable Relay Station Zone
- Landfall Zone
- Local Authority Boundary
- Construction Phase Road Traffic Emissions Study Area
- Air Quality Monitoring Location

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Source Protection Zones

Figure: 3.5 Drawing No: PB5640-102-037

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	DT	A4	1:350,000
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Co-ordinate System: British National Grid **EPSG:** 27700

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Construction phase road traffic emissions

934. The study area has currently been considered for construction phase road traffic emissions, based on worst case traffic routes acting in a cumulative way with existing sources of air-borne pollution. Much of the air quality monitoring data within this study area is focused in built up areas which are avoided by the current onshore cable corridor. The onshore scoping area is in itself rural in nature and therefore unlikely to have existing air quality issues.

935. The most recent air quality monitoring data available from the NNDC website were provided in the 2013 Air Quality Progress Report (NNDC, 2013). The 2013 Progress Report stated that monitoring undertaken by NNDC is concentrated within Hoveton, which is located on the boundary of the maximum extent of the Construction Phase Road Traffic Emissions Study Area. NNDC has identified an air quality hotspot around the junction of the A1151 Norwich Road and Station Road in Hoveton with regard to the annual mean NO_2 Objective, although a statutory Air Quality Management Area (AQMA) has not been designated. Annual mean NO_2 concentrations in Hoveton were in exceedance of the Objective in some locations, particularly in 2010; however, there was a large fluctuation in monitored concentrations at diffusion tubes between 2009 and 2012. Data recorded at the continuous analyser showed consistent results in 2011 and 2012.

936. BDC does not undertake automatic air pollution monitoring, however diffusion tube monitoring is undertaken at 16 locations in the district, mainly focussed in the south in Hellesdon, Burlingham and Wroxham. Recent monitoring data within the Construction Phase Road Traffic Emissions Study Area, up to 2014, undertaken by BDC was obtained from the 2015 Updating and Screening Assessment from BDC's website (BDC, 2015). Annual mean NO_2 concentrations were below the Objective at all monitoring locations in the study area in 2010 – 2014.

937. BDC undertakes automatic and diffusion tube monitoring within its area of jurisdiction. The only monitoring undertaken within the maximum extents of the study area is at two diffusion tubes in Dereham. Recent monitoring data were obtained from the 2016 Annual Status Report (BC, 2016). Annual mean NO_2 concentrations were below the Objective at both monitoring locations in the study area in 2011 – 2015.

938. Following a review of its latest Local Air Quality Management report (Norwich City Centre, 2015), Norwich City Council does not undertake any air pollution monitoring within the study area; monitoring is focussed within the city centre statutory designated AQMA which is bordered by the inner ring road. This area is not anticipated to experience increases in project development-generated traffic.

Designated sites

939. There are a number of designated ecological sites within the study area (Section 3.6), which may contain features that are sensitive to nutrient nitrogen and NO_x deposition. Where possible, the current onshore cable corridor, landfall and substation site selection has avoided these designated sites. Consideration will be given to potential impacts on designated sites within the study area. These will be identified in the Onshore Ecology ES Chapter and the potential inter-relationships will be assessed.

Sensitive receptors

940. As the precise locations of the landfall, cable route, construction laydown areas, onshore project substation, cable relay station and National Grid works are not yet defined, identification of specific sensitive receptors could not be undertaken at this stage. The following receptors will be considered in the assessment:

- Human receptor locations sensitive to dust within 350m of proposed construction phase activities;
- Receptors sensitive to air pollution situated within 200m of the road network to be utilised by construction traffic;
- Ecological receptor locations sensitive to dust within 50m of the proposed construction phase activities; and
- Ecological receptor locations within 200m of roads affected by the proposed development.

941. The maximum extent of the study area, for the construction phase dust assessment and road traffic emissions assessment, is detailed in Figure 3.5.

942. It should be noted that not all road links within the study area shown in Figure 3.5 would be affected by traffic associated with Norfolk Boreas. Those links which are expected to receive additional traffic during the construction of the project will be screened as part of the air quality assessment and a detailed assessment will be undertaken for those links that exceed the screening criteria.

3.3.2 Potential impacts

943. Full details of the project description are provided in Section 1.5.

3.3.2.1 Potential impacts during construction

944. The potential impacts associated with the construction phase of Norfolk Boreas are:

- The generation of dust and particulates (e.g. from earth moving or transport of dry materials) potentially having an adverse impact on sensitive receptors; and

- Exhaust emissions from construction traffic having the potential to contribute to local ambient concentrations of nitrogen dioxide (NO_2), and particulate matter (PM_{10} and $PM_{2.5}$).

945. Dust emitted by construction activities has the potential to affect nearby receptors, such as residential properties through:

- Nuisance caused by soiling of surfaces; and
- Effects on human health through fine particulate matter.

3.3.2.2 Potential impacts during operation

946. The potential impacts during the operational phase Norfolk Boreas are likely to be negligible. Operation of the proposed built infrastructure (the substation and cable relay station) and maintenance activities would not lead to a significant change in vehicle flows within the study area.

947. Operational air quality impacts are therefore likely to be negligible and it is proposed to scope this out from further consideration in the EIA process.

3.3.2.3 Potential impacts during decommissioning

948. No decision has been made regarding the final decommissioning policy for the substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. It is likely that the substation and cable relay station equipment would be removed and reused or recycled. It is expected the onshore cables would be removed from ducts and recycled, with the transition pits and ducts left in situ.

949. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan would be provided.

950. It is anticipated that the decommissioning impacts would be similar in nature to those of construction.

951. The decommissioning phase of Norfolk Boreas may result in fugitive dust emissions and a temporary increase in vehicle movements (including HGVs) on the local road network.

3.3.2.4 Potential cumulative impacts

952. The approach to assessing cumulative impacts is detailed in Section 3.13.

953. Cumulative impacts may arise in relation to the generation of dust and particles and exhaust emissions.

954. Further consideration will be given to these potential cumulative scenarios as part of the EIA in combination with other projects, particularly in respect to the combined Norfolk Vanguard and Norfolk Boreas scenarios, and the cable route for the proposed Hornsea Project 3.

3.3.2.5 Summary of potential impacts

Table 3.4 Summary of impacts relating to air quality

Potential impacts	Construction	Operation	Decommissioning
Increase in traffic based air quality pollutant concentrations – human receptor locations	✓	x	✓
Increase in traffic based air quality pollutant concentrations – ecological habitats	✓	x	✓
Construction dust impacts – human receptors	✓	x	✓
Construction dust impacts – ecological habitats	✓	x	✓
Cumulative impacts	✓	x	✓

Scoped in (✓) and scoped out (x)

3.3.3 Mitigation

955. Embedded mitigation is likely to include the following:

- Construction and decommissioning works would be undertaken in accordance with best practice measures (including dust management measures) and proportional to the likely impacts;
- An Air Quality Management Plan would be developed as part of the CoCP; and
- A Construction Traffic Management Plan would be put in place to control employee and HGV movements.

956. Any requirement for additional air quality and dust mitigation measures will be determined through liaison with stakeholders such as the Environmental Health Officer (EHO) through the EPP as part of the air quality impact assessment.

3.3.4 Approach to assessment and data gathering

957. The approach to assessment and data gathering outlined below is informed by methodology discussed with regulators during the EPP for Norfolk Vanguard.

3.3.4.1 Approach to assessment

958. Air quality guidance (IAQM, 2014) identifies specific methodologies for assessing the significance of impacts associated with construction dust and fine particulate matter, and road traffic exhaust emissions. These approaches differ from the standard EIA significance methodology, and are detailed below.

Construction, dust and fine particulate matter

959. The potential effects of the construction phase on nearby receptors are associated with dust soiling onto buildings and cars and people's exposure to airborne dust and fine particulate matter. The Institute of Air Quality Management (IAQM) guidance (IAQM, 2014) on assessing the significance of construction dust effects advises a risk-based approach, considering the scale of the activities and the sensitivity of the potential receptors. The guidance is applicable for standard construction activities, including construction and earthworks, and is therefore considered to be appropriate for the assessment of the potential for construction phase dust impacts associated with a development of this nature.

960. The dust emission magnitude is determined based on the scale of each construction activity to be undertaken. The sensitivity of the study area is determined based on the sensitivity of receptors and their proximity to the construction works. The dust emission magnitude and sensitivity of the area are then combined to determine the risk of effects prior to mitigation.

961. The IAQM recommends mitigation measures that are commensurate with the level of risk of the site. Once these are identified, the significance of construction phase effects can be determined. The aim is to prevent significant effects at receptors due to the implementation of effective mitigation, which is usually achievable.

Construction phase road traffic exhaust emissions

962. In accordance with IAQM and EPUK guidance (IAQM and EPUK, 2015), the requirement for a detailed air quality assessment will be screened using the two-stage criteria approach detailed in the guidance. Because Norfolk Boreas will exceed an area of more than 0.5ha, the screening process proceeds to stage 2 and the following criteria should be applied:

- A change in Light Duty Vehicle (LDV) flows of more than 100 Annual Average Daily Traffic (AADT) within or adjacent to an AQMA, or more than 500 AADT elsewhere; or
- A change in Heavy Duty Vehicle (HDV) flows of more than 25 AADT within or adjacent to an AQMA or 100 AADT elsewhere.

963. If the stage 2 criteria are exceeded, a detailed air quality assessment should be undertaken for each road link exceeding the criteria.

964. Guidance is also provided by the IAQM and EPUK (IAQM and EPUK, 2015) to determine the significance of a development's impact on local air quality. Table 3.5 details the impact descriptors at identified individual receptors that take account of the magnitude of changes in pollutant concentrations, and the concentration in relation to the air quality Objectives.

Table 3.5 IAQM and EPUK Impact Descriptors for Individual Receptors

Long Term Average Concentration at Receptor in Assessment Year	% Change in Concentration Relative to the Air Quality Assessment Level (AQAL)			
	1	2 - 5	6-10	>10
75% or less of AQAL	Negligible	Negligible	Slight	Moderate
76-94% of AQAL	Negligible	Slight	Moderate	Moderate
95-102% of AQAL	Slight	Moderate	Moderate	Substantial
103-109 of AQAL	Moderate	Moderate	Substantial	Substantial
110% or more of AQAL	Moderate	Substantial	Substantial	Substantial

Note: Figures are to be rounded up to the nearest round number. Any value less than 1% after rounding (effectively less than 0.5%) will also be described as "Negligible".

965. Further to the determination of the impact at individual receptors, IAQM and EPUK guidance (IAQM and EPUK, 2015) recommends that assessment is made of the overall significance of the impact of a development on local air quality. The overall significance will need to take into account the following factors:

- The existing and future air quality in the absence of the development;
- The extent of current and future population exposure to the impacts; and
- The influence and validity of any assumptions adopted when undertaking the prediction of impacts.

966. The guidance also states that a judgement of the significance should be made by a competent professional who is suitably qualified. The air quality assessment and determination of the significance of the development on local air quality will be undertaken by experienced members of the IAQM.

3.3.4.2 Data gathering

967. Sufficient Local Authority air quality monitoring data is available for use in the air quality assessment and therefore a site-specific monitoring survey will not be undertaken. This was agreed by the Planning Inspectorate during consultation undertaken for Norfolk Vanguard's onshore works and is assumed to therefore also be the case for Norfolk Boreas. The latest available monitoring data will be obtained during further consultation during the EPP (detailed in Section 1.6.2). Consultation will be undertaken at key stages throughout the EIA process.

3.4 Water resources and flood Risk

3.4.1 Baseline

3.4.1.1 Data sources

968. The data sources to be used to inform the water resources and flood risk baseline within the EIA are shown in Table 3.6:

Table 3.6 Water resource and flood risk data sources

Source no.	Data	Source	Date
1	Information on the current classification and status objectives of surface and groundwater bodies under the WFD, which is included in the Environment Agency's Catchment Data Explorer.	Environment Agency	2016
2	Additional information on water body status, included in the Anglian River Basin Management Plan	Environment Agency	2015
3	Designated sites	Natural England	undated
4	Detailed information on the condition of designated sites	Natural England	undated
5	The Environment Agency's Risk of Flooding from Surface Water tool	Environment Agency	2012
6	Environment Agency's Risk of Flooding from Rivers and Sea (Flood Map for Planning) tool	Environment Agency	2012

969. Any additional data sets will be identified through feedback from stakeholders following this Scoping Request. Consideration will be made of Anglian Water's Resource Management Plan[23].

3.4.1.2 Surface water catchments

970. The onshore works of Norfolk Boreas are located in three main surface water catchments:

- The River Bure and several of its tributaries would be crossed by the onshore cable corridor. The river rises near Briston, from where it flows in an easterly direction until it reaches Aylsham. From here, it continues to flow to the south east until it enters the sea at Great Yarmouth. The downstream reaches of the river include a wide range of wetland features, including Hoveton Great Broad and Marshes,

[23] http://www.anglianwater.co.uk/_assets/media/WRMP_091213.pdf

Woodbastwick Fens and Marshes, Bure Marshes and the Norfolk Broads.

- The River Wensum and several of its tributaries would be crossed by the onshore cable corridor. The river rises near Whissonsett, from where it flows north towards Fakenham before continuing in a broadly south easterly direction towards Norwich. The River Wensum is designated as a SSSI and SAC (see Section 3.6).
- The River Wissey, the headwaters of which would include the proposed grid connection at the existing Necton National Grid substation. The Wissey rises to the south of Dereham, from where it drains in a westerly direction towards Necton before eventually joining the River Great Ouse at Denver Sluice, near Downham Market.

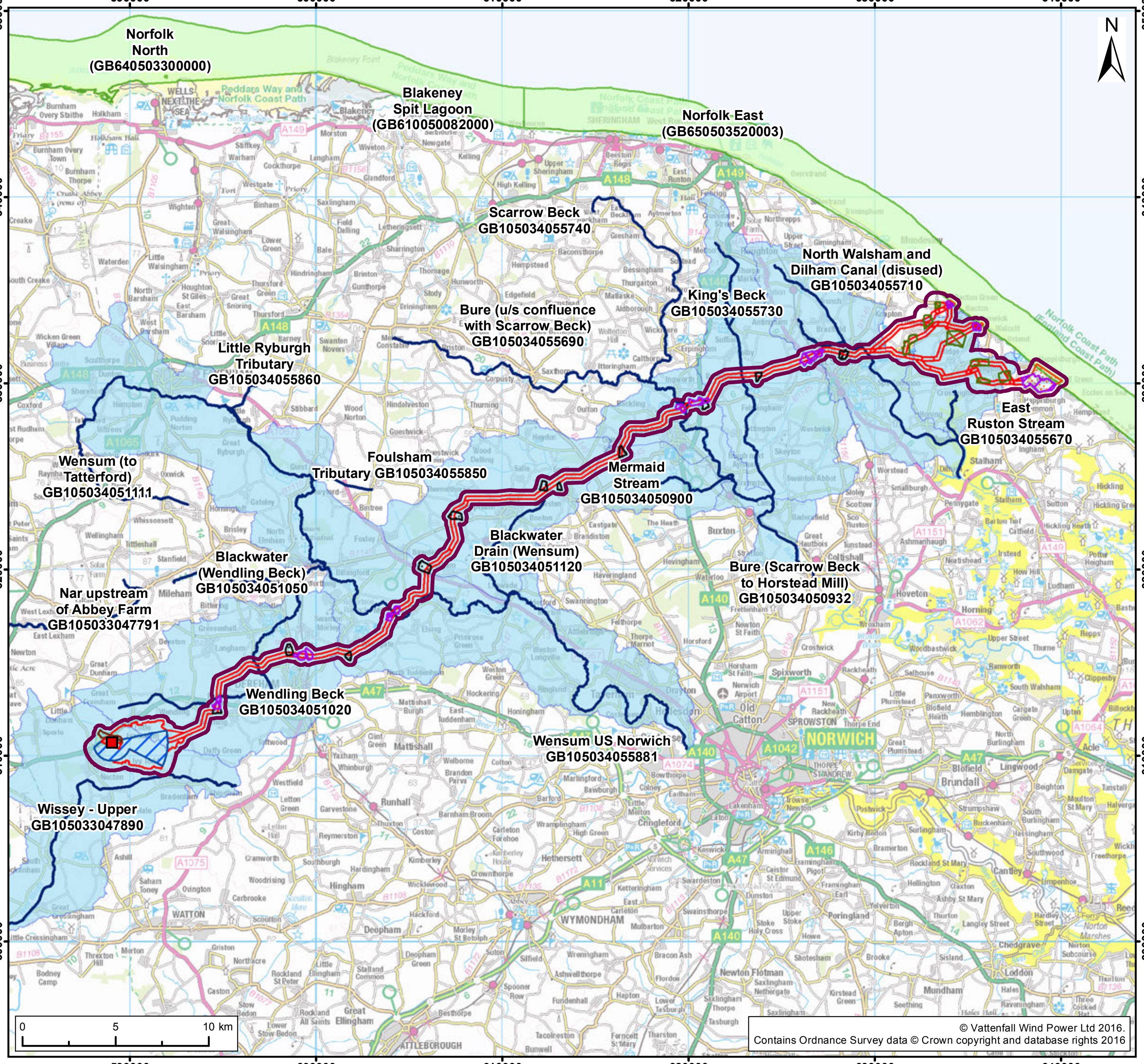
971. Each of these catchments is divided into a number of separate water bodies for Water Framework Directive (WFD) classification purposes. Water bodies that could potentially be affected by Norfolk Boreas have initially been identified using the Environment Agency's Catchment Data Explorer. The initial screening exercise has demonstrated that Norfolk Boreas is located within nine river water body catchments, five of which are directly crossed by the onshore cable corridor (Figure 3.6). The proposed activities are also located within four groundwater bodies (Figure 3.7). Note that all the activities that take place within 1nm of the coast will take place within the Norfolk East coastal water body (Figure 3.6). Further details of each water body are provided in Table 3.7.

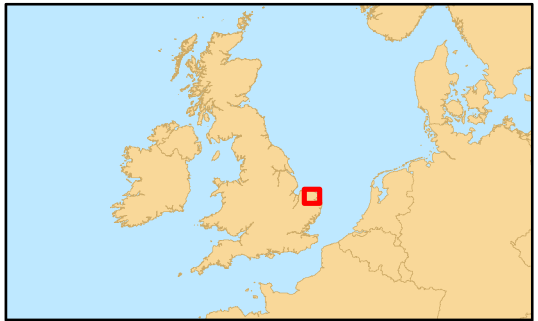
972. The main characteristics of the river water bodies can be summarised as follows:

- The North Walsham and Dilham Canal (GB105034055710) is designated as Heavily Modified due to ongoing land drainage, flood protection and recreational uses. The water body is currently at Bad Ecological Potential as a result of pressures on fish and macrophyte populations.
- The East Ruston Stream (GB105034055670) is a Heavily Modified Water Body due to its ongoing land drainage function. The water body is currently at Moderate Ecological Potential as a result of low dissolved oxygen concentrations and pressures on fish populations.
- The King's Beck (GB105034055730) is Heavily Modified due to its ongoing land drainage function. The water body is currently at Moderate Ecological Potential as a result of pressures on fish and macrophyte populations.
- The River Bure (Scarrow Beck to Horstead Mill) (GB105034050932) is designated as a Heavily Modified Water Body due to its ongoing recreational usage. The water body is currently at Moderate Ecological Potential as a result of pressures on fish and macrophyte populations.
- The Mermaid Stream (GB105034050900) is Heavily Modified due to its ongoing land drainage function. The water body is currently at Moderate Ecological Potential as a result of pressures on fish and a lack of measures to improve geomorphological

diversity

- The Blackwater Drain (Wensum) (GB105034051120) is Heavily Modified due to its ongoing land drainage function. The water body is currently at Moderate Ecological Potential as a result of pressures on fish and macrophytes.
- The River Wensum (upstream of Norwich) (GB105034055881) is designated as a Heavily Modified Water Body on account of its ongoing flood protection function. The water body is currently at Moderate Ecological Potential as a result of hydromorphological modifications and pressures on phytobenthos.
- The Wendling Beck (GB105034051020) is designated as a Heavily Modified Water Body as a result of ongoing land drainage and flood protection functions. The water body is currently at Good Ecological Potential, although pressures on fish and macrophytes are identified in the RBMP.
- The River Wissey (upper) (GB105033047890) is not designated as a Heavily Modified Water Body. The water body is currently at Moderate Ecological Status as a result of modifications to the hydrological regime, high phosphate concentrations, and pressures on macrophytes and phytobenthos.





Legend:

- Onshore Scoping Area
- Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
- Cable Relay Station Zone
- Landfall Zone
- WFD Fluvial Waterbody[1]
- WFD River Waterbody Catchment[1]
- WFD Coastal Waterbody[1]

[1] Environment Agency, 2016.

Project: Norfolk Boreas

Report: Environmental Impact Assessment Scoping Report

Title: Water Framework Directive coastal and fluvial waterbodies

Figure: 3.6 | Drawing No: PB5640-102-038

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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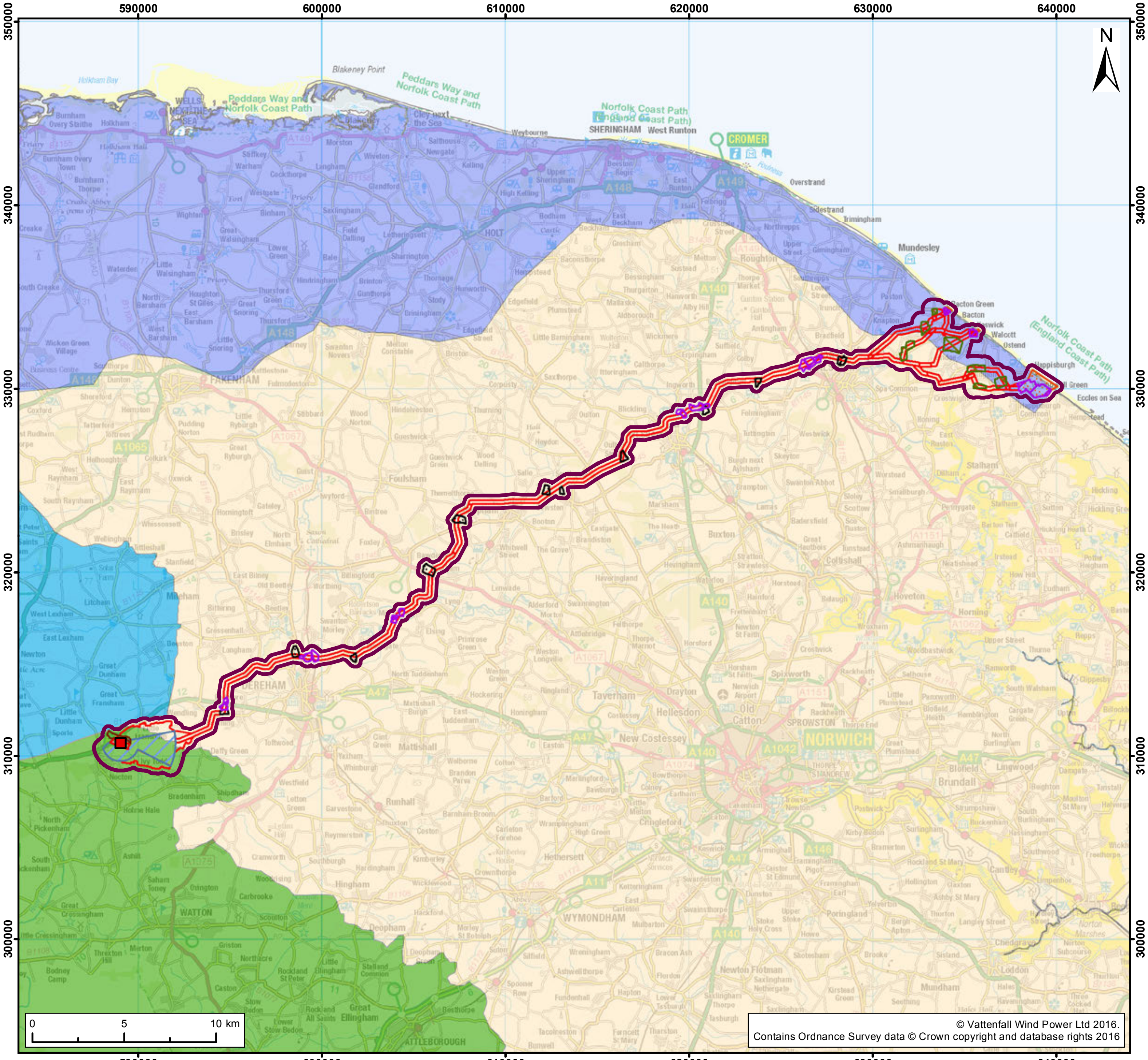

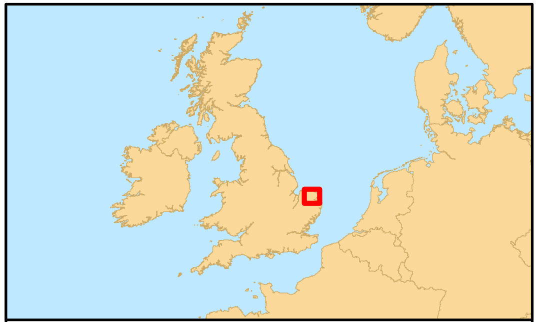

Legend:

- Onshore Scoping Area
- Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
- Cable Relay Station Zone
- Landfall Zone

WFD Groundwater body [1]

- Broadlands Rivers Chalk & Crag
- Cam and Ely Ouse Chalk
- North Norfolk Chalk
- North West Norfolk Chalk

[1] Environment Agency, 2016.

Project: Norfolk Boreas

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Water Framework Directive groundwater waterbodies

Figure: 3.7 Drawing No: PB5640-102-039

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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3.4.1.3 Other surface watercourses

973. The WFD river water body lines presented on Figure 3.6 represent the main stem channel of each watercourse, and were originally based on the Environment Agency's main river network, and there are also a large number of smaller watercourses that drain into these water bodies. These include small streams as well as a large number of agricultural drainage channels. The majority of these features are unnamed and due to the number within the onshore development area cannot be individually listed here.

974. Any further watercourses which have the potential to be impacted by Norfolk Boreas will be identified as part of the more detailed desk based review, prior to commencement of the assessment process.

Table 3.7 WFD water bodies potentially affected by Norfolk Boreas (Figure 3.6)

Water body name	Water body ID	Type	Hydromorphological designation	Current WFD water body status / potential	Project activities required within catchment?	Project crossing main channel?
North Walsham and Dilham Canal	GB105034055710	River	Heavily Modified	Bad	✓	✓
East Ruston Stream	GB105034055670	River	Heavily Modified	Moderate	✓	-
King's Beck	GB105034055730	River	Heavily Modified	Moderate	✓	✓
Bure (Scarrow Beck to Horstead Mill)	GB105034050932	River	Heavily Modified	Moderate	✓	✓
Mermaid Stream	GB105034050900	River	Heavily Modified	Moderate	✓	-
Blackwater Drain (Wensum)	GB105034051120	River	Heavily Modified	Moderate	✓	-
Wensum u/s Norwich	GB105034055881	River	Heavily Modified	Moderate	✓	✓
Wendling Beck	GB105034051020	River	Heavily Modified	Good	✓	✓ (x2)
Wissey - Upper	GB105033047890	River	-	Moderate	✓	-
Norfolk East	GB650503520003	Coastal	Heavily Modified	Moderate	✓	-
Broadland Rivers Chalk and Crag	GB40501G400300	Groundwater	-	Poor	✓	-
Cam and Ely Ouse Chalk	GB40501G400500	Groundwater	-	Poor	✓	-
North Norfolk Chalk	GB40501G400100	Groundwater	-	Poor	✓	-
North West Norfolk Chalk	GB40501G400200	Groundwater	-	Poor	✓	-

3.4.1.4 Flood risk

975. Environment Agency flood zone maps (Environment Agency, 2012a&b) indicate that the majority of the onshore scoping area is located within an area of low flood risk (Flood Zone 1). Flood Zone 1 is defined as land with a less than 1 in 1,000 annual probability of river flooding (<0.1%).

976. At landfall, the infrastructure is located within close proximity to an area of Flood Zone 3, which is deemed to be at high flood risk. This area of high flood risk is likely to be tidally controlled and as such would be deemed to have a 0.5% or greater annual chance of flooding. The area is also shown not to benefit from any formal flood defences.

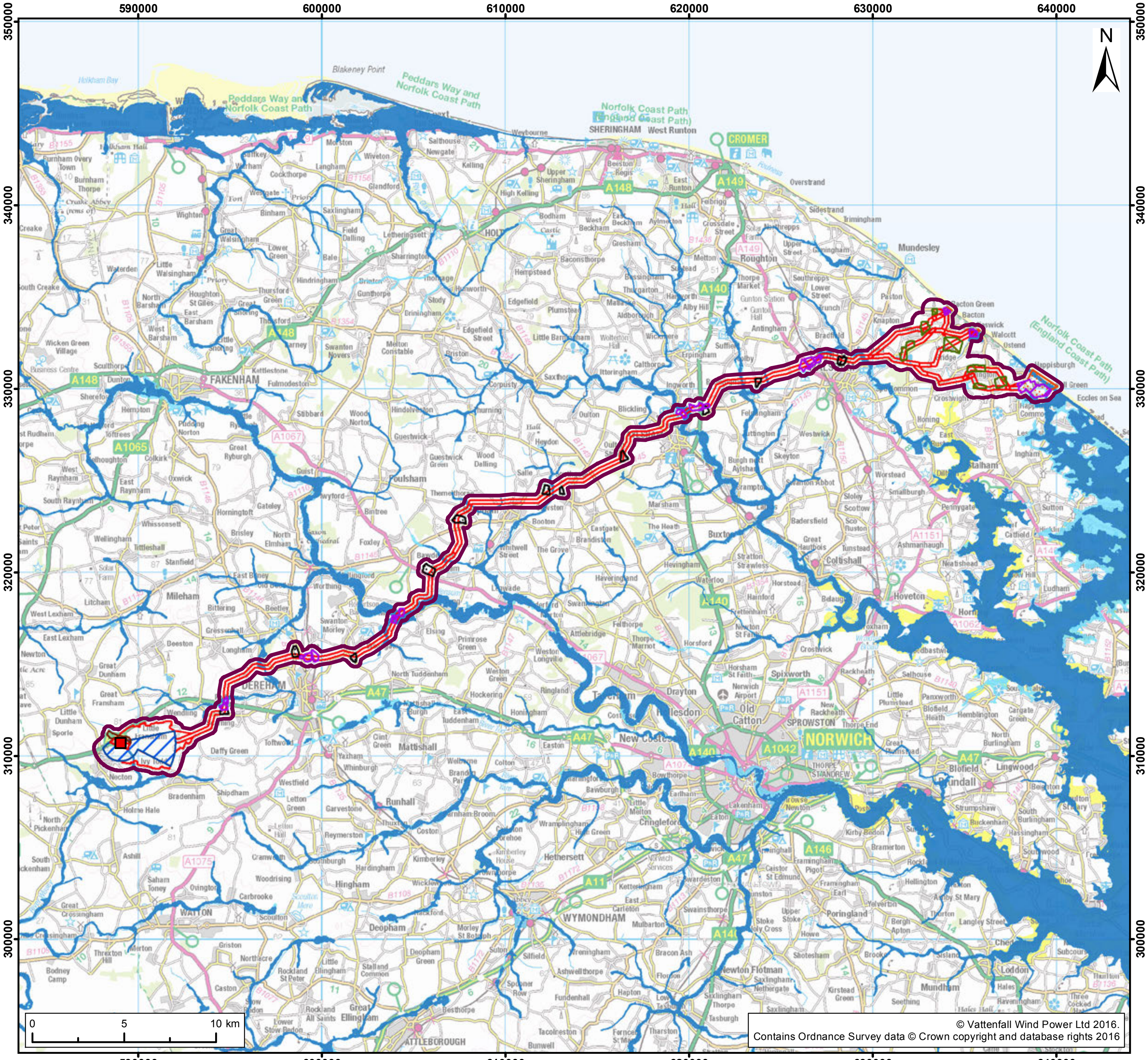
977. The development would intercept a number of watercourses and at these locations. The Environment Agency's flood zone maps show areas of Flood Zone 2 (Figure 3.8), deemed to be at medium fluvial flood risk (between 0.1% - 1% annual risk of flooding) and areas of Flood Zone 3, deemed to be at high fluvial flood risk (1% or greater).

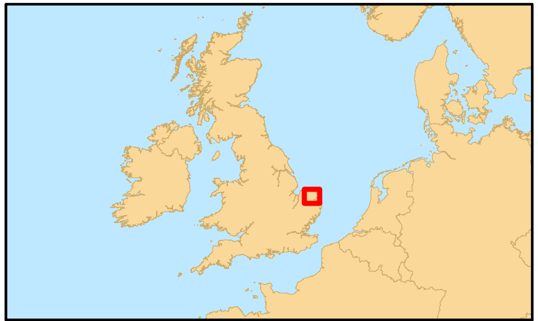
978. It is important to note that Figure 3.6 does not show all watercourses the development would come in contact with, and as such further areas at medium or high risk of fluvial flooding may occur along the development route. Areas designated for substation locations will require further detailed flood risk assessment to ensure all plant is located above any potential flood risk, from fluvial, surface water and other sources.

3.4.1.5 Groundwater

979. Regionally, the principal groundwater body covering the majority of area of the proposed onshore scoping area is the Broadland Rivers Chalk & Crag. The chalk bedrock is designated as a Principal Aquifer and a number of groundwater Source Protection Zones (SPZs) are identified within the area (see Figure 3.3), with both inner and outer zones of the SPZs extending across the eastern section of the onshore cable corridor.

980. There are small sections of the onshore scoping area close to the coast, north of North Walsham, which are underlain by the North Norfolk Chalk groundwater body. The far west of the onshore scoping area, particularly around the proposed grid connection, is underlain by the Cam and Ely Ouse Chalk and North West Norfolk Chalk groundwater bodies (Figure 3.7).





Legend:

- Onshore Scoping Area
- Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
- Cable Relay Station Zone
- Landfall Zone
- Flood Zone 2[1]
- Flood Zone 3[1]

[1] Environment Agency, 2016.

Project: Norfolk Boreas

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Title:

Flood Zones

Figure: 3.8 Drawing No: PB5640-102-040

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3.4.1.6 Designated sites

981. The River Wensum is designated as a Special Area of Conservation (SAC) and Site of Special Scientific Interest (SSSI) on account of the water-dependent features and habitats that it supports.

982. The river was designated as a SSSI because it provides an exceptional example of an enriched, calcareous lowland river, supporting a diverse assemblage of plants and invertebrates. The SSSI is currently in unfavourable condition due to hydrological pressures, high phosphate concentrations, high turbidity and siltation-related issues.

983. The Wensum was also designated as a SAC because it supports Annex 1 watercourses with *Runuculion fluitantis* and *Callitricho-Batrachion* vegetation communities. It also supports Annex II species such as white clawed crayfish, Desmoulin's whorl snail, brook lamprey and bullhead.

3.4.2 Potential impacts

984. Full details of the project description are provided in Section 1.5.

3.4.2.1 Potential impacts during construction

985. **Direct disturbance of surface water bodies:** The installation of the cable infrastructure has the potential to directly disturb the bed and banks of the watercourses it crosses. Although trenchless techniques have been proposed for the larger watercourse crossings (specifically the Rivers Wensum and Bure), it is likely that open trench techniques would also be used for crossing water bodies.

986. The chosen method for all watercourse crossings will be considered on a case by case basis, taking account of the potential impacts for trenchless or open trench techniques. Open trench cutting techniques have the potential to alter the geomorphology of the watercourse by disrupting flow conveyance and sediment transport (particularly of coarse bed sediments), and cause localised disruption to the bed and banks. The likelihood of this occurring is dependent on the method of installation, the size of the crossing in relation to the watercourse, and whether any parts of the cable ducting are proud of the natural bed.

987. All cable ducting would need to be installed at sufficient depth beneath the bed of the watercourse to prevent geomorphological impacts (e.g. bed scour and channel instability) and avoid exposure during periods of higher energy flow where the bed could be mobilised. This depth is dependent upon the characteristics of each individual watercourse, but it would be necessary to install cabling below the active bed to prevent impacts.

988. Temporary dams installed while trenching takes place would reduce flow and sediment conveyance, create upstream impoundment, and could potentially encourage fine sedimentation. They could also act as a barrier to the movement of fish and other aquatic organisms, which is important from a WFD compliance perspective. Furthermore, other temporary structures such as bridges, which may require additional temporary works, also have the potential to affect the geomorphology of the channel.

989. **Increased surface water runoff and altered groundwater flows**: The proposed onshore infrastructure has the potential to alter surface drainage patterns, increase surface water runoff and increase flood risk as a result of:

- The installation of surface and buried infrastructure, which has the potential to change surface and subsurface flow routes and change the distribution of groundwater;
- The installation of watercourse crossings, which has the potential to alter surface flows (e.g. by impounding watercourses);
- Soil compaction by construction vehicles, which could potentially reduce infiltration and increase surface runoff; and
- Any dewatering of trenches could increase surface flows.

990. **Increased sediment supply:** The proposed construction activities (at the landfall, cable relay station, onshore cable corridor, onshore project substation and National Grid substation extension and overhead line modification construction sites) would involve extensive earthworks and create areas of bare ground by removing surface vegetation cover. This is likely to increase the potential for the erosion of soil particulates, resulting in an increase in the supply of fine sediment to surface watercourses through surface runoff.

991. Increased sediment supply could also result in increased deposition on the bed of the channel. This could smother existing substrates, and could potentially cause deterioration in the status of the morphology of the affected channel.

992. In addition, an increase in fine sediment supply could result in localised increases in turbidity and may temporarily increase sediment deposition in the channel downstream. This could potentially smother existing bed habitats and reduce light penetration, adversely affecting biological quality elements (e.g. macrophytes, aquatic invertebrates and fish) and causing deterioration in water body status. Chalk streams such as the River Wensum are likely to be particularly sensitive to such increases in fine sediment supply.

993. **Accidental release of fuels, oils, lubricants and construction materials**: There is the potential for the accidental release of lubricants, fuel oils and drilling fluid from

construction machinery (including HDD equipment) working in or adjacent to surface watercourses, through spillage, leakage and in-wash from vehicle storage areas after rainfall. There is also the potential for accidental release of construction materials (including concrete) into the aquatic system during construction.

994. If significant leakage or spillage is left unmitigated, there is the potential for adverse impacts upon water quality if these substances enter the river water bodies or percolate into the groundwater body. Any changes in surface or groundwater quality could also affect potable water quality (particularly of any private water supplies in the area).

3.4.2.2 Potential impacts during operation

995. **Increased surface water run-off:** The permanent above-ground infrastructure, including the landfall, cable relay station, onshore project substation, extension to the existing Necton National Grid substation and any new, permanent access tracks are likely to result in enduring changes to land use. The change in use from existing agricultural land use could create an increase in impermeable area locally. Whilst permeable surface treatments would be used where possible, the substation and cable relay station are expected to include areas of roads and other areas of development with impermeable surfaces.

996. There is likely to be an increase in surface water runoff from impermeable areas. This could impact upon the hydrology of the surface water system and increase downstream flood risk. Furthermore, increases in runoff could also result in permanent changes to geomorphology and physical habitat condition as a result of changes to surface water flows (e.g. increased runoff and flow velocities). These could impact upon the geomorphology of surface watercourses by increasing erosion rates and encouraging geomorphological adjustment.

997. **Supply of fine sediment and other contaminants:** The operation of Norfolk Boreas could result in the supply of fine sediment, fuels, oils and lubricants from the road network and other impermeable surfaces. This could potentially affect the geomorphology and water quality in the surface drainage network. Any changes in surface or groundwater quality could also affect potable water quality (particularly of any private water supplies in the area).

998. **Changes to water quality as a result of imported fill material:** There is potential for changes to the chemistry of ground and surface waters as a result of the importation of fill material along the cable route, particularly if the fill has a different pH to the material it is replacing. This could potentially affect water quality and ecological receptors. There is also potential for any changes in water quality to affect the quality of any private water supplies in the vicinity.

3.4.2.3 Potential impacts during decommissioning

999. No decision has been made regarding the final decommissioning policy for the substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. It is likely that the substation and cable relay station equipment would be removed and reused or recycled. It is expected the onshore cables would be removed from ducts and recycled, with the transition pits and ducts left in situ.

1000. The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan would be provided.

1001. It is anticipated that the decommissioning impacts would be similar in nature to those of construction.

3.4.2.4 Potential cumulative impacts

1002. The approach to assessing cumulative impacts is detailed in Section 3.13.

1003. Other developments with potential to impact upon water resources and flood risk receptors will be considered. These are likely to include schemes that involve watercourse crossings, other forms of direct disturbance to the river channel, and ground disturbance that could potentially increase the supply of sediment and other contaminants into the surface drainage system.

1004. Further consideration will be given to these potential cumulative scenarios as part of the EIA in combination with other projects, particularly in respect to the combined Norfolk Vanguard and Norfolk Boreas scenarios, and the cable route for the proposed Hornsea Project 3.

3.4.2.5 Summary of potential impacts

1005. A summary of impacts relating to water and flood risk is presented in Table 3.8.

Table 3.8 Summary of impacts relating to water resources and flood risk

Potential impacts	Construction	Operation	Decommissioning
Impacts on water resources	✓	✓	✓
Flood risk	✓	✓	✓
Cumulative impacts	✓	✓	✓

Scoped in (✓) and scoped out (X)

3.4.3 Mitigation

1006. Embedded mitigation is likely to include the following:

- Avoidance of impact through cable route selection (i.e. avoiding the inner zone SPZ);
- Avoidance of impact through methodology selection (e.g. trenchless techniques to drill under certain water bodies and other sensitive receptors). It is noted that although trenchless techniques such as HDD are recognised as a method of working at sensitive locations, there may be residual risks to the environment and these will still be addressed in the ES and CoCP;
- Development of a CoCP in line with relevant CIRIA guidance and Pollution Prevention Guidelines, taking account of objectives of the WFD and the actions outlined in the RBMP;
- Application for any water resources licences;
- Development of a draft drainage strategy to manage surface run-off during construction;
- Development of a draft drainage strategy for permanent above-ground developments (i.e. substation, metalled roads);
- Reuse of as much of the local fill material as possible to avoid changes in soil chemistry, and ensure the chemistry of any imported material is as close to local conditions as reasonably possible; and
- Consideration of Sustainable Drainage Systems (SuDS) schemes in accordance with appropriate guidance including “Non-statutory technical standards for sustainable drainage systems”, Department for Environment, Food and Rural Affairs (2015).

1007. In addition to embedded mitigation, potential further mitigation measures will be identified through the EPP in consultation with the Environment Agency, Norfolk County Council and relevant Internal Drainage Boards across the onshore cable corridor.

1008. Additional mitigation measures would be discussed and agreed with stakeholders depending on any potential impacts identified.

3.4.4 Approach to assessment and data gathering

1009. The approach to assessment and data gathering outlined below is informed by methodology discussed with regulators during the EPP for Norfolk Vanguard.

1010. The assessment would be informed by desk-based assessment and review of available data from the Environment Agency and Lead Local Flood Authority (LLFA), site visits, consultation with relevant statutory consultees (Local Authority LLFA, Environment Agency, Natural England and the appropriate Water Authority) and a field survey.

Desk based assessment

1011. The desk-based assessment would involve a review of publicly available information sources, such as:

- Historical maps;
- Geological maps;
- BGS borehole records and ground water levels;
- Topographical survey data;
- Any previous site investigation data obtained from the local authority and the Environment Agency;
- Public sewer records; and
- Flood mapping and hydrological investigations carried out by the Environment Agency.

1012. GIS analysis will be used to identify potential receptors, based on the potential for hydrological connectivity with Norfolk Boreas activities. This will be informed by comparing the site red line boundary (including details of the location of cable route, relay stations, substations and all access routes) to three primary data sets:

- WFD river water body outlines, which represent discrete catchments (or sub-catchments) for surface hydrology. Any activities undertaken within these catchments have the theoretical potential to impact upon water receptors within the catchment area;
- A detailed representation of the surface drainage network, which will be used to identify individual surface water receptors within each catchment that could potentially be affected by Norfolk Boreas; and
- WFD groundwater body outlines, which will be used to identify sub-surface water receptors.

1013. The results of this GIS analysis will be used to:

- Produce a definitive list of surface water receptors that could be indirectly impacted by Norfolk Boreas (e.g. as a result in changes to hydrology and runoff characteristics); and
- Produce a definitive list of surface water receptors that will be directly impacted (i.e. crossed) by the proposed transmission route.

1014. For each receptor, the potential mechanisms for impact based on the nature of the proposed construction and O&M activities and the degree of hydrological connectivity between them and the receptor will be identified. This will include the potential for changes to surface and groundwater hydrology, geomorphology, water quality and flood risk. This definitive list of receptors will be used as the basis for all subsequent stages of the assessment, including the Environmental Impact Assessment, Flood Risk Assessment, and WFD compliance assessment.

Field data collection

1015. The onshore cable corridor crosses a variety of surface waters, ranging from major watercourses to small agricultural drainage ditches. Norfolk Boreas includes six crossings of watercourses that are designated as main rivers by the Environment Agency and are also river water bodies under the Water Framework Directive (see Section 3.4.1.2 for further information). The onshore cable corridor and onshore grid connection are also close to several other watercourses.

1016. It is proposed that a targeted walkover survey is undertaken to characterise the surface water conditions at each proposed crossing point, and any other watercourses where there is a high potential for impact (e.g. the grid connection point, substations and construction compounds). These surveys will consider a variety of factors that are necessary to characterise the baseline geomorphology, including:

- Flow conditions, including dominant flow types and the degree of variability within each reach.
- Channel form, including planform, width and depth variation, bank form and condition, substrate types and the type and presence of bed forms such as pools, riffles and bars.
- Floodplain characteristics, including connectivity to the river channel, and the structure of the riparian zone.
- Evidence of channel modification, including enlargement and re-sectioning, artificial bank protection, embankments and in-channel structures.

1017. At the proposed crossing points, the walkover survey will encompass the onshore cable corridor width and at least 200m upstream and downstream. In areas where the spatial extent of the works is greater (e.g. the grid connection, substations and construction compounds), the walkover survey will encompass the entire length of any watercourses within the Norfolk Boreas footprint, and, where appropriate, a representative distance upstream and downstream. The walk over survey will assist in the method selection process for each crossing point.

1018. Based on the initial information presented in this report, the following primary locations for the walkover survey have been identified:

1019. The North Walsham and Dilham Canal at Little London.

- King's Beck at Banningham.
- The River Bure at Abbot's Hall Farm, Drabblegate.

- An unnamed tributary of the Blackwater Drain near Sparham.
- The River Wensum at Old Hall Farm, Mill Street.
- Wendling Beck at Old Brigg, Gressenhall, and Podmore.
- Watercourses situated within the proposed grid connection site, including an unnamed tributary draining into the River Wissey to the south of Ivy Todd, and a headwater stream of Wendling Brook adjacent to Great Wood.

1020. Additional surveys may be required if major watercourses are identified in onshore project substation or compound areas or along the onshore cable corridor. This will be confirmed by comparing the Norfolk Boreas footprint to the detailed drainage network in GIS prior to the commencement of any field surveys.

Flood risk assessment

1021. A Flood Risk Assessment (FRA) would also be undertaken using the most up to date climate change allowances and in accordance with the NPPF to assess the flood risk (tidal and fluvial) to the development and surrounding areas. This would inform the identification of any required mitigation measures. Furthermore, a WFD compliance assessment would be undertaken to evaluate whether Norfolk Boreas is likely to cause deterioration in the WFD status of any water bodies.

1022. Flood risk assessments for the Norfolk Boreas project will incorporate data from a number of sources, including;

- The relevant level of Environment Agency flood data;
- Relevant Internal Drainage Board flood data;
- Topographic survey data, or remotely sensed LiDAR data;
- Local Council Policy and Local Plan;
- Strategic Flood Risk Assessments; and
- Surface Water Management Plans.

1023. Given the development is for essential infrastructure the type of flood risk assessment will be tailored to meet the needs of each individual site. For development located in close proximity to potentially sensitive receptors a joined up approach will be required to ensure development can be undertaken without increasing flood risk, or negatively affecting the ecology of an area. Permanent structures and temporary structures will also need to be managed differently.

WFD compliance assessment

1024. The WFD compliance assessment would be undertaken to assess compliance with the requirements of the WFD, in line with The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003. Following the recommendations made by the Environment Agency in their internal guidance

(Environment Agency, 2016), the approach adopted in this assessment is to determine whether the scheme has:

- Potential to cause deterioration in surface water body status by adversely affecting biological, hydromorphological and/or physico-chemical quality elements.
- Potential to cause deterioration in groundwater body status by adversely affecting quantitative and chemical quality elements.
- Potential to prevent achieving WFD status objectives by impacting upon proposed mitigation measures already identified for water bodies in the area.
- Potential to incorporate mitigation measures included in the appropriate River Basin Management Plan(s).

1025. Where the assessment suggests that deterioration in water body status is likely to occur as a result of the scheme, measures to mitigate the likely impacts and therefore avoid deterioration in status are recommended.

1026. A four stage process will be used to undertake the WFD compliance assessment. These stages will be described in more detail in the subsequent sections:

- Stage 1: Screening assessment.
- Stage 2: Scoping assessment.
- Stage 3: Detailed compliance assessment (if required).
- Stage 4: Summary of mitigation, improvements and monitoring (if required).

3.5 Land use

3.5.1 Baseline

3.5.1.1 Data sources

1027. A desk based review of onshore land use receptors has been undertaken. The Environmental Statement will build upon this information to thoroughly characterise the baseline environment and identify the receptors that could potentially be impacted by Norfolk Boreas. The results of the initial desk based review presented below will be used as a basis for a more detailed desk based assessment to characterise the baseline for onshore land use receptors.

1028. The data sources to be used to inform the land use baseline include those listed in Table 3.9:

Table 3.9 Land use data sources

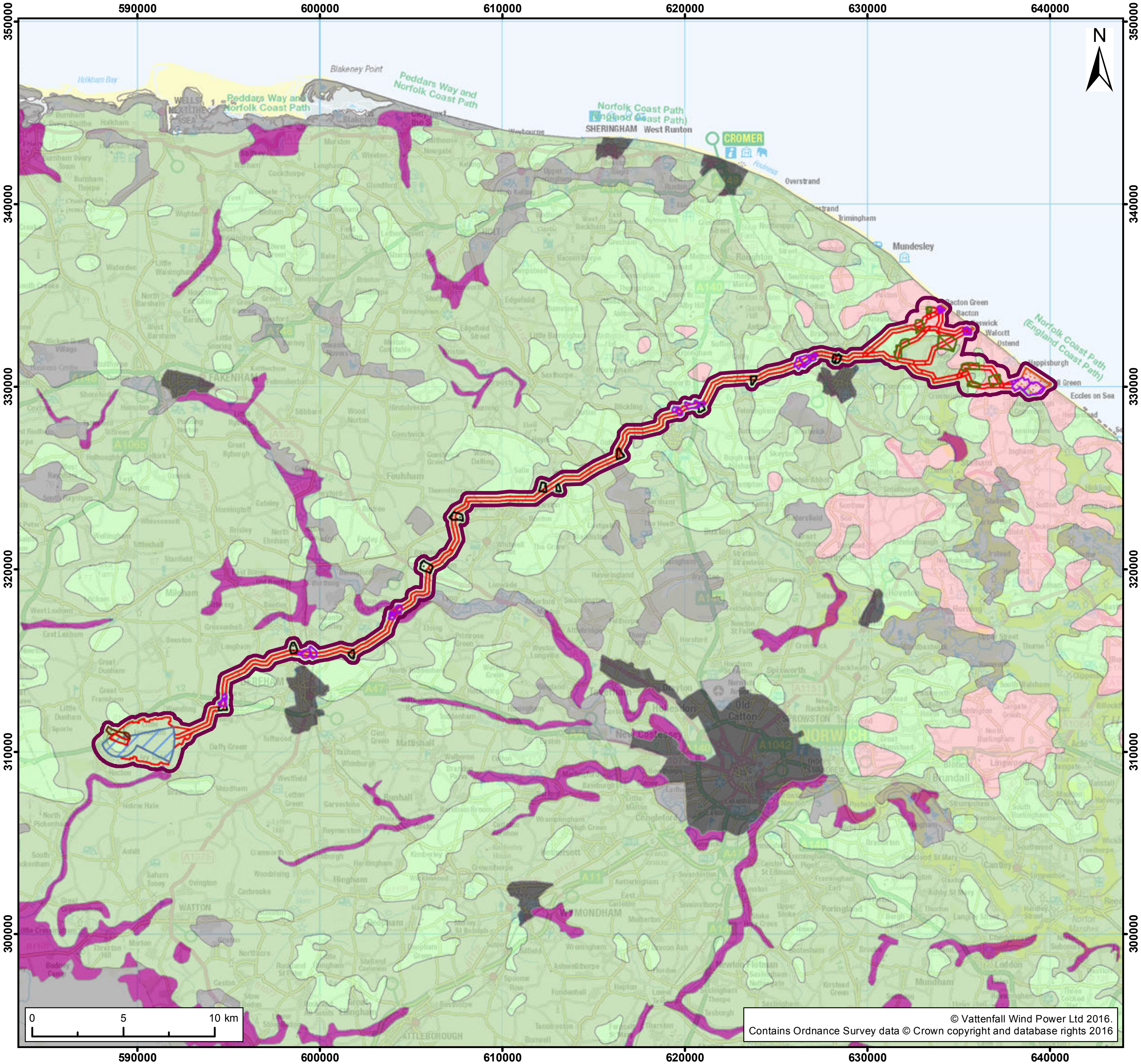
Source no.	Data	Source	Date
1	'A' Roads, Railway Lines and Urban Areas	Ordnance Survey	2016
2	Coastal Paths	Natural England	2016
3	Agriculture Land Classifications	Natural England	2015
4	Sheringham Shoal and Dudgeon Underground Cables	Royal HaskoningDHV	(2016c)
5	Public Rights of Way (PRoW)	Norfolk County Council	2016
6	Regional and National Cycle Routes	Sustrans	2016
7	High Pressure Gas Pipelines	National Grid	2015

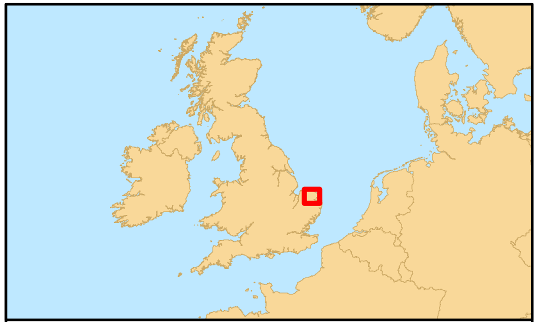
1029. The assessment to be undertaken as part of the EIA will use the Natural England Agricultural Land Classification (ALC) system. This system grades agricultural land from Grade 1 (best quality) through to Grade 5 (poorest quality) based on factors including climate, nature of the soil and site-based factors.

1030. ALC data for the onshore scoping area is presented in Figure 3.9 whilst PRoWs, urban areas, roads and utilities are presented on Figure 3.10.

3.5.1.2 Characterisation of the onshore scoping area

1031. The land use in the onshore scoping area is predominantly agricultural with urban areas around the coastal fringe and the settlements of Happisburgh, Bacton and Walcott are located close to the onshore scoping area. There are several patches of 'non-agricultural' land, which is comprised of areas of woodland and waterbodies (e.g. rivers, lakes and ponds).





Legend:

- Onshore Scoping Area

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
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- Landfall Zone

Agricultural Land Classification[1]

- Grade 1
- Grade 2
- Grade 3
- Grade 4
- Non-Agricultural
- Urban

[1] Natural England, 2016.

Project:	Report:
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Main Land Use Types

Figure: 3.9 | Drawing No: PB5640-102-041

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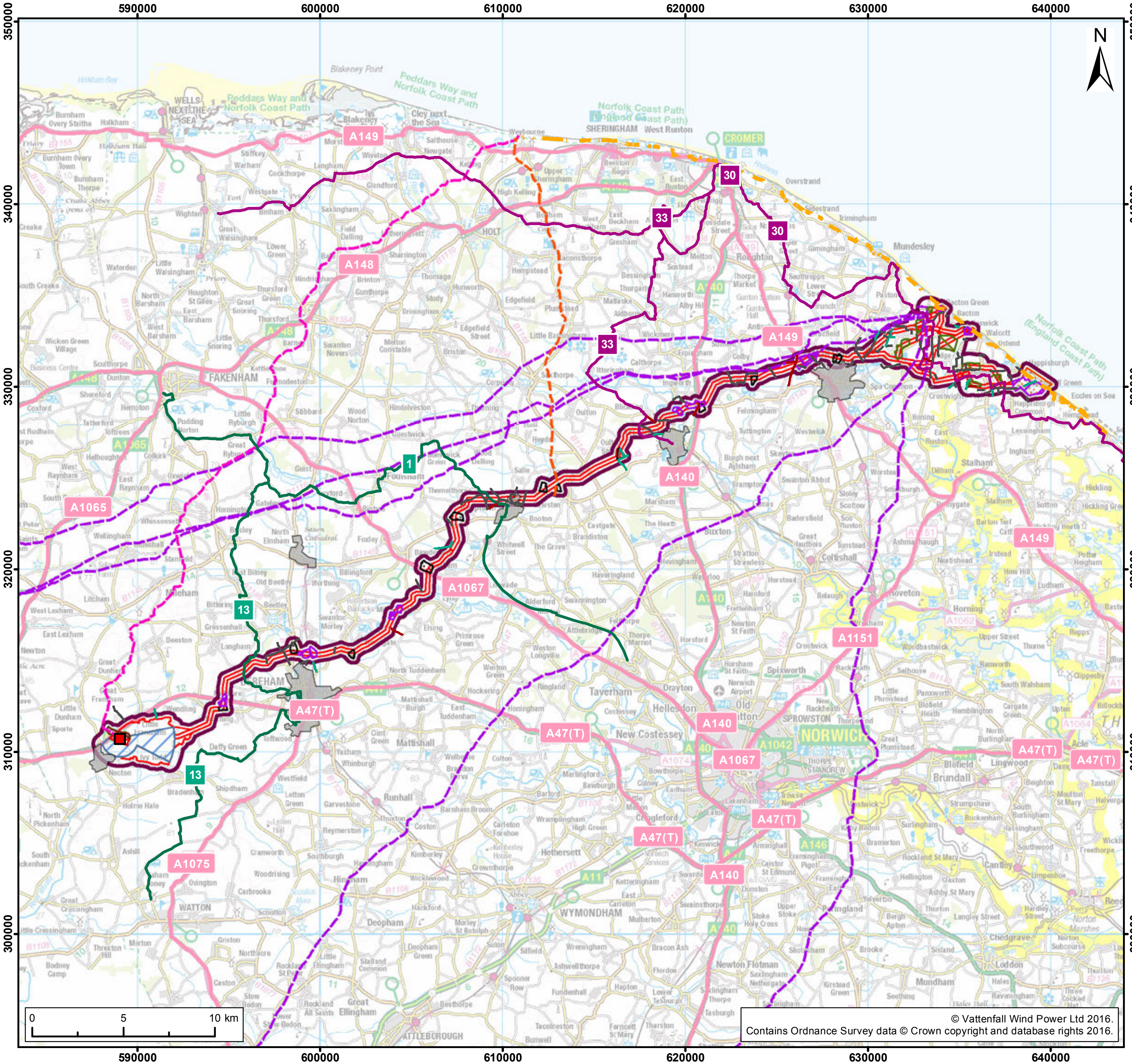

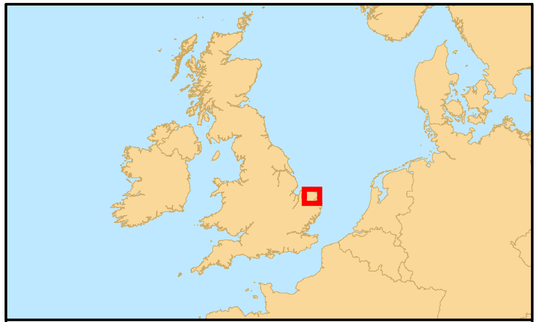

Legend:

- Onshore Scoping Area
- Existing Necton 400kV National Grid Substation

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
- Cable Relay Station Zone
- Landfall Zone
- A Road
- Coastal Path[1]

Urban Areas

- Large Urban Area

Cables and Pipelines

- Sheringham Shoal Underground Cable (Indicative)
- Dudgeon Underground Cable (Indicative)
- High Pressure Gas Pipe location[2]

National Cycle Network[3]

- Regional Cycle Route
- National Cycle Route

Public Rights of Way[4]

- Footpath
- Bridleway
- Restricted Byway

[1] Natural England, 2016. [2] Natural Grid, 2016.
[3] Sustrans, 2016. [4] Norfolk County Council

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

PRoWs, Urban Areas, Roads and Utilities

Figure: 3.10 | Drawing No: PB5640-102-042

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Co-ordinate System: British National Grid **EPSG:** 27700

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3.5.1.3 Landfall and onshore cable relay station zones

1032. There are three potential zones for the landfall: Bacton Green, Walcott Gap and Happisburgh South, and seven potential locations for the onshore cable relay station (Figure 1.3).

1033. The potential landfall locations comprise ALC Grade 1 (excellent quality) agricultural land, with the surrounding areas comprising mainly ALC Grade 2 (very good) agricultural land.

1034. The Norfolk Coast Path and a number of other footpaths cross the potential landfall locations, and a regional cycle route and a buried, high pressure gas pipe pass close to the Bacton Green location.

1035. The cable relay station zones are located within land classed as ALC Grade 1 (excellent quality) agricultural land and ALC Grade 2 (very good) agricultural land. A number of footpaths and buried, high pressure gas pipes pass near the locations, as well as a regional cycle route.

1036. There are no large settlements within any of the potential locations for the landfall or cable relay substation; however there are several villages including Happisburgh, Bacton and Walcott adjacent. There are no A-roads in the surrounding area, but several local roads as well as the B1159.

3.5.1.4 Onshore cable corridor area

1037. The onshore cable corridor from landfall to the onshore grid connection at the existing Necton National Grid Substation is approximately 63km long and passes through a number of different grades of agricultural land, primarily ALC Grade 2 at Banningham, Aylsham and Southgate and ALC Grade 3 in the areas between. There is a small area of ALC Grade 4 (moderate to poor quality) agricultural land at Mill Street, which is the proposed location of HDD zone.

1038. Although the onshore cable corridor avoids major urban areas, there are a number of built up urban areas in close proximity to the onshore cable corridor (North Walsham, Aylsham, Reepham and Dereham). There are also several large waterbodies (River Wensum near Mill Street and River Bure crossing the onshore cable corridor north of Aylsham) and an army barracks north of Woodgate.

1039. The A47, A1067, A140 and A149 all cross the current onshore cable corridor and there are a number of PRoWs as well as National Cycle Routes 1 and 13, and Regional Cycle Route 33 crossing the current onshore cable corridor at various points. The Weavers Way and Paston Way long distance trails cross the current onshore cable corridor. The onshore cable corridor runs parallel to the Marriott's

Way for several kilometres near to the town of Reepham and twice crosses it. The Bure Valley Way runs from Aylsham to Hoveton but is not intersected by the onshore cable corridor at any point. A number of local footpaths are intersected by the onshore cable corridor throughout.

1040. The Sheringham Shoal Offshore Wind Farm underground cables (from Saxthorpe to Cawston) run through the onshore cable corridor at approximately its mid-point.

1041. There are a number of jointing pits proposed along the onshore cable corridor at roughly equal intervals approximately 500m - 1000m apart. All are located away from major urban areas with the exception of the pit closest to the landfall, which is just north of North Walsham.

3.5.1.5 Onshore project substation

1042. The substation zone is comprised of ALC Grade 3 (good to moderate quality) agricultural land.

1043. The A47 runs adjacent to the north-west part of the substation search zone and a number of minor roads run along the southern and eastern boundaries.

1044. There are no large urban areas around the grid connection location at the existing Necton National Grid Substation, with the closest urban area being Dereham over 10km away. There are several villages and settlements including Necton, Little Dunham and Little Fransham, close to but outside the substation zone.

1045. The Dudgeon Offshore Wind Farm underground cable route comes into the substation search zone from the north.

3.5.1.6 Local planning policies and designations

1046. The substation search zone falls within Breckland District (approximately from Necton to Lyng), and therefore is within the remit of the Breckland District Council (2011) emerging Local Plan 2011-2036. The emerging Local Plan sets out strategic planning policies within Breckland (which replaces the Core Strategy and suite of documents that make up the adopted Local Plan).

1047. The onshore scoping area that falls within Broadland District (Reepham to Aylsham) will be covered by the current Local Plan, which includes the Joint Core Strategy (a partnership between Broadland, Norwich and South Norfolk Councils), the Development Management Development Plan Document (Broadland District Council, 2015) and the Site Allocations (to identify areas for housing, employment, retail, recreation etc.).

1048. North Norfolk District encompasses the eastern part of the onshore cable corridor. North Norfolk District Council currently has an Emerging Local Plan 2016-2036, providing the context for development across North Norfolk. Within the Local Plan sit the Core Strategy and Site Allocation Plans setting out more detailed, site specific policies.

1049. Norfolk County Council is responsible for the planning for how waste produced in Norfolk is dealt with, and how much mineral extraction is needed. The adopted Norfolk Minerals and Waste Development Framework is of relevance and contains the following 3 minerals and waste planning policy documents and a policies map.

- Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010-2026 (adopted September 2011);
- Minerals Site Specific Allocations Development Plan Document (DPD) (adopted October 2013); and
- Waste Site Specific Allocations Development Plan Document (DPD) (adopted October 2013).

3.5.2 Potential impacts

1050. Full details of the project description are provided in Section 1.5.

3.5.2.1 Potential impacts during construction

1051. **Agricultural productivity:** There is potential for adverse impacts to soil structure and future agricultural productivity of soils impacted during construction through the use of heavy machinery and disturbance. Ground conditions and potential contamination is discussed further in Section 3.2.

1052. **Drainage**: The excavation of the cable trench, earthworks associated with substation construction and the excavation and stockpiling of soils has the potential to cause an adverse impact to the natural and artificial field drainage systems during construction works.

1053. **Disruption to farming practices:** All aspects of the onshore construction works have the potential to cause adverse impacts on farming and other land use practices through the temporary loss of land availability, restricted access and disruption caused by the footprint of construction for onshore infrastructure and construction traffic.

1054. The ducts and jointing pits would be buried at sufficient depth to ensure these structures would cause no restrictions on normal farming activities on the surrounding land with the exception of Link boxes may require a small above ground structure (Section 1.5.4.2). Any deep workings over cables and jointing pits would likely require the permission of the operator or the cables.

1055. The excavation of soils and earthworks associated with the onshore infrastructure has the potential to result in temporary loss of ALC land due to the removal of soil during excavation for onshore cable installation. Impacts to soil will take account of Government's policy for the protection of the best and most versatile (BMV) agricultural land as set out in paragraph 112 of the National Policy Planning Framework (NPPF).

1056. There is potential for adverse impacts to soil structure and future agricultural productivity of soils impacted during construction through the use of heavy machinery and disturbance. Ground conditions and potential contamination is discussed further in Section 3.2.

1057. There is potential for land sterilisation (restricting activities on a plot or area of land by isolating it) to occur along the cable route. The socioeconomic impacts of this are discussed further in Section 4.3.

1058. There is also a potential for a beneficial impact to local farmers if access tracks are upgraded. The temporary haul road would be removed and reinstated upon completion of the construction phase.

1059. **Temporary closure of PRoWs/cycle paths**: Temporary closures of PRoWs and cycle paths and the provision of temporary alternative routes may be necessary during the construction period. Any crossing of PRoWs would be discussed with the local PRoW officer and the appropriate mitigation would be put in place on a case by case basis. The impacts of this on tourism and recreation are discussed further in Section 4.4.

1060. **Existing utilities:** Cable installation activity has the potential to impact on water, power and gas infrastructure.

1061. Changes to ground levels beneath or close to existing overhead lines have the potential to reduce safety clearances for the overhead lines. The only overhead line which would be crossed is the main National Grid line from the Necton substation. In addition, there is the potential for ground levels above existing electricity cables to be altered.

1062. Drilling or excavation work could have the potential to disturb or adversely affect the foundations of existing electricity towers.

1063. There is the potential for adverse impacts relating to the gas pipeline that the onshore cable route is required to cross. Eight gas pipeline crossings would be required (Figure 3.10).

1064. Further information will be gathered as part of the EIA process on water and sewerage pipes that may need to be crossed.

1065. **Public health and safety**: The EIA will focus on elements which could be of concern to members of the public, for example issues relating to invasive plant species, notifiable scheduled diseases and procedures required to prevent any health or safety issues arising in relation to existing buried gas, electric and water services. Issues relating to public health are considered in Section 3.11.

3.5.2.2 Potential impacts during operation

1066. Operation and maintenance activities would follow standard procedures to minimise potential impacts. In addition, non-routine maintenance would be subject to robust and effective planning and risk assessment procedures.

1067. **Loss of land:** The presence of permanent infrastructure at the project substation, cable relay station and Necton National Grid extension (including modification of the overhead lines) would result in the permanent loss of land including farmland, and therefore also a loss in agricultural productivity of these areas.

1068. **Drainage:** Permanent infrastructure and hardstanding at the substation and cable relay station, plus the presence of buried cables has the potential to permanently impact upon land drainage. Impacts on drainage will be considered further in the Onshore Water Resources and Flood Risk Method Statement (Section 3.4).

1069. **Disruption to farming practices / land use:** There is the potential for farming practices to be restricted due to the presence of cables and access restrictions, and also where maintenance and repair works are being carried out along the cable route and on other onshore infrastructure. It is anticipated all haul road would be removed and land reinstated upon completion of construction works. Ducts and jointing pits (apart from the requirement for above ground structures associated with Link boxes described in Section 1.5.4.2) would be buried at sufficient depths not to cause prohibition of normal farming activities; however it is likely that there would be restrictive covenants over the cable easement which would restrict a number of activities such as planting trees, erecting buildings and any form of deep ploughing.

1070. There is also the potential for a permanent/long-term reduction in quality of ALC land along the cable route.

1071. **Redirection of PRoWs/cycle paths:** PRoWs or cycle paths in the footprint of the substation have the potential to be redirected; however this would be avoided wherever possible through sensitive siting of onshore infrastructure. Any crossing of

PRoWs would be discussed with the local PRoW officer and the appropriate mitigation would be put in place on a case by case basis.

1072. **Public health and safety:** Issues of public concern and health such as EMF arising in relation to buried cables will be considered further in Section 3.11.

1073. **Soil heating:** Buried cable systems emit some heat, potentially causing impacts on soil characteristics and productivity. The electrical system is designed to minimise heat loss to a level which is not likely to affect crop growth.

3.5.2.3 Potential impacts during decommissioning

1074. No decision has been made regarding the final decommissioning policy for the substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. It is likely that the substation and cable relay station equipment would be removed and reused or recycled. It is expected that the onshore cables would be removed from ducts and recycled, with the transition pits and ducts left in situ.

1075. The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan would be provided.

1076. It is anticipated that the decommissioning impacts would be similar in nature to those of construction.

3.5.2.4 Potential cumulative impacts

1077. The approach to assessing cumulative impacts is detailed in Section 3.13.

1078. Other developments with potential to impact upon land use receptors will be considered. These are likely to include schemes that involve disturbance to drainage, utilities, PRoWs and farming practices.

1079. Further consideration will be given to these potential cumulative scenarios as part of the EIA in combination with other projects, particularly in respect to the combined Norfolk Vanguard and Norfolk Boreas scenarios, and the cable route for the proposed Hornsea Project 3.

3.5.2.5 Summary of potential impacts

Table 3.10 Summary of impacts relating to land use

Potential impacts	Construction	Operation	Decommissioning
Agricultural productivity	✓	✓	✓
Drainage	✓	✓	✓

Potential impacts	Construction	Operation	Decommissioning
Disruption to farming practices	✓	✓	✓
Temporary closure/redirection of PRoWs/cycle paths	✓	✓	✓
Existing utilities	✓	x	✓
Public health and safety	✓	✓	✓
Loss of land	x	✓	x
Diversion of PRoWs	x	✓	x
Soil heating	x	✓	x
Cumulative impacts	✓	✓	✓

Scoped in (✓) and scoped out (x)

3.5.3 Mitigation

3.5.3.1 Agricultural productivity and drainage

1080. Soils would be handled in accordance with best practice, in order to minimise risk to the integrity of soil resource and land quality during construction and reinstatement. This could include the development of a soil and drainage management strategy based on results of pre-construction surveys for the restoration of the onshore cable corridor, which would be appended to the CoCP. All drainage systems would be fully reinstated in consultation with landowners and specialist drainage contractors.

3.5.3.2 Disruption to farming practices

1081. The Applicant would ensure that where practicable, steps would be taken to avoid creation of isolated land parcels, cutting off farm access routes and isolating key assets such as water sources. Burial of ducts and jointing pits to sufficient depths would allow continuation of normal farming practices at most locations along the cable route with the exception of within the immediate vicinity of above ground structures associated with link boxes and (Section 1.5.4.2) and deep ploughing activities.

1082. Early and ongoing consultation with farmers through land agents will ensure concerns are well understood and that site specific conditions can be taken into account so that potential impacts upon farming practices can be minimised as far as possible from the outset.

3.5.3.3 Temporary closure of PRoWs/cycle paths

1083. PRoWs will be identified and classified in consultation with the relevant local authorities through the EPP. Any PRoW that may be affected by Norfolk Boreas would be considered on a case by case basis, with alternative routes or closures agreed with the local PRoW officer. The requirement for permanent closures/alternative routes would be minimised as far as possible.

3.5.3.4 Existing utilities

1084. Mitigation may be required where the cable route crosses existing pipelines and cables. Major utilities would be covered by identifying protective provisions in the drafting of the DCO, and with the use of crossing agreements.

3.5.3.5 Public health and safety

1085. The cables would be buried to a depth that complies with health and safety guidelines in order to mitigate impacts associated with EMF, however the outcomes of similar infrastructure developments in relation to EMF will be reviewed during the EIA. A desk-based assessment will identify local invasive plants and notifiable diseases (see Section 3.6 for more information on proposed ecological surveys on invasive plant species). These would be managed through the use of construction method statements and management plans.

3.5.3.6 Permanent loss of land

1086. Land lost for agricultural use will be extensively consulted on with landowners and the local authorities and avoided as far as possible.

3.5.3.7 Soil heating

1087. Detailed design would ensure an appropriate burial depth and use of imported backfill material (if required). This will be captured in the Soils Management Plan.

3.5.4 Approach to assessment and data gathering

1088. The approach to assessment and data gathering outlined below is informed by methodology discussed with regulators during the EPP for Norfolk Vanguard.

1089. The Norfolk Boreas assessment will be informed by desk-based assessment and review of available data from the Environment Agency and Lead Local Flood Authority (LLFA), site visits, consultation with relevant statutory consultees (Local Authority LLFA, Environment Agency, Natural England and the appropriate Water Authority) and a field survey.

1090. The assessment of effects in relation to land use will include a desk-based assessment of:

- A review of local and national planning policy documents and guidance;
- ALC;

- Environmental Stewardship Schemes;
- Notifiable Scheduled Diseases;
- Injurious weeds and invasive plant species;
- Open access and common land;
- Existing utilities;
- EMF;
- Soil resources affected by construction activities;
- Likely effects on agricultural practices (including land quality and soil types) and other land uses during the construction phase; and
- Likely effects on PRoWs, roads and cycle routes.

1091. The EIA for land use will identify the likely impacts of Norfolk Boreas, assess the effects and identify appropriate mitigation measures if required. This process will lead to an assessment of residual effects. The assessment will consider both direct and indirect impacts.

1092. The methodology for the assessment of the effects on land use will be informed by the following current guidance and information sources:

- Ordnance Survey (OS) 1:50,000, 1:25,000 and 1:10,000 scale mapping;
- Natural England – Nature on the Map (Natural England, 2012a);
- NE124 – Look after your land with Environmental Stewardship (Natural England, 2012b);
- National Soil Resource Institute;
- Public consultation events and questionnaires;
- Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 6 (Land Use);
- DEFRA guidance including the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (2009);
- Aerial photography;
- DEFRA farming statistics; and
- Land Registry information.

1093. The potential impacts of the onshore construction works on farming practices will be assessed qualitatively, informed by the results of the desk based assessment outlined in Section 3.2 as well as consultations with farmers and questionnaires. All farmers who would be affected by the construction works will be consulted (i.e. all those whose land falls within the footprint of the onshore construction works).

1094. The assessment will assume that any primary and tertiary mitigation measures incorporated into the scheme design would be in place, for example a CoCP would be employed during site works to ensure that all appropriate good practice guidelines are followed.

1095. The approach to assessment and data gathering will be discussed and agreed as part of the EPP (detailed in Section 1.6.2) prior to commencement. Consultation will be undertaken at key stages throughout the EIA process as part of the EPP.

3.6 Onshore ecology

3.6.1 Baseline

3.6.1.1 Data sources

1096. The scoping assessment has been undertaken based on an ecological desk-based assessment. This ecological desk-based assessment has used existing available ecological information to identify the ecological receptors present within the onshore scoping area.

1097. The data sources used to inform this ecological desk-based assessment are shown in Table 3.11.

Table 3.11 Onshore ecology data sources

Data	Source	Date
European designated sites (SPA, SAC, Ramsar sites)	Joint Nature Conservation Committee (JNCC)	2017
UK designated sites (SSSI, NNR, LNR)	Joint Nature Conservation Committee (JNCC) Natural England	2017
UK Habitats of Principal Importance	Joint Nature Conservation Committee (JNCC)	2017
Protected species records	Norfolk Biodiversity information Service (NBIS)	2017

3.6.1.2 Baseline

Statutory Designated Sites

1098. The onshore scoping area has been selected and developed with one of its key objectives to avoid designated sites wherever possible. Table 3.12 lists the 40 statutory designated sites that are located within 2km of the onshore scoping area, as shown on. Of these, 1 SAC, 1 LNR and 9 Ancient Woodlands are located within the onshore scoping area but would be avoided by use of trenchless techniques and micrositing. Table 3.12 also provides a summary of the qualifying features/reasons for notification of these designated sites. The legislation underpinning statutory designated sites is discussed in Section 1.4.

1099. The Applicant understands that two new county wildlife sites are being proposed: Pigneys wood which is currently a Local Nature reserve and the Kerdiston. As these have not yet been designated they are not included within Table 3.12 or displayed as CWS within Figure 3.11 but will be considered further within the EIA.

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Table 3.12 Designated sites for nature conservation of relevance to onshore ecology within 2 km of the onshore scoping area

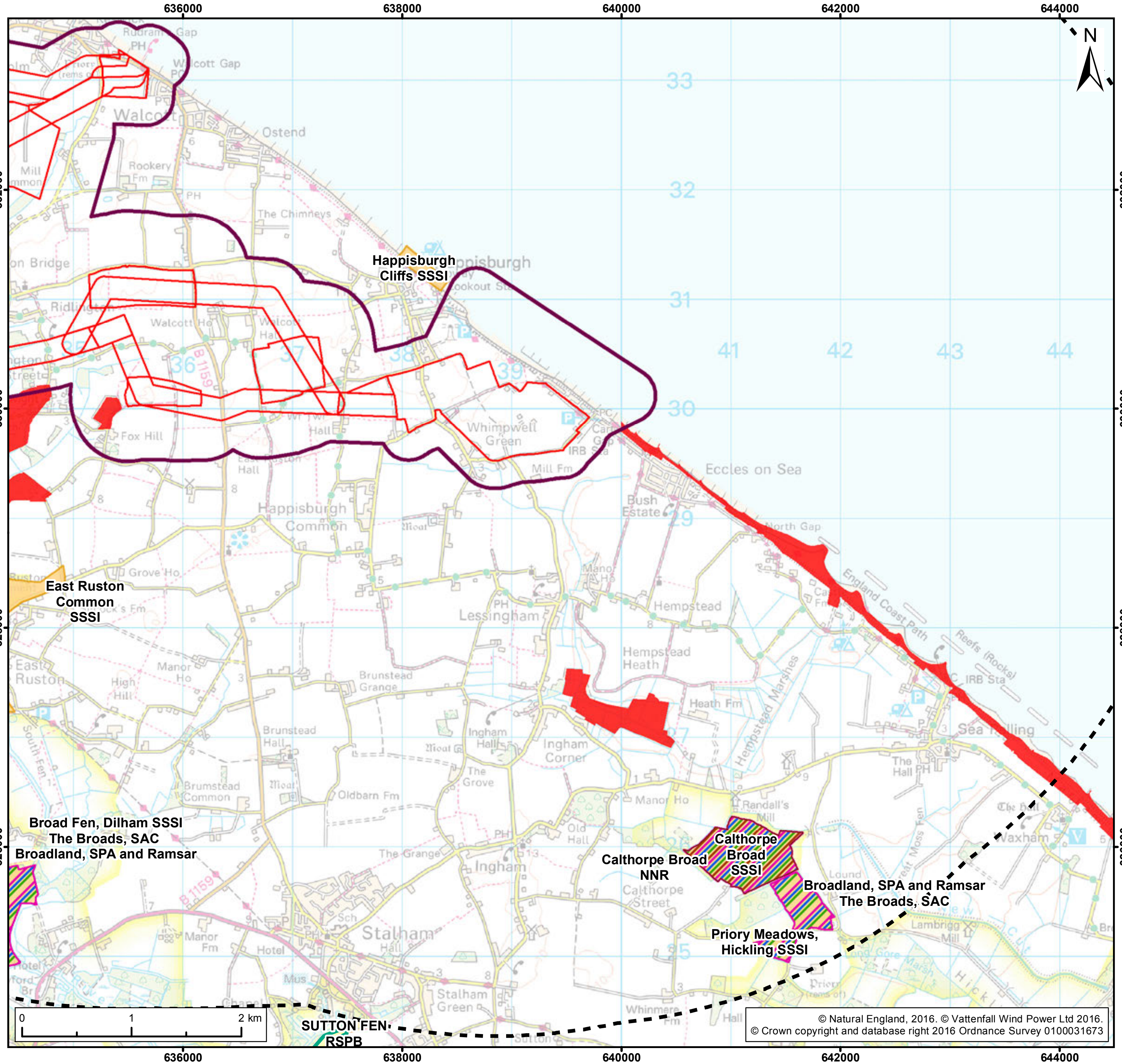
Name	Design-ation	Location (NGR) / size (ha)	Qualifying features/reasons for notification	Located within onshore scoping area
Norfolk Valley Fens	SAC	TL 937960 616.48	Annex I habitats that are a primary reason for selection of this site: • Alkaline fens Annex I habitats present as a qualifying feature, but not a primary reason for selection of this site: • Northern Atlantic wet heaths with *Erica tetralix* • European dry heaths • Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (* important orchid sites) • Molinia meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) • Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae* (Priority feature) • Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)(priority feature) Annex II species that are a primary reason for selection of this site: • Narrow-mouthed whorl snail *Vertigo angustior* • Desmoulin`s whorl snail *Vertigo moulinsiana*	No
River Wensum	SAC, SSSI	TF 942246 to TG 250078 306.79	**SAC** Annex I habitats that are a primary reason for selection of this site: • Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation Annex II species that are a primary reason for selection of this site: • White-clawed (or Atlantic stream) crayfish Annex II species present as a qualifying feature, but not a primary reason for selection of this site: • Desmoulin`s whorl snail *Vertigo moulinsiana* • Brook lamprey *Lampetra planeri* • Bullhead *Cottus gobio* **SSSI**	Yes but would be avoided though trenchless techniques

Name	Design-ation	Location (NGR) / size (ha)	Qualifying features/reasons for notification	Located within onshore scoping area
			The Wensum has been selected as one of a national series of rivers of special interest as an example of an enriched, calcareous lowland river. With a total of over 100 species of plants, a rich invertebrate fauna and a relatively natural corridor, it is probably the best whole river of its type in nature conservation terms, although short stretches of other similar rivers may show a slightly greater diversity of species. ***Key features***: calcareous river habitat, flora, invertebrate assemblage.	
Parston Great Barn	SAC, SSSI, NNR		**SAC** **Annex II species that are a primary reason for the selection of this site** Barbastelle bat *Barbastella barbastellus* SSSI This site is notified as it supports the only barbastelle bat maternity roost in Norfolk and one of only three known in the UK NNR Paston Great Barn NNR is one of the best preserved and few remaining thatched medieval great barns left in England. It also supports the only known breeding colony of barbastelle bats, one of the UK's rarest mammals, to be found in a building. ***Key features:*** The insect-rich semi-natural grassland and eight species of bat	No
Beetley & Hoe Meadows	SSSI	TF 982174 to TF 979169 11.7	Beetley and HoE Meadows are situated in the valley of a tributary of the River Wensum, and represent one of the finest remaining areas of wet unimproved grassland in Norfolk. Springs emerge from the valley-side and variations in the acidity and dampness of the underlying soils account for the exceptionally wide range of grassland communities occurring on the site. The unimproved grassland is species-rich and includes several locally uncommon plants. The meadows are under a traditional management of summer grazing. ***Key features***: wet unimproved grassland habitat, locally uncommon flora	No
Dereham Rush Meadow	SSSI	TF 976140 20.6	This site comprises an area of winter-flooded meadowland and alder carr along the valley of a small tributary of the River Wensum, and exhibits a wide range of grassland and woodland communities which are particularly unusual in Norfolk. The site is also of interest for its breeding bird population including snipe, lapwing, sedge warbler and reed warbler, and winter floods are periodically used by waterfowl. ***Key features***: grassland and woodland habitats, breeding bird assemblage	No
Foxley Wood	SSSI, NNR	TG 056227	**SSSI** Foxley Wood forms the largest area of ancient woodland now remaining in Norfolk, and includes an unusually	No

Name	Design-ation	Location (NGR) / size (ha)	Qualifying features/reasons for notification	Located within onshore scoping area
		122.7	wide range of woodland stand types, including several which are nationally rare. The wood is also exceptionally rich in plant species, with over 250 different species recorded, and there is in addition considerable entomological interest, in particularly butterfly species. **NNR** Foxley Wood NNR is the Norfolk Wildlife Trust's premier woodland reserve and the largest remaining ancient woodland in the county. The site is a good example of how an ancient woodland can be restored following coniferisation. ***Key features***: ancient woodland, nationally rare woodland stands types, flora assemblage, rare butterflies	
Dillington Carr, Gressenhall	SSSI	TF 971158 49.0	This site is an extensive area of carr woodland and open water occupying the valley floor and sides of a small tributary of the River Wensum. The wettest areas of carr are probably the best example of sump alder woodland in west Norfolk, closely resembling the carr woodlands found in Broadland. The site also includes extensive stands of the nationally rare lowland bird cherry-alder woodland. Irrigation reservoirs have been created within the carr and these flooded areas of former woodland support the freshwater component of an outstanding assemblage of breeding birds including several uncommon species. ***Key features***: sump alder woodland habitat, lowland bird cherry-alder woodland habitat, breeding bird assemblage	No
East Ruston Common	SSSI	TG 340280 38.3	East Ruston Common is a large area of unimproved heathland and fen situated in the valley of a tributary of the River Ant. Acidic flushes emerging from sands and gravels at the base of surrounding high ground, are a notable feature of the site and an unusual plant community has developed in these conditions, providing a contrast with the majority of the spring-fed fens which are calcareous. There is a very clear zonation of vegetation types from acidic grassland through acidic flush and fen to carr woodland on the lowest-lying ground. Two rare species of spider have been recorded on the site. ***Key features***: unusual acidic fen habitat, rare spider species	No
Holly Farm Meadow, Wendling	SSSI	TF 936131 2.5	This site which is situated in the valley of a small tributary of the River Wensum, is a valuable example of a calcareous spring-line meadow with gradations between wet and dry conditions. It supports an area of species-rich unimproved fen grassland which is maintained by seasonal grazing. ***Key features***: calcareous spring-line meadow habitat	No
Honeypot Wood, Wendling	SSSI	TF 932144 9.03	A good example of an ancient, coppiced, ash-maple wood on calcareous soil. ***Key features***: ancient woodland habitat	No

Name	Design-ation	Location (NGR) / size (ha)	Qualifying features/reasons for notification	Located within onshore scoping area
Whitwell Common	SSSI	TG 088206 19.17	Whitwell Common lies in the valley of a tributary of the R Wensum and supports a wide range of wetland plant communities characteristic of peat-based soils. Calcareous flushes are present in low-lying hollows created by past peat cutting and a variety of interesting plants are associated with this uncommon habitat type. Wet valley alder wood, fen communities and unimproved neutral grassland are also represented on the site. ***Key features***: unimproved grassland habitat, alder carr habitat, flora assemblage	No
Bryant's Heath, Felmingham	SSSI	TG 259294 17.56	Bryant's Heath is an area of dry acidic heathland, unusual in that it encompasses within a relatively small area a mix of dry heath, wet heath and fen communities. Rich plant communities, including several plants that are now uncommon in East Anglia are present. ***Key features***: dry heathland habitat., wet heathland habitat, nationally uncommon flora	No
Cawston and Marsham Heaths	SSSI	TG 170235 125.7	Cawston and Marsham Heaths form the largest area of Heather-dominated heathland now remaining in east Norfolk. They represent a locally scarce type which shows affinities to the Atlantic coastal heaths found in western Britain.. There is a diverse flora which includes a rich assemblage of lichens. The site is also of considerable ornithological interest. ***Key features***: dry heathland habitat, breeding bird assemblage, wintering bird roost (hen harriers)	No
Happisburgh Cliffs	Geological SSSI, no ecological reasons for notification			No
Booton Common	SSSI	TG 113230 7.73	Booton Common lies in the valley of a tributary of the River Wensum, about 1 mile east of Reepham. The principal interest of the site is associated with a mosaic of wet calcareous fen grassland and acid heath communities which have developed due to the naturally undulating ground. Areas of tall fen and a strip of valley alder woodland occupy the lower ground adjacent to the stream. ***Key features***: wet heathland habitat, calcareous fen habitat, breeding bird assemblage	No
Felmingham Cutting	LNR	TG 248 287 1.04	A butterfly nature reserve, home to 16 different species.	No
Knapton Cutting	LNR	TG 299 329 0.87	A butterfly nature reserve.	No

Name	Design-ation	Location (NGR) / size (ha)	Qualifying features/reasons for notification	Located within onshore scoping area
Pigney's Wood	LNR	TG29531 9 20.87	Pigney's Wood is a woodland site with reedbeds, a scrape, and wildflowers, butterflies, trees and birds.	Yes but would be avoided through micrositing
Great Wood	Ancient Wood land	N/A	N/A	Yes but would be avoided through micrositing
Necton Wood		N/A	N/A	
North Grove		N/A	N/A	
Old Carr		N/A	N/A	
Old Lane Carr		N/A	N/A	
Sparham Grove		N/A	N/A	
The Leaselands		N/A	N/A	
2 Un named		N/A	N/A	
Cawston Wood		N/A	N/A	No
Potters Grove		N/A	N/A	
Foxley Wood		N/A	N/A	
Sporle Wood		N/A	N/A	
The Tollands		N/A	N/A	
Newhall Grove		N/A	N/A	
High Grove		N/A	N/A	
Honeypot Wood		N/A	N/A	
Jack bells Grove		N/A	N/A	
4 unnamed sites		N/A	N/A	



Legend:

- Onshore Scoping Area
- 5km Ornithology Study Area
- Onshore Cable Corridor
- Site of Special Scientific Interest (SSSI)[1]
- Special Area of Conservation (SAC)[1]
- Special Protection Area (SPA)[1]
- Ramsar[1]
- National Nature Reserve (NNR)[1]
- County Wildlife Site[1]
- RSPB Reserve[2]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Statutory and Non-Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.11a | Drawing No: PB5640-102-043

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:50,000
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Co-ordinate System: British National Grid **EPSG:** 27700

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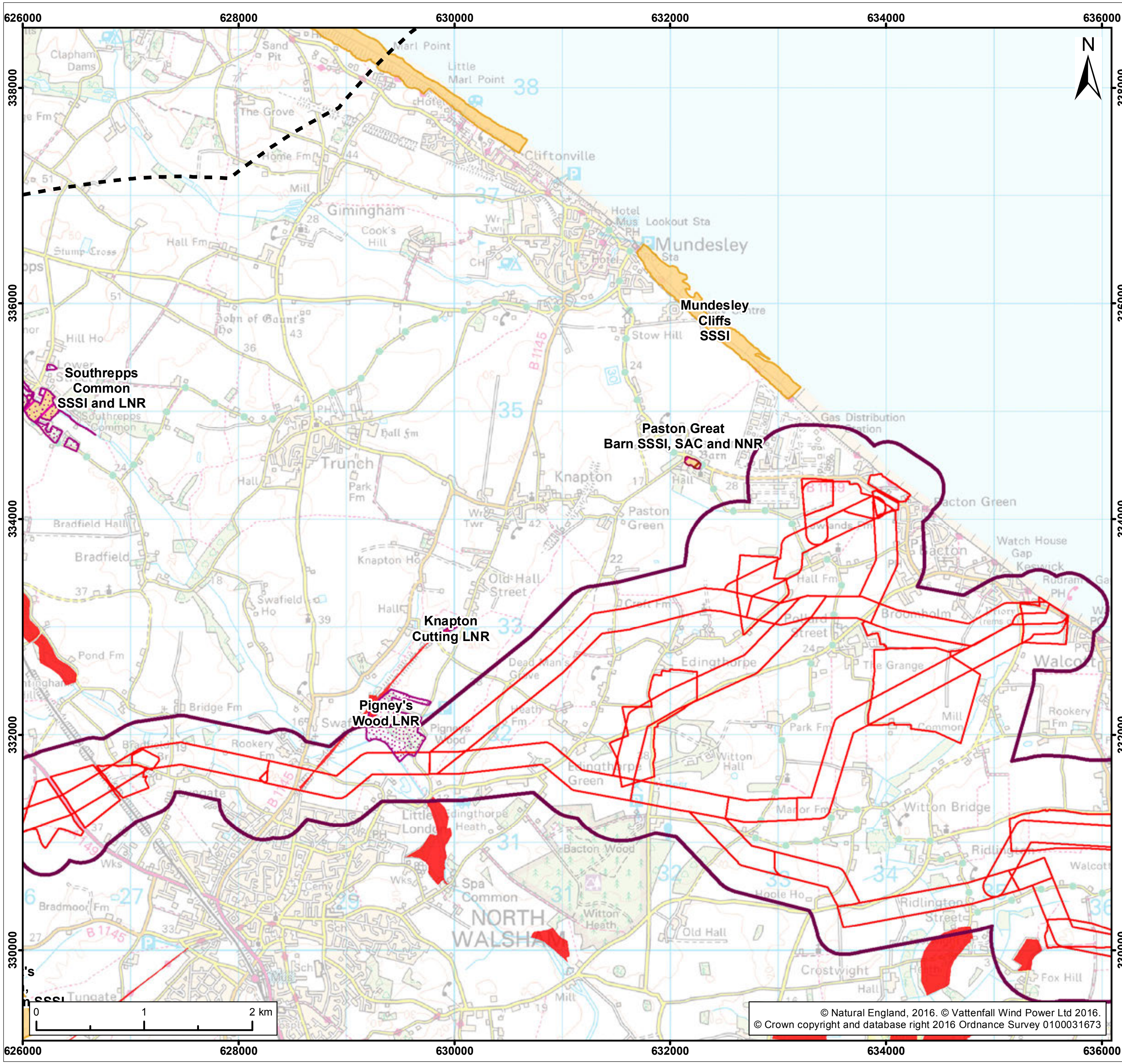

Legend:

- Onshore Scoping Area
- 5km Ornithology Study Area
- Onshore Cable Corridor
- Site of Special Scientific Interest (SSSI)¹
- Special Area of Conservation (SAC)¹
- National Nature Reserve (NNR)¹
- Local Nature Reserve (LNR)¹
- County Wildlife Site¹

¹ Natural England, 2016.
² RSPB, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Statutory and Non-Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.11b | Drawing No: PB5640-102-043

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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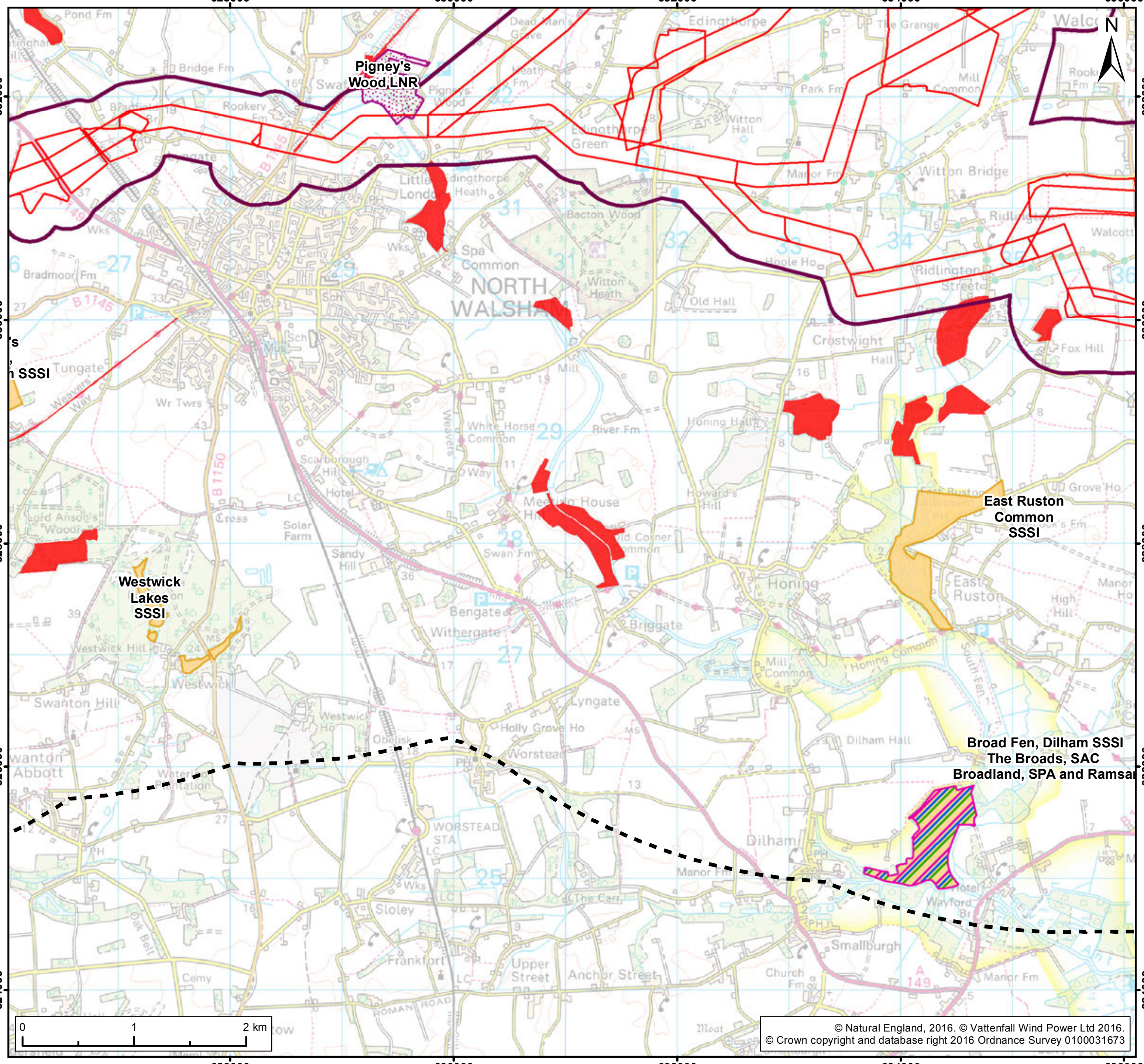

Legend:

- Onshore Scoping Area
- 5km Ornithology Study Area
- Onshore Cable Corridor
- Site of Special Scientific Interest (SSSI)[1]
- Special Area of Conservation (SAC)[1]
- Special Protection Area (SPA)[1]
- Ramsar[1]
- Local Nature Reserve (LNR)[1]
- County Wildlife Site[1]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Statutory and Non-Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.11c | Drawing No: PB5640-102-043

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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01	13/03/17	AB	DT	A4	1:50,000

Co-ordinate System: British National Grid **EPSG:** 27700

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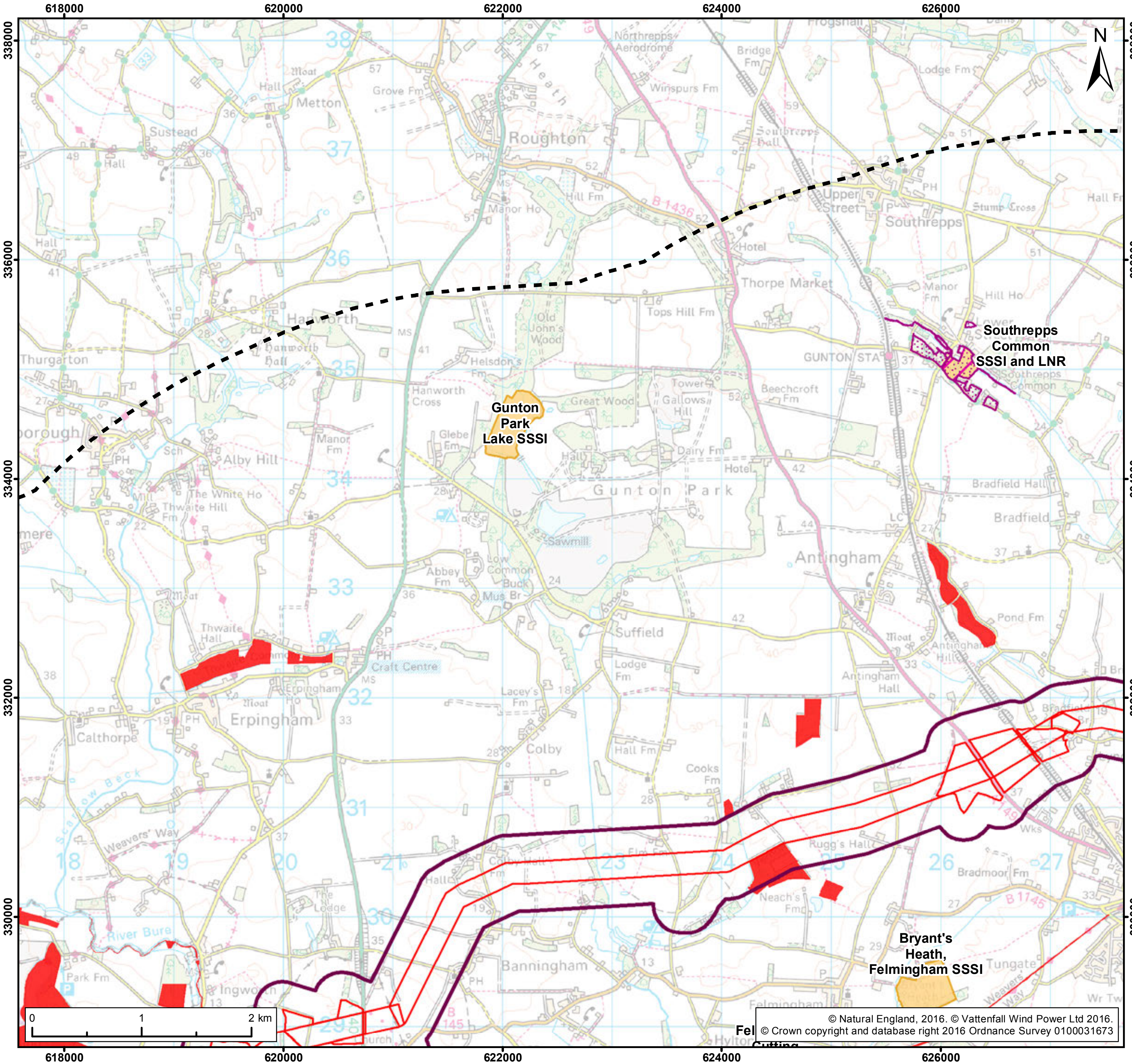

Legend:

- Onshore Scoping Area
- 5km Ornithology Study Area
- Onshore Cable Corridor
- Site of Special Scientific Interest (SSSI)[1]
- Special Area of Conservation (SAC)[1]
- Local Nature Reserve (LNR)[1]
- County Wildlife Site[1]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Statutory and Non-Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.11d | Drawing No: PB5640-102-043

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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01	13/03/17	AB	DT	A4	1:50,000

Co-ordinate System: British National Grid **EPSG:** 27700

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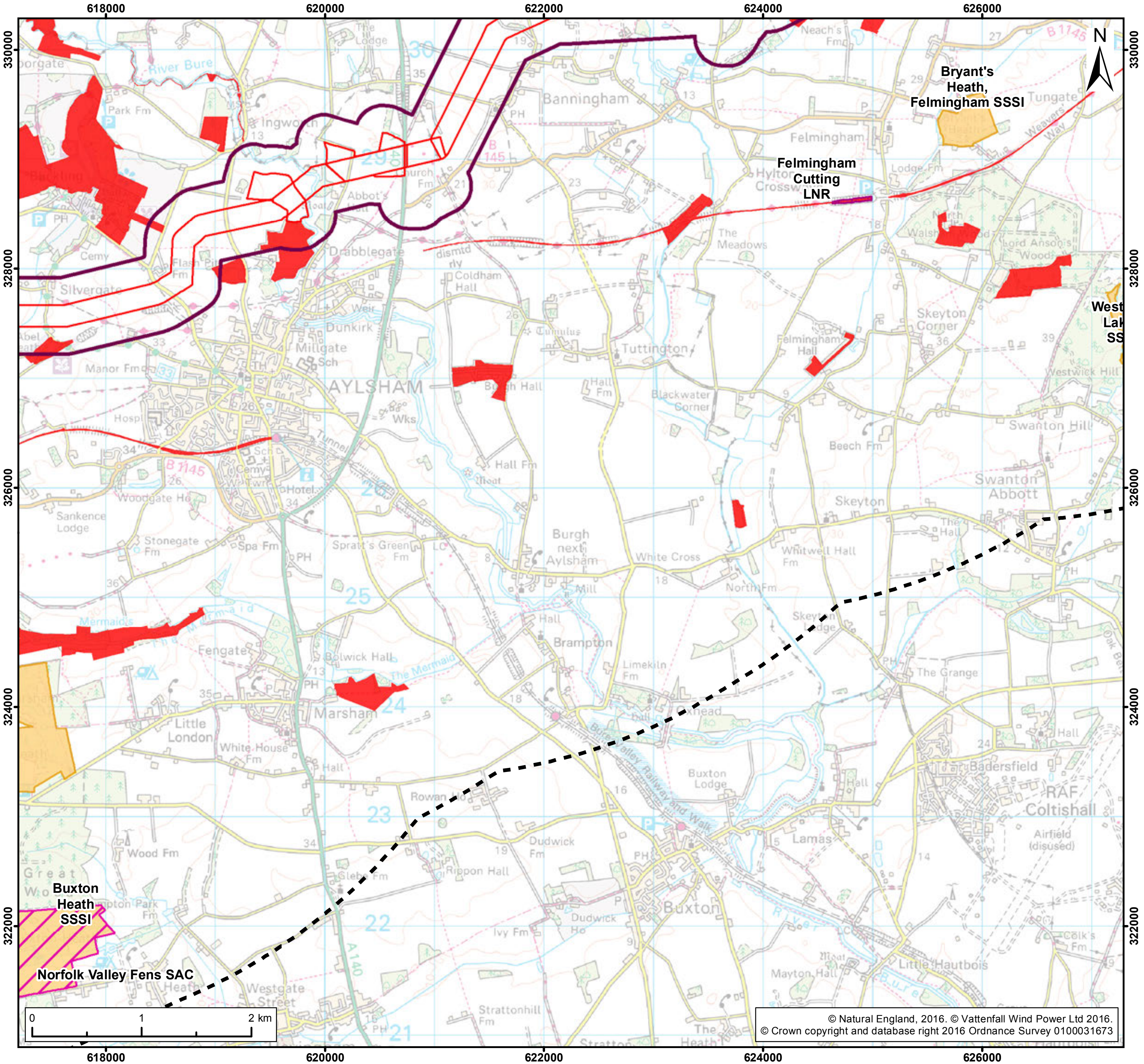

Legend:

- Onshore Scoping Area
- 5km Ornithology Study Area
- Onshore Cable Corridor
- Site of Special Scientific Interest (SSSI)[1]
- Special Area of Conservation (SAC)[1]
- Local Nature Reserve (LNR)[1]
- County Wildlife Site[1]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Statutory and Non-Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.11e | Drawing No: PB5640-102-043

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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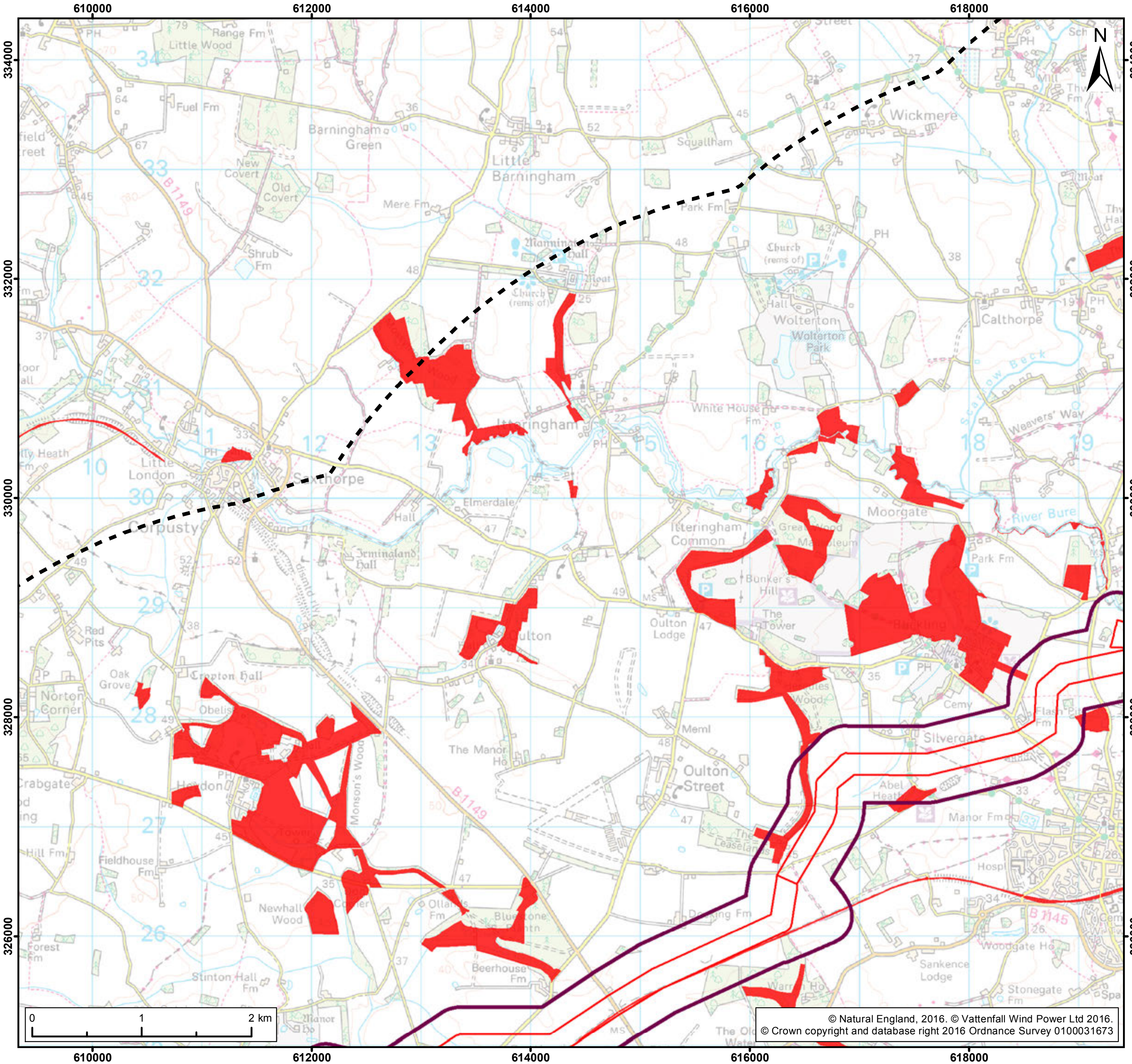

Legend:

- Onshore Scoping Area
- 5km Ornithology Study Area
- Onshore Cable Corridor
- County Wildlife Site[1]

[1] Natural England, 2016.

[2] RSPB, 2016.

Project: Norfolk Boreas	Report: Environmental Impact Assessment Scoping Report

Title:

Statutory and Non-Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.11f Drawing No: PB5640-102-043

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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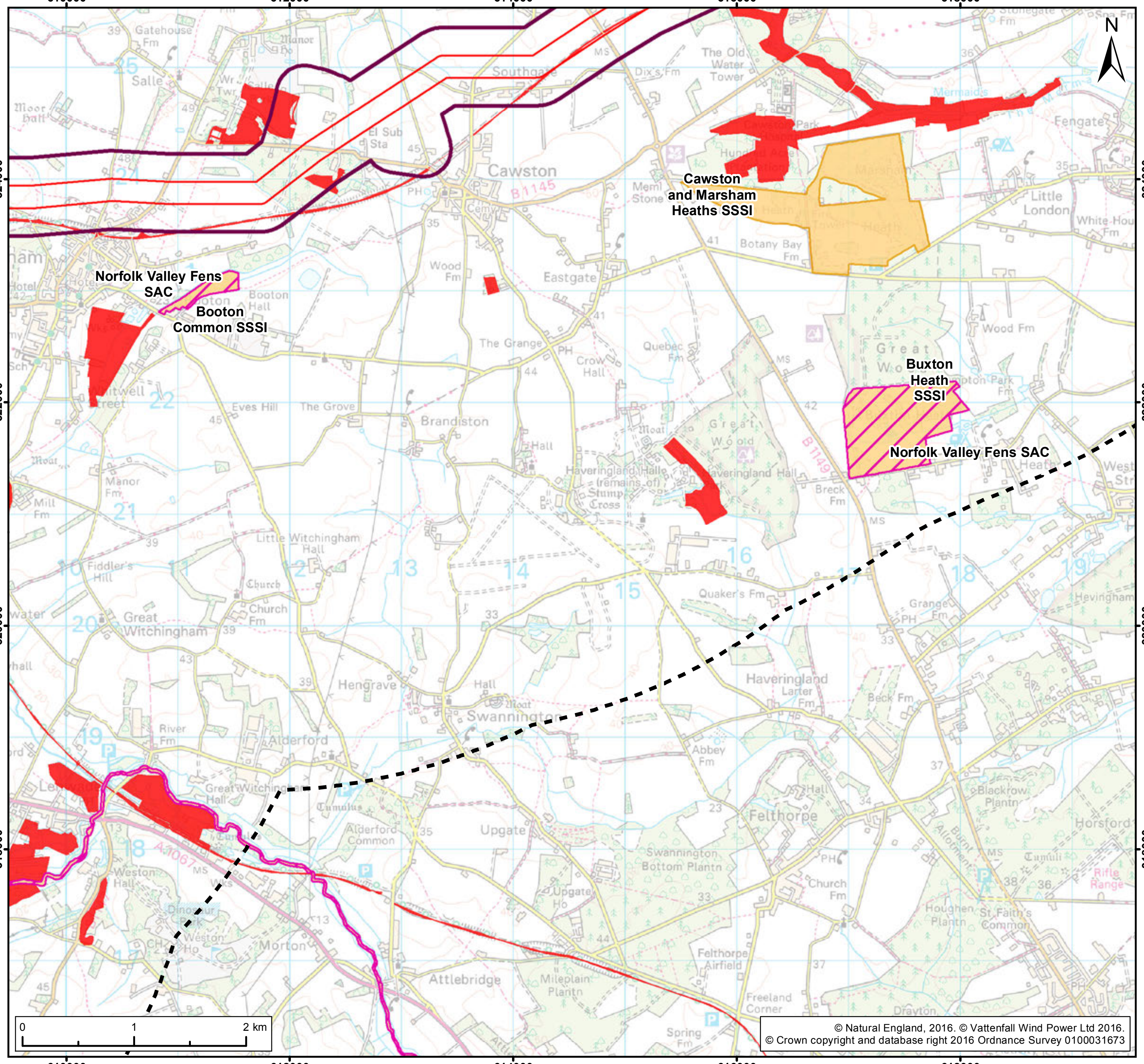

Legend:

- Onshore Scoping Area
- 5km Ornithology Study Area
- Onshore Cable Corridor
- Site of Special Scientific Interest (SSSI)[1]
- Special Area of Conservation (SAC)[1]
- County Wildlife Site[1]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Statutory and Non-Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.11g | Drawing No: PB5640-102-043

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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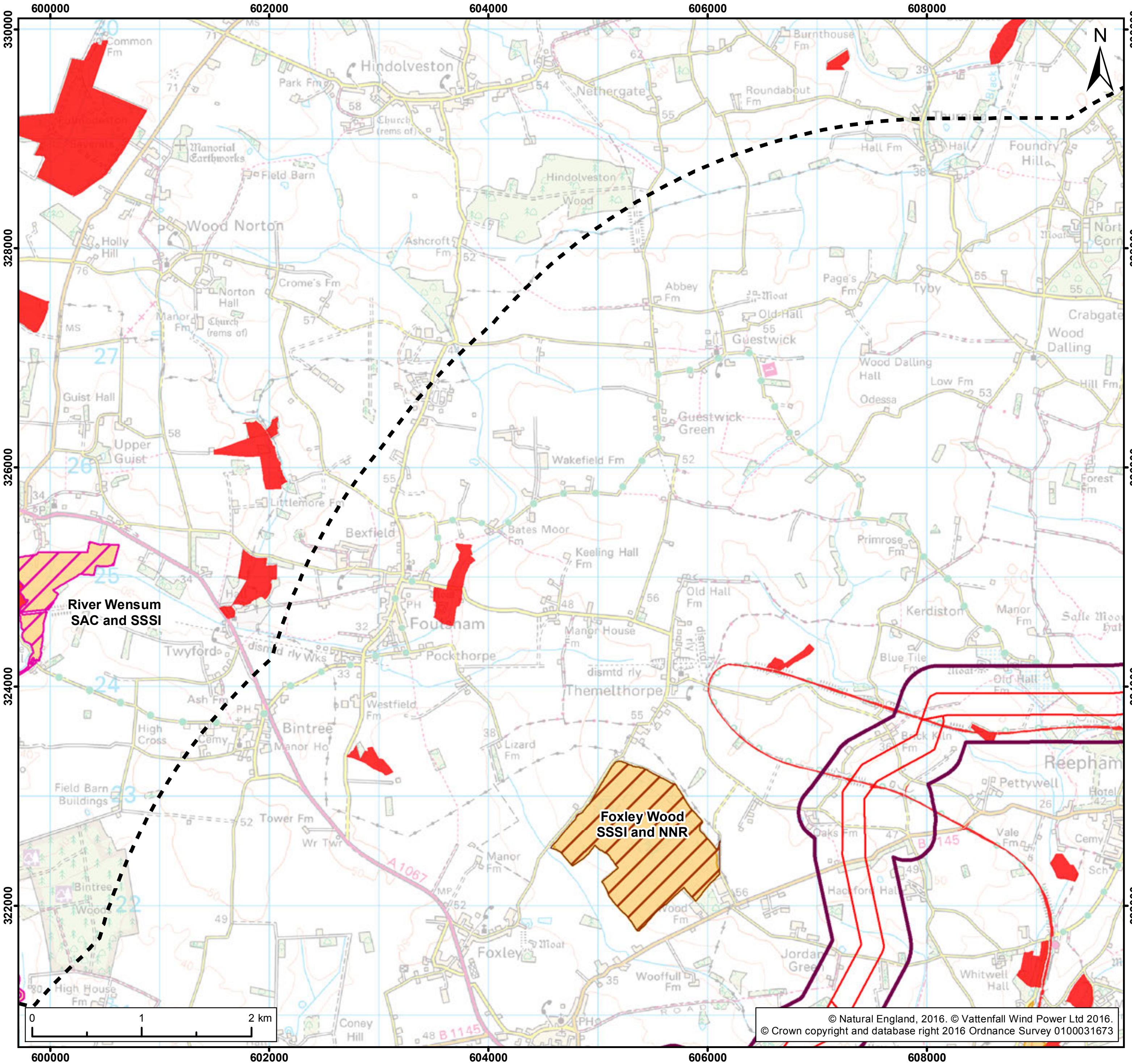

Legend:

- Onshore Scoping Area
- 5km Ornithology Study Area
- Onshore Cable Corridor
- Site of Special Scientific Interest (SSSI)¹
- Special Area of Conservation
- National Nature Reserve (NNR)¹
- County Wildlife Site¹

¹ Natural England, 2016.
² RSPB, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Statutory and Non-Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.11h | Drawing No: PB5640-102-043

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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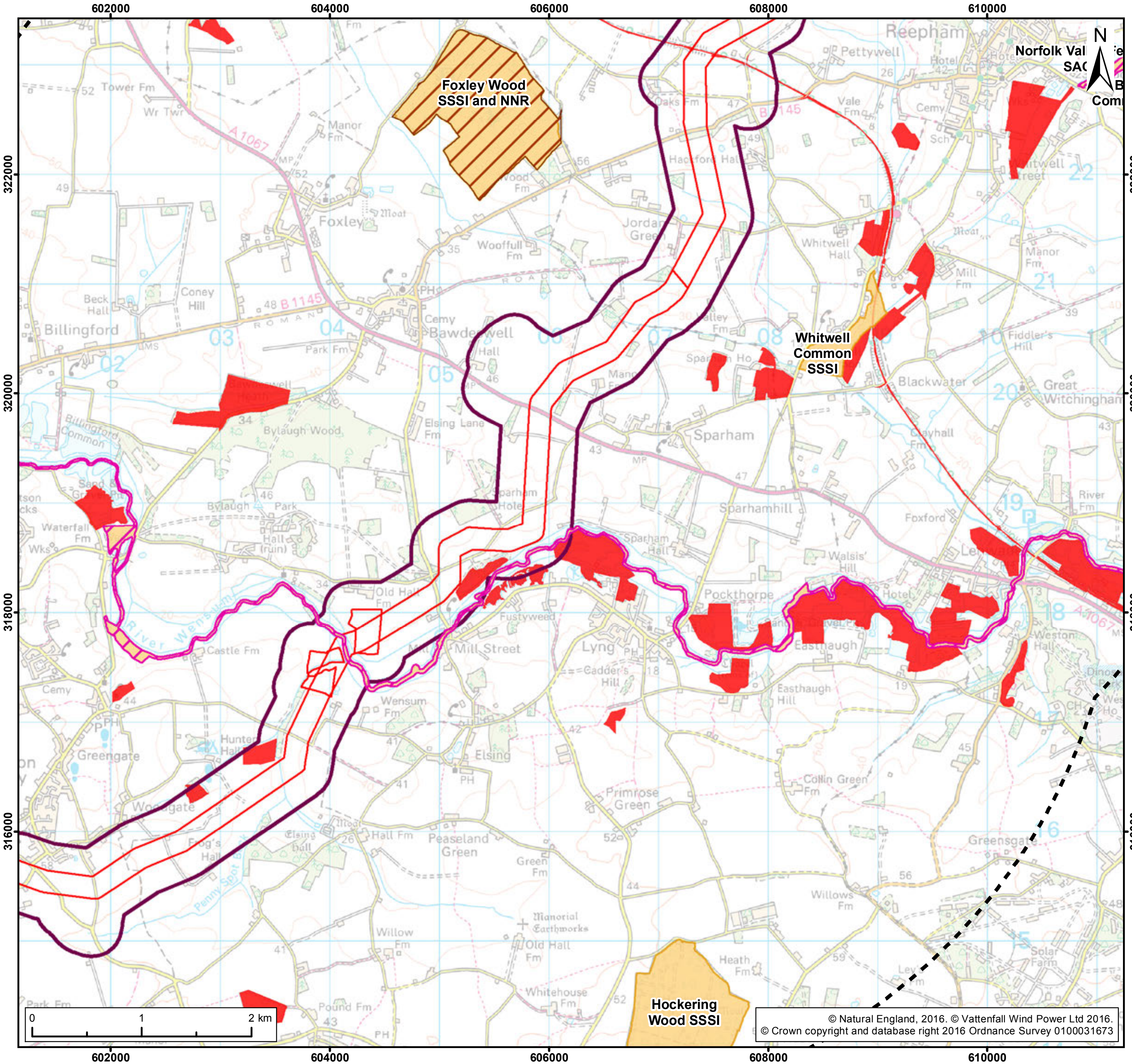

Legend:

- Onshore Scoping Area
- 5km Ornithology Study Area
- Onshore Cable Corridor
- Site of Special Scientific Interest (SSSI)[1]
- Special Area of Conservation (SAC)[1]
- National Nature Reserve (NNR)[1]
- County Wildlife Site[1]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Statutory and Non-Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.11i | Drawing No: PB5640-102-043

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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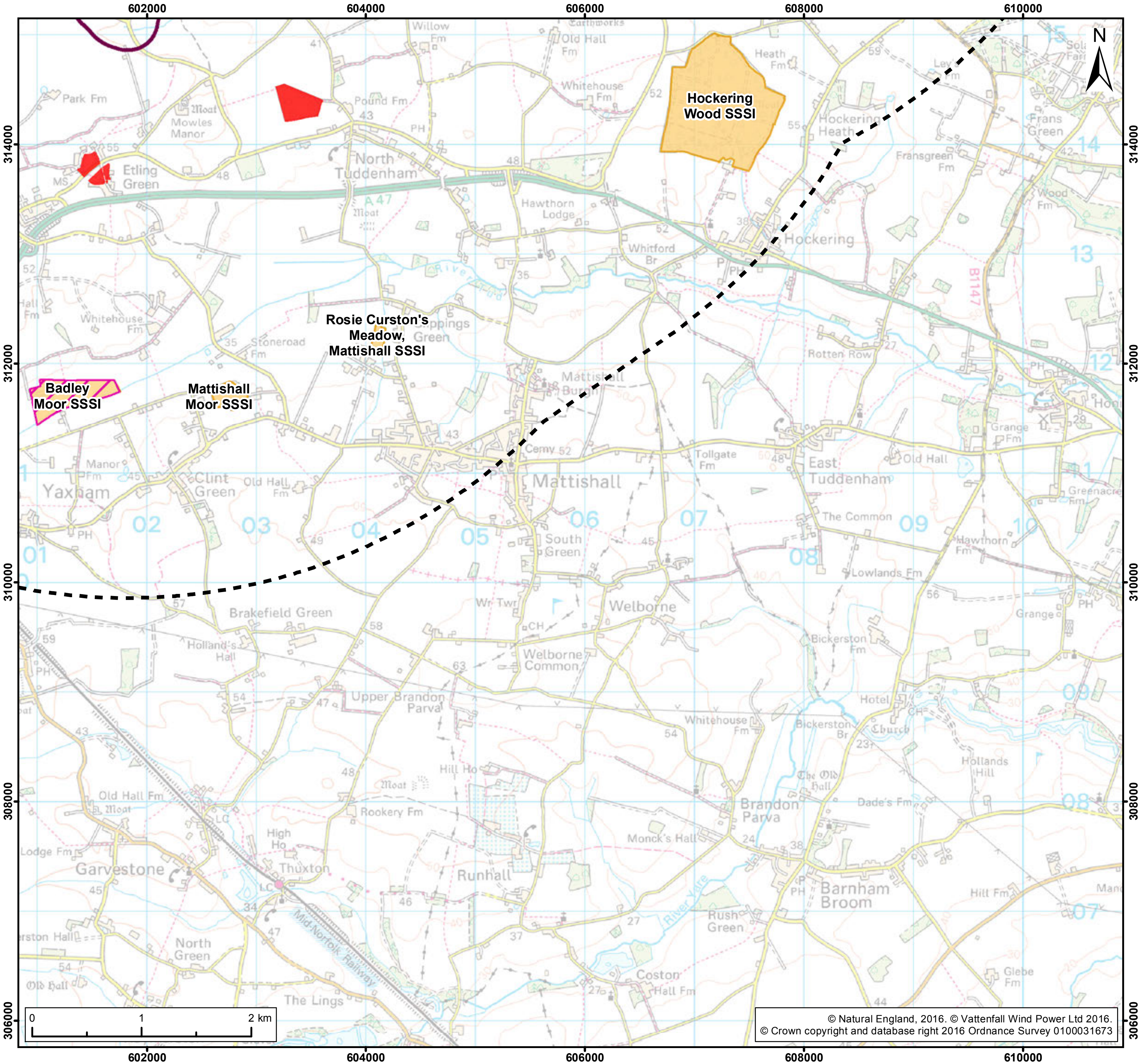

Legend:

- Onshore Scoping Area
- 5km Ornithology Study Area
- Site of Special Scientific Interest (SSSI)[1]
- Special Area of Conservation (SAC)[1]
- County Wildlife Site[1]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project: Norfolk Boreas

Report: Environmental Impact Assessment Scoping Report

Title: Statutory and Non-Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.11j

Drawing No: PB5640-102-043

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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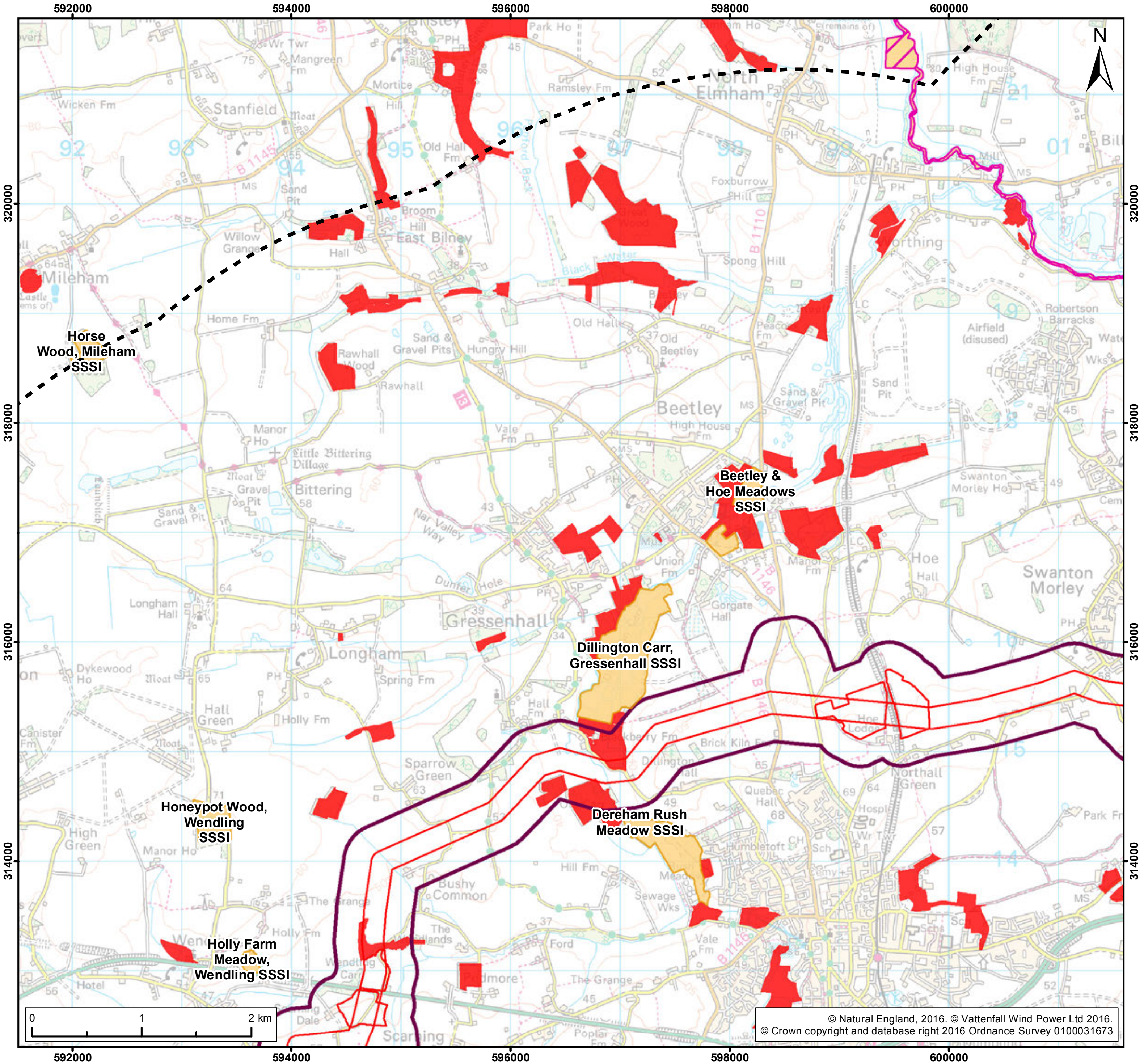

Legend:

- Onshore Scoping Area
- 5km Ornithology Study Area
- Onshore Cable Corridor
- Site of Special Scientific Interest (SSSI)[1]
- Special Area of Conservation (SAC)[1]
- County Wildlife Site[1]

[1] Natural England, 2016.

[2] RSPB, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Statutory and Non-Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.11k | Drawing No: PB5640-102-043

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Co-ordinate System: British National Grid **EPSG:** 27700

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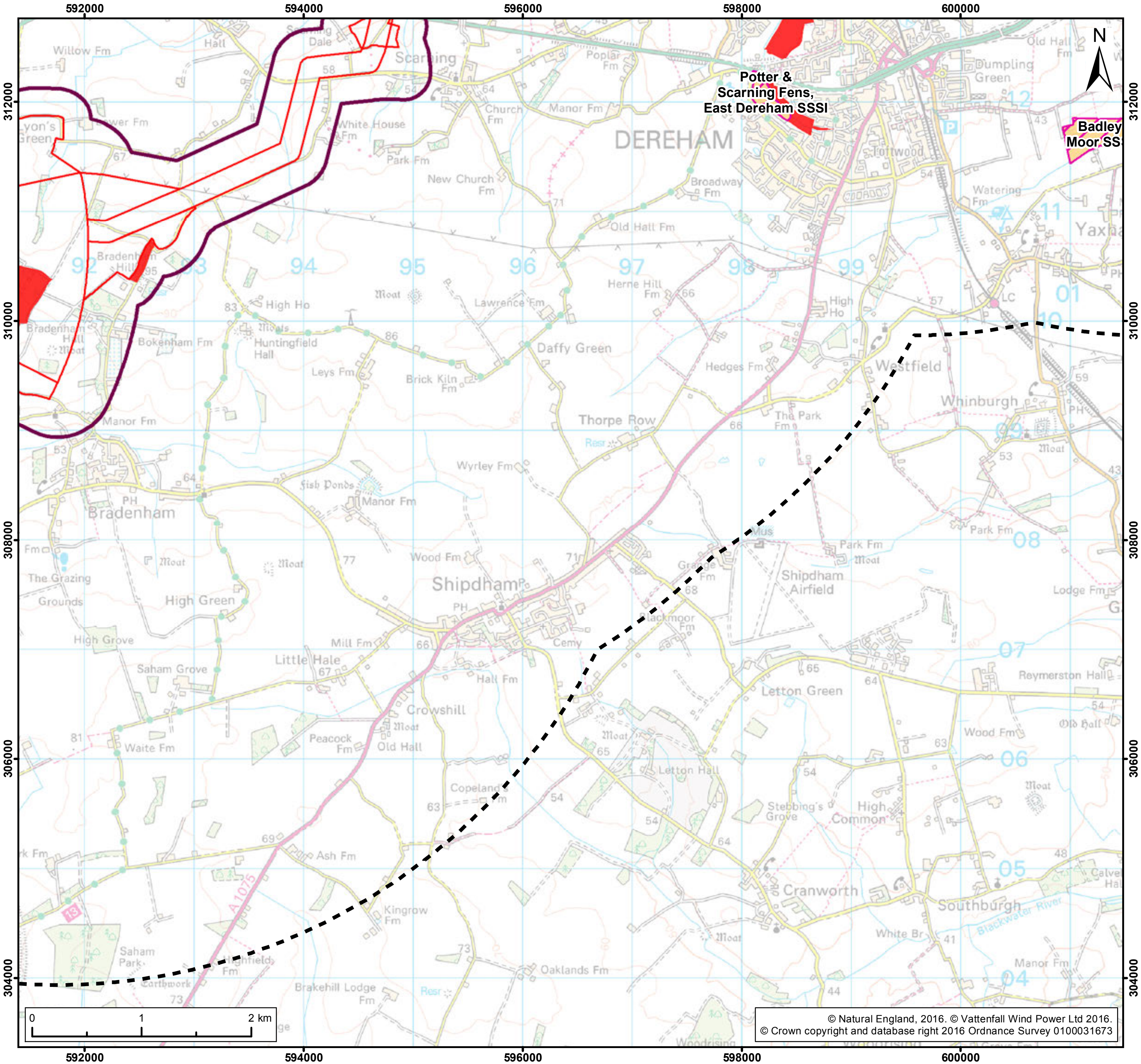

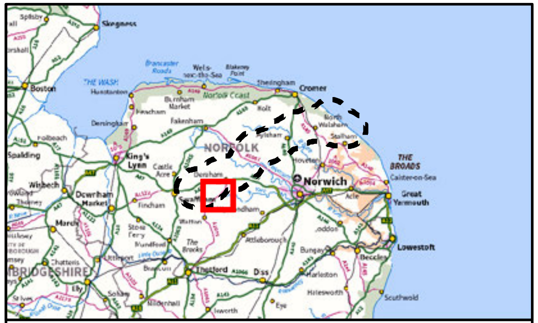

Legend:

- Onshore Scoping Area
- 5km Ornithology Study Area
- Onshore Cable Corridor
- Site of Special Scientific Interest (SSSI)[1]
- Special Area of Conservation (SAC)[1]
- County Wildlife Site[1]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Statutory and Non-Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.11l Drawing No: PB5640-102-043

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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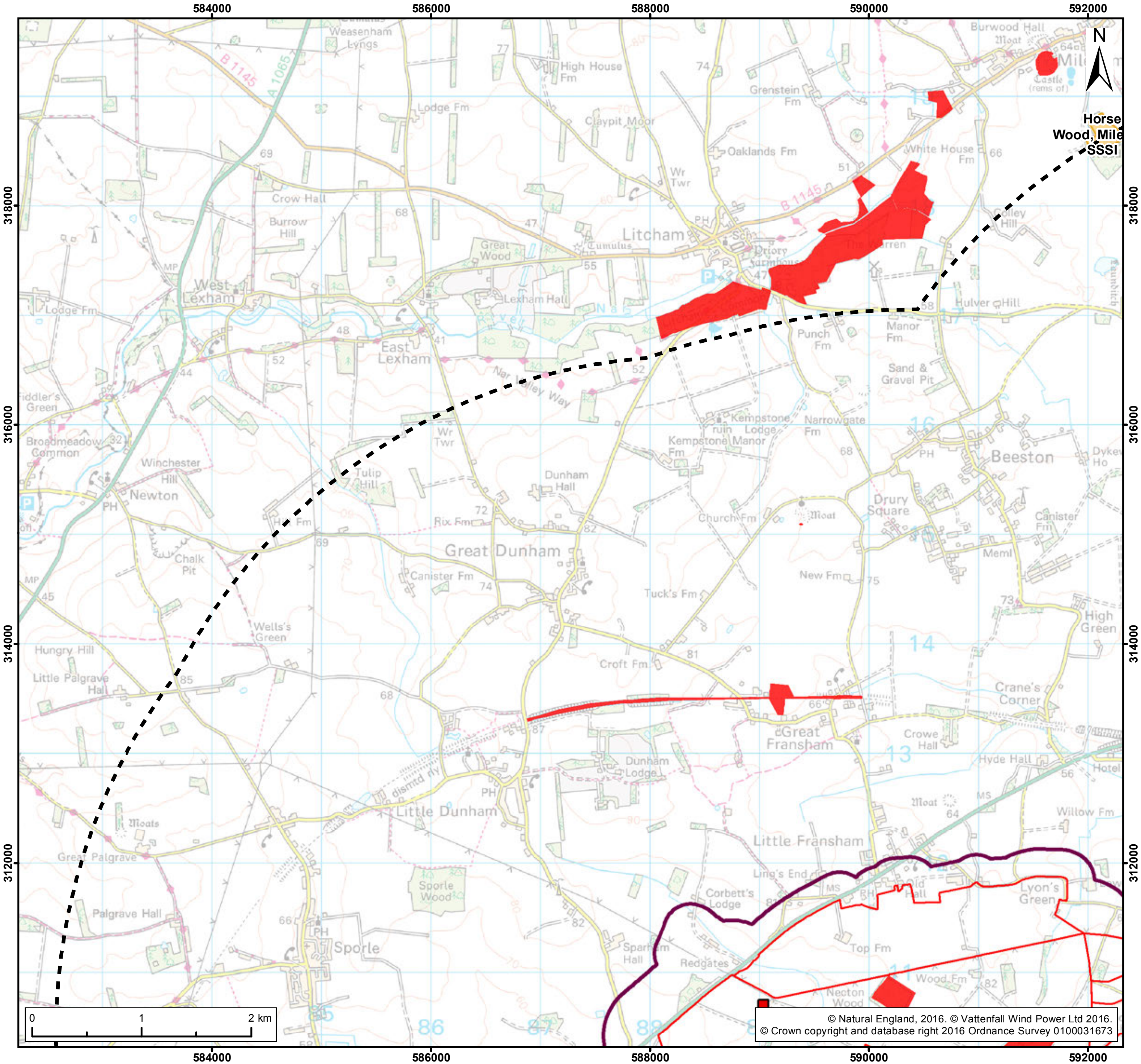

Legend:

- Onshore Scoping Area
- 5km Ornithology Study Area
- Existing Necton 400kV National Grid Substation
- Onshore Cable Corridor
- Site of Special Scientific Interest (SSSI)[1]
- County Wildlife Site[1]

[1] Natural England, 2016.

[2] RSPB, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Statutory and Non-Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.11m	Drawing No: PB5640-102-043				
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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01	13/03/17	AB	DT	A4	1:50,000

Co-ordinate System: British National Grid **EPSG:** 27700

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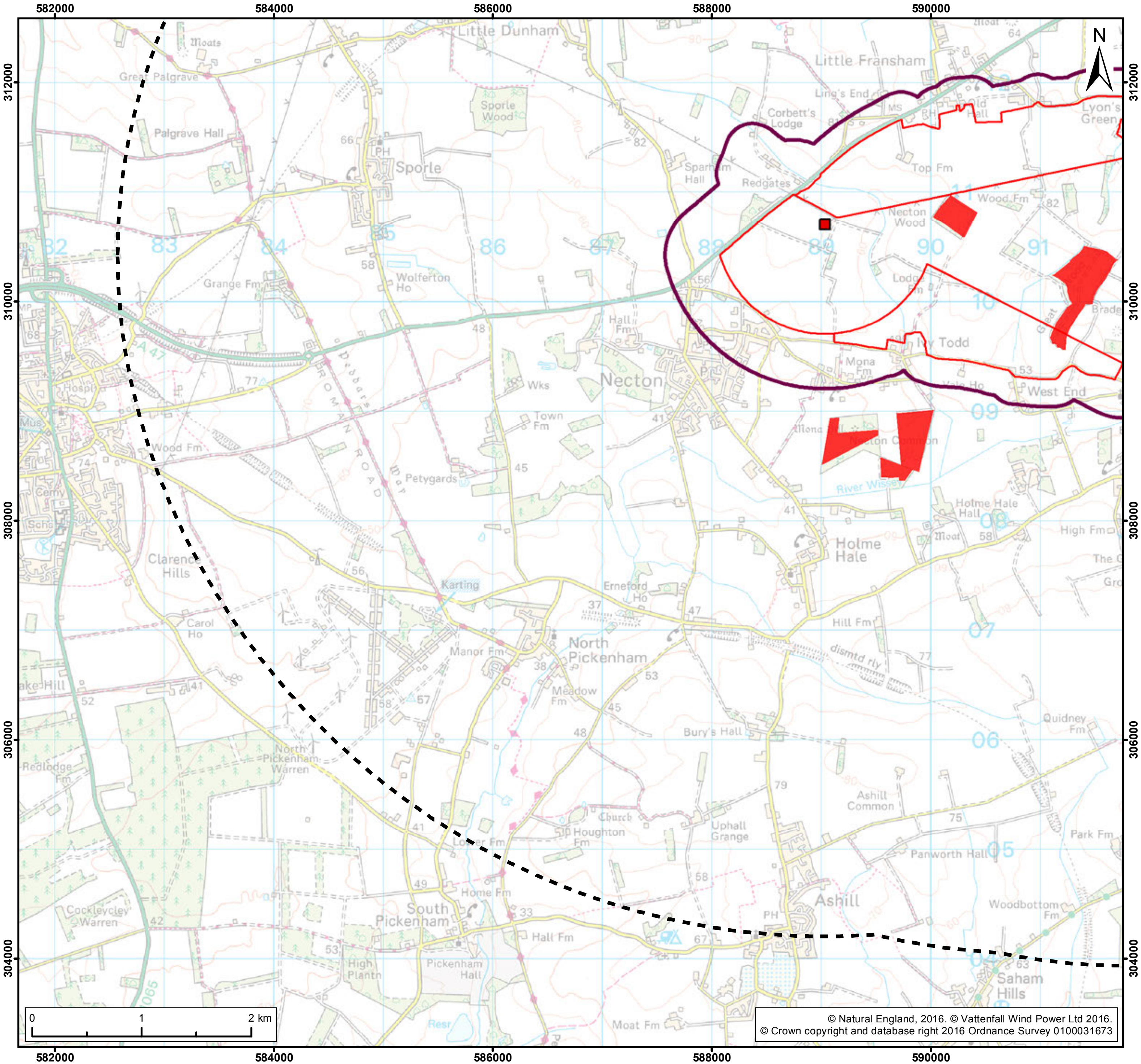

Legend:

- Onshore Scoping Area
- 5km Ornithology Study Area
- Existing Necton 400kV National Grid Substation
- Onshore Cable Corridor
- County Wildlife Site[1]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project: Norfolk Boreas

Report: Environmental Impact Assessment Scoping Report

Title:

Statutory and Non-Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.11n | Drawing No: PB5640-102-043

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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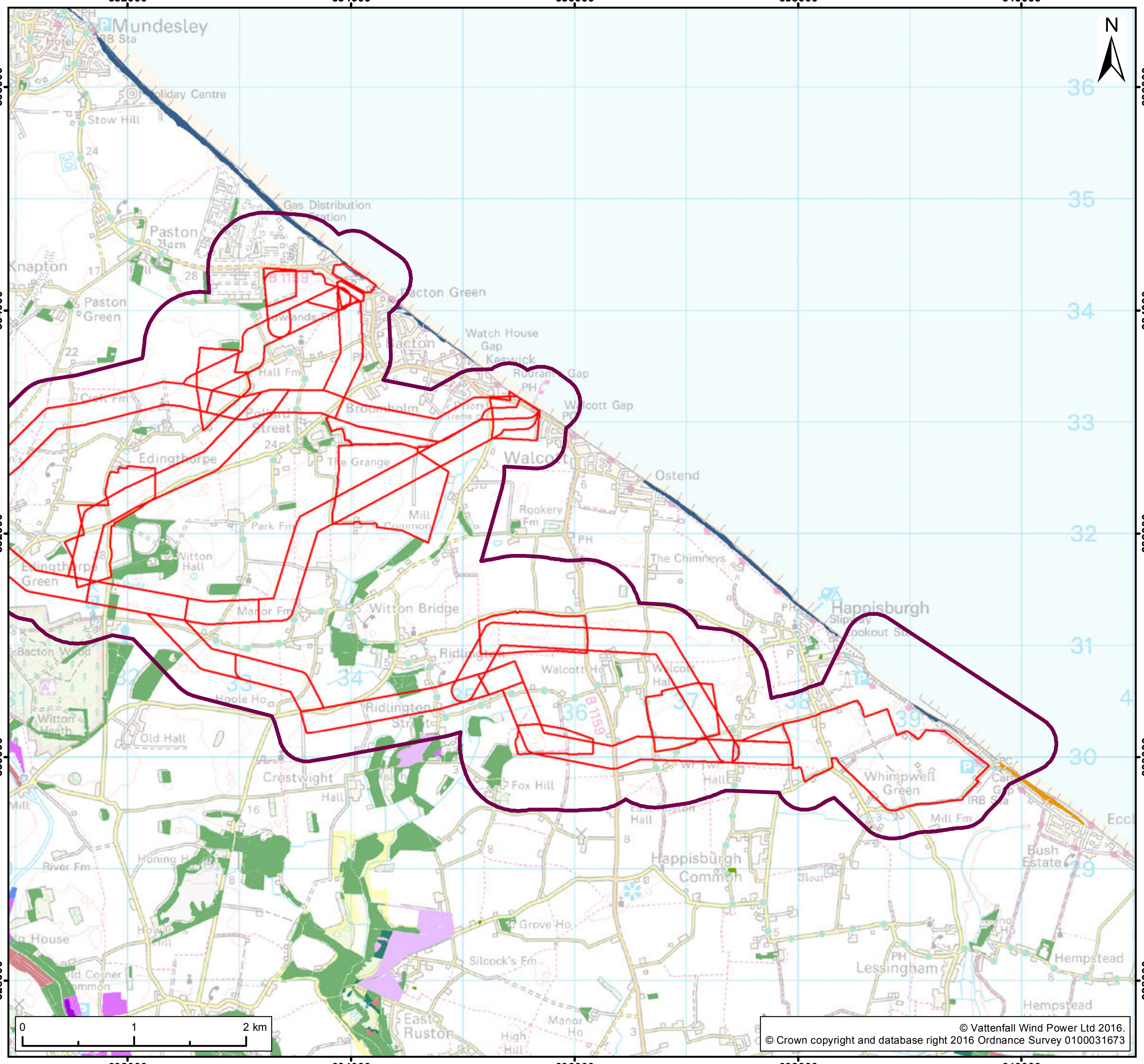

Legend:

- Onshore Scoping Area
- Onshore Cable Corridor

UK BAP Priority Habitat[1]

- Coastal and floodplain grazing marsh
- Coastal sand dune
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland fen
- Lowland heathland
- Maritime cliff and slope
- Purple moor grass and rush pasture
- Reedbed
- Traditional orchard

[1] Natural England, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

UK Habitats of Principal Importance

Figure: 3.12a | Drawing No: PB5640-102-044

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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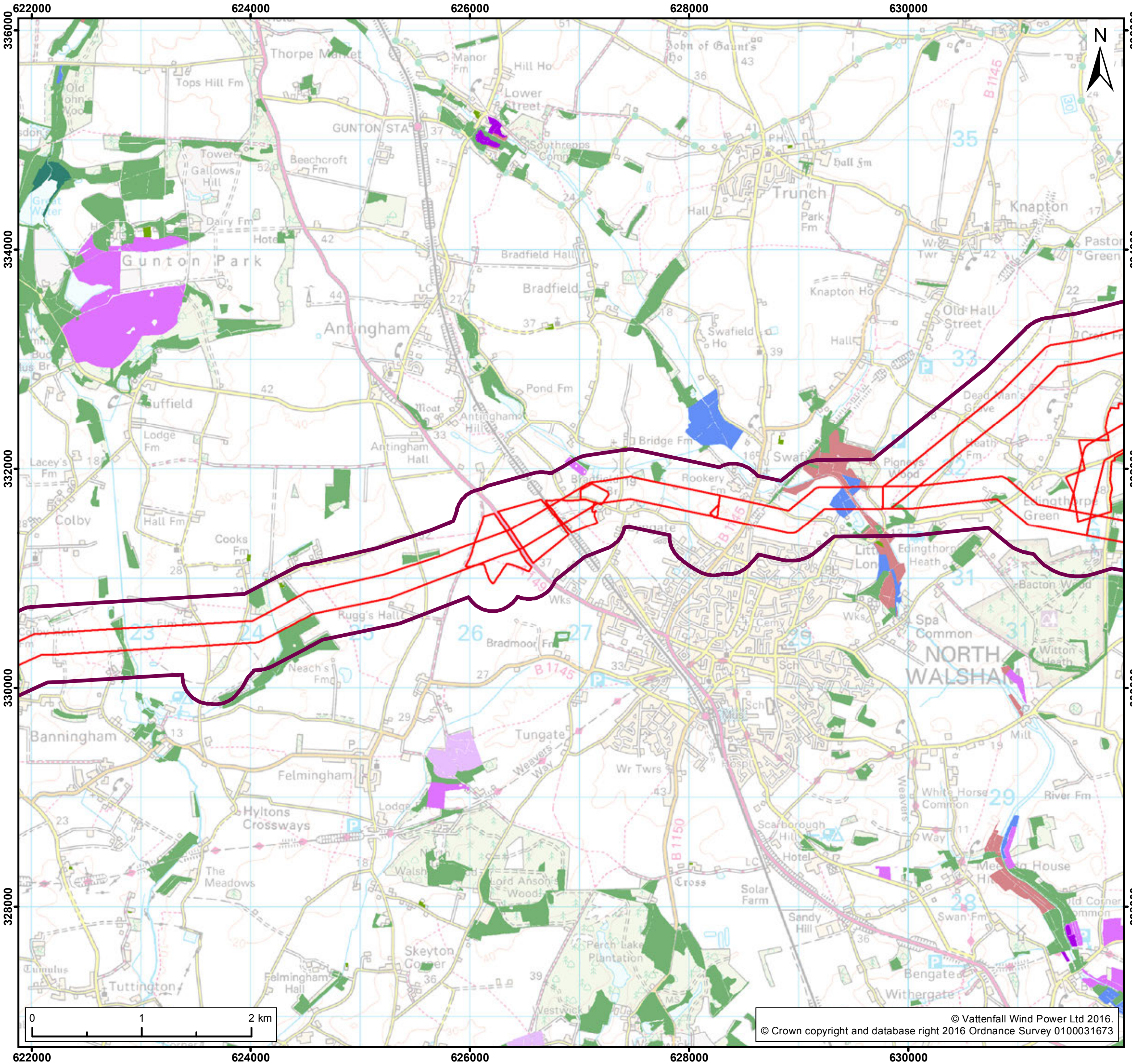

Legend:

- Onshore Scoping Area
- Onshore Cable Corridor

UK BAP Priority Habitat[1]

- Coastal and floodplain grazing marsh
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland fen
- Lowland heathland
- Purple moor grass and rush pasture
- Reedbed
- Traditional orchard

[1] Natural England, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

UK Habitats of Principal Importance

Figure: 3.12b | Drawing No: PB5640-102-044

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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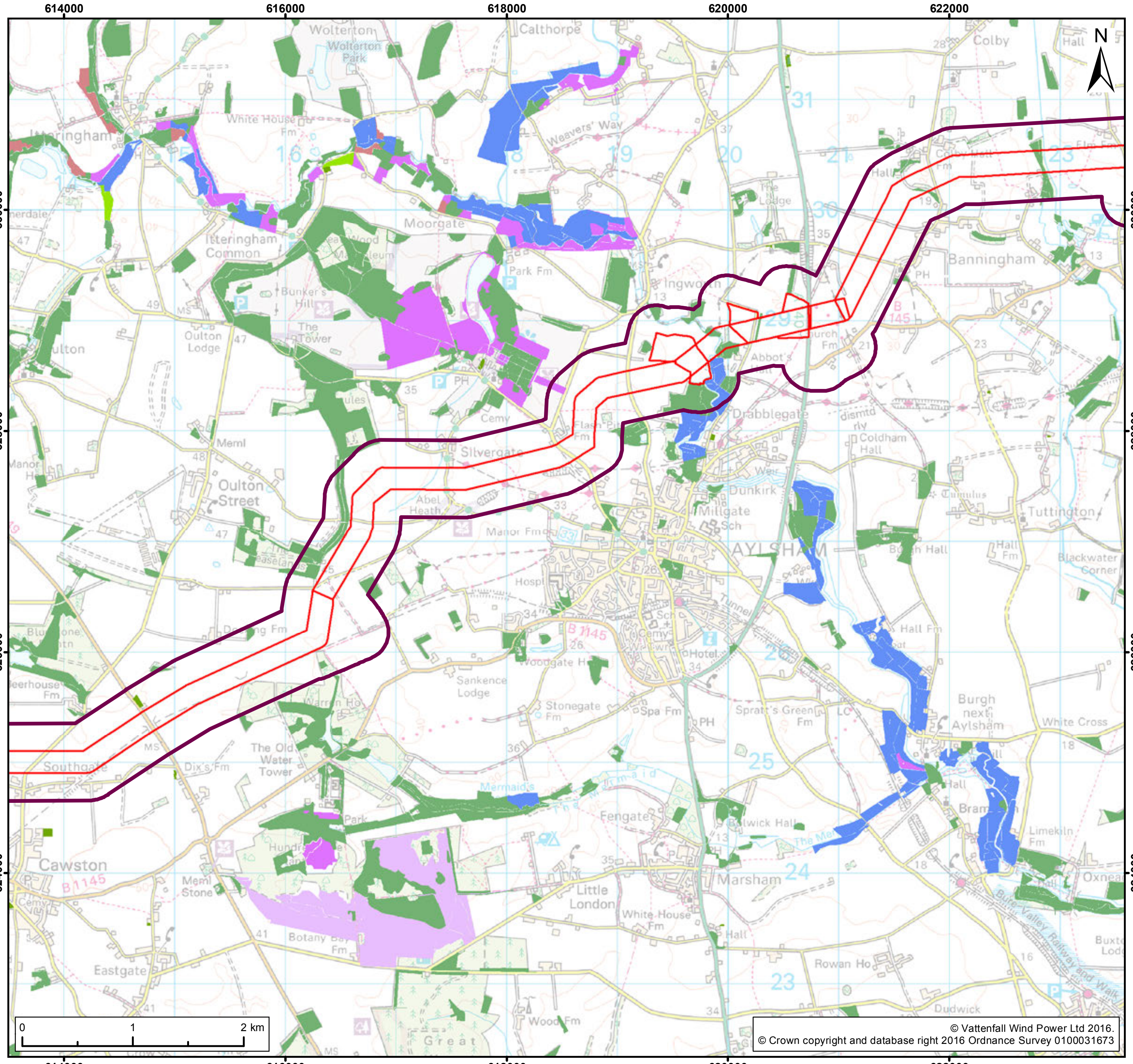

Legend:

- Onshore Scoping Area
- Onshore Cable Corridor

UK BAP Priority Habitat[1]

- Coastal and floodplain grazing marsh
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland fen
- Lowland heathland
- Lowland meadow
- Traditional orchard

[1] Natural England, 2016.

Project: Norfolk Boreas	Report: Environmental Impact Assessment Scoping Report

Title:

UK Habitats of Principal Importance

Figure: 3.12c | Drawing No: PB5640-102-044

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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01	13/03/17	AB	DT	A4	1:50,000

Co-ordinate System: British National Grid **EPSG:** 27700

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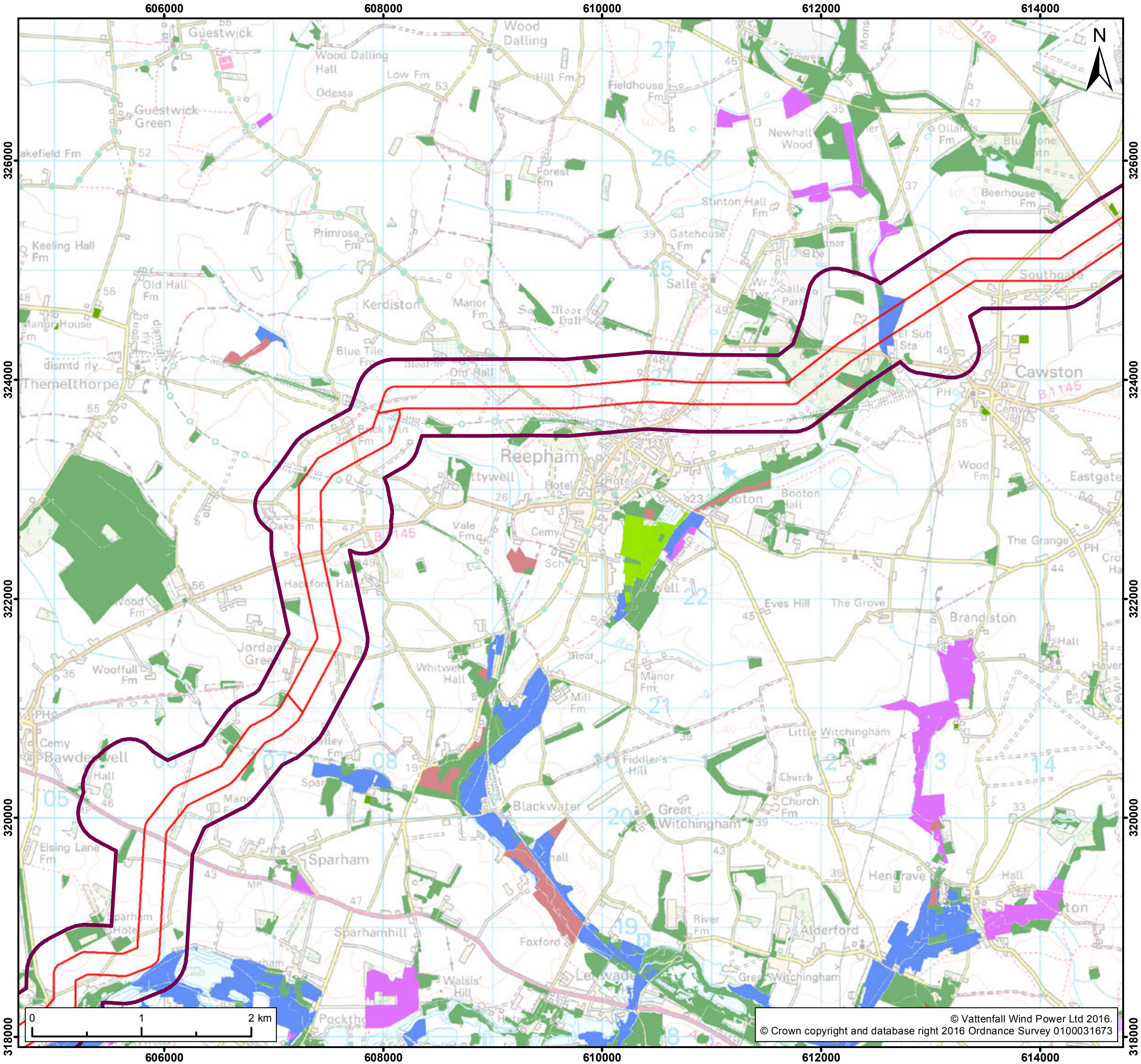

Legend:

- Onshore Scoping Area
- Onshore Cable Corridor

UK BAP Priority Habitat[1]

- Coastal and floodplain grazing marsh
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland calcareous grassland
- Lowland fen
- Lowland heathland
- Lowland meadow
- Traditional orchard

[1] Natural England, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

UK Habitats of Principal Importance

Figure: 3.12d | Drawing No: PB5640-102-044

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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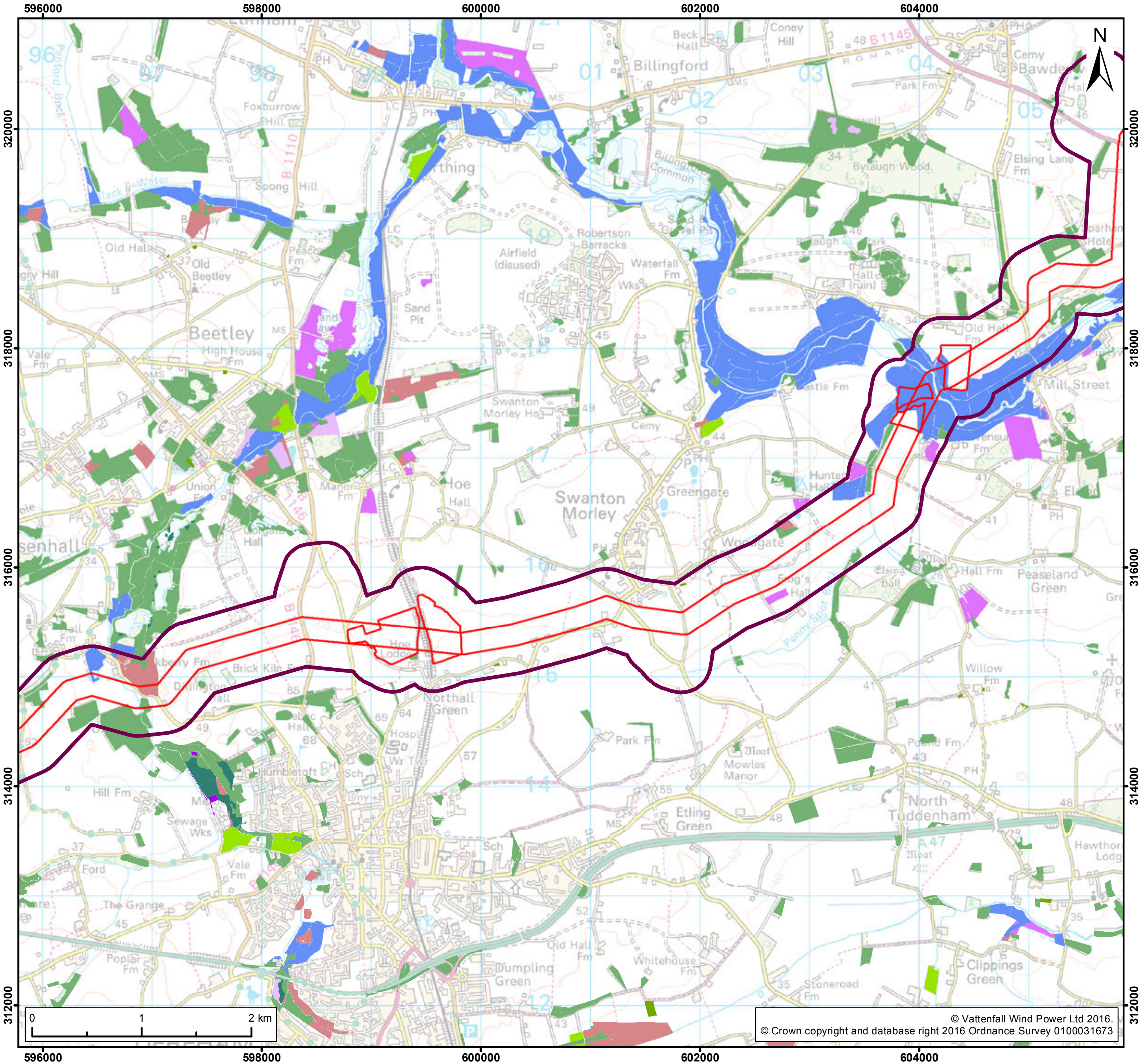

Legend:

- Onshore Scoping Area
- Onshore Cable Corridor

UK BAP Priority Habitat[1]

- Coastal and floodplain grazing marsh
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland fen
- Lowland heathland
- Lowland meadow
- Reedbed
- Traditional orchard

[1] Natural England, 2016.

Project: Norfolk Boreas

Report: Environmental Impact Assessment Scoping Report

Title: UK Habitats of Principal Importance

Figure: 3.12e

Drawing No: PB5640-102-044

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	JM	A4	1:50,000
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Co-ordinate System: British National Grid **EPSG:** 27700

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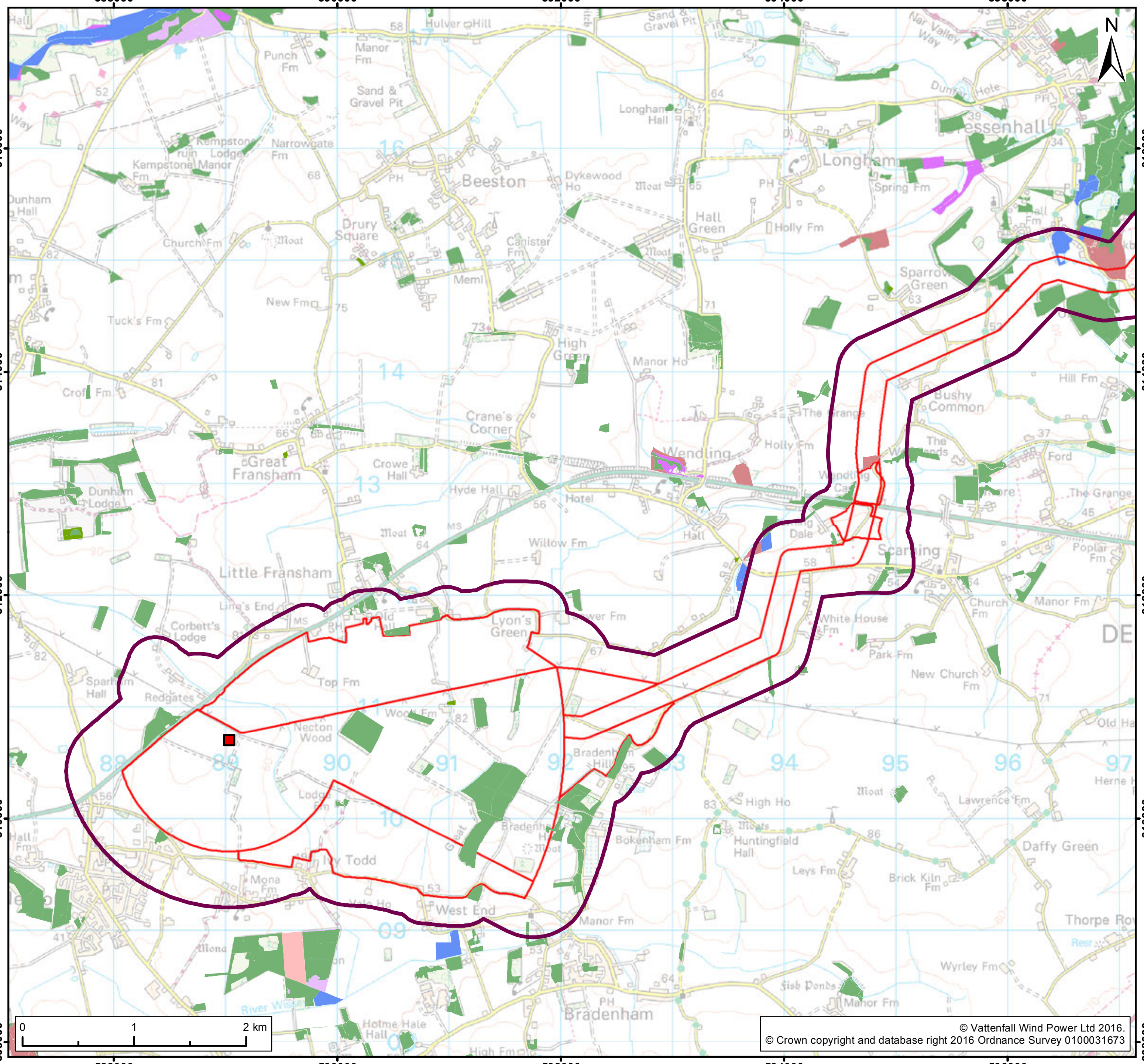

Legend:

- Onshore Scoping Area
- Existing Necton 400kV National Grid Substation
- Onshore Cable Corridor

UK BAP Priority Habitat[1]

- Coastal and floodplain grazing marsh
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland fen
- Lowland heathland
- Reedbed
- Traditional orchard

[1] Natural England, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

UK Habitats of Principal Importance

Figure: 3.12f | Drawing No: PB5640-102-044

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Non-statutory Designated Sites

1100. A total of 29 non-statutory designated sites (County Wildlife Sites (CWS)) (Figure 3.11) and 2 potential CWS have been identified within the onshore scoping area.

Terrestrial Habitats

1101. UK Habitats of Principal Importance recorded within the onshore scoping area, as shown on Figure 3.12 include the following:

- Coastal and floodplain grazing marsh;
- Coastal sand dunes;
- Deciduous woodland;
- Good quality semi-improved grassland;
- Lowland dry acid grassland;
- Lowland fens;
- Lowland heathland;
- Lowland meadows;
- Maritime cliff and slope;
- Purple moor grass and rush pastures;
- Reedbeds; and
- Traditional orchard.

1102. The legislation underpinning UK Habitats of Principal Importance is discussed in Section 1.4.

Protected, Notable and Invasive Species

1103. A review of biological data records indicates that there are records for the following legally protected species within the onshore scoping area:

- Great crested newt *Triturus cristatus* (an European Protected Species (EPS));
- Reptiles (including common lizard *Zootoca vivipara* and slow worm *Anguis fragilis*);
- Otter *Lutra lutra* (an EPS);
- Badger *Meles meles*;
- Water Vole *Arvicola amphibious*; and
- Bats (including Western Barbastelle *Barbastella barbastellus*, Serotine *Eptesicus serotinus*, *Myotis spp*., Daubenton's Bat *Myotis daubentonii*, Natterer's Bat *Myotis nattereri*, Lesser Noctule *Nyctalus leisleri*, Noctule Bat *Nyctalus noctula*, Pipistrelle *Pipistrellus pipistrellus*, Nathusius's Pipistrelle *Pipistrellus nathusii*, Soprano Pipistrelle *Pipistrellus pygmaeus*, Long-eared Bat species *Plecotus spp*., and Brown Long-eared Bat *Plecotus auritus*) (all bats are EPS).

1104. There are numerous records of notable terrestrial and aquatic invertebrate species recorded within the onshore scoping area, including a range of moth species.

1105. The notable plant species holly-leaved naiad *Najas marina* has been recorded in the vicinity within the onshore scoping area but not within the footprint itself.

1106. Several invasive species listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) have been recorded within the onshore scoping area, including, Japanese knotweed *Fallopia japonica*, and signal crayfish *Pacifastacus leniusculus*. Giant hogweed *Heracleum mantegazzianum*, floating pennywort *Hydrocotyle ranunculoides* Chinese mitten crab *Eriocheir sinensis* and killer shrimp *Dikerogammarus spp*. are also known to be in the area.

1107. The legislation underpinning legally protected species and invasive species is discussed in Section 1.4.

3.6.2 Potential impacts

1108. Full details of the project description are provided in Section 1.5.

1109. Potential impacts upon onshore ornithology including impacts upon breeding, passage and wintering birds are discussed separately within Section 3.7, and are not considered within this section.

3.6.2.1 Potential impacts during construction

1110. **Impacts to statutory and non-statutory designated sites:** The site selection process for the location of the onshore electrical infrastructure for Norfolk Boreas considered the location of statutory designated sites for nature conservation (i.e. National Parks, SACs, SPAs, Ramsar sites and SSSIs) and Ancient Woodland habitat. Trenchless techniques would be employed under all statutory sites which could not be avoided by micrositing. Onshore electrical infrastructure has therefore been located to avoid all statutory designated sites. As such, direct impacts upon statutory designated sites would not occur.

1111. The following potential indirect impacts upon statutory designated sites could still occur during construction, and will be considered during the EIA:

- Changes to hydrological processes which underlie statutory designated sites (i.e. The River Wensum SAC, Norfolk Valley Fens SAC and component SSSIs);
- Impacts upon interest features of the statutory designated sites which may be present in, or utilising the habitats immediately surrounding each site (functionally-linked land);
- Spread of invasive species;
- Pollution of watercourses; and

- Disturbance caused by works at the onshore project substation, cable route, landfall, cable relay station and National Grid substation extension zone due to activities which generate fugitive emissions (i.e. noise and dust) and lighting.

1112. The following potential direct and indirect impacts upon non-statutory designated sites will be considered within the EIA:

- Direct impacts upon Norfolk County Wildlife Sites (CWS) arising through location of the onshore electrical infrastructure within a CWS; and
- Indirect impacts upon Norfolk CWS due to activities which generate fugitive emissions (i.e. noise and dust), activities which may alter the local drainage patterns and activities which result in changes in land use type adjacent to statutory and non-statutory designated sites.

1113. **Impacts to Habitats**: The site selection process for the location of the onshore electrical infrastructure for Norfolk Boreas considered the location of Ancient Woodland habitat. Onshore electrical infrastructure has been located to avoid all areas of Ancient Woodland. Therefore direct impacts to ancient woodland would not occur and it is proposed that this impact should be scoped out from further consideration within the EIA. Indirect impacts may occur due to activities which generate fugitive emissions (i.e. noise and dust).

1114. Impacts upon UK Habitats of Principal Importance and Norfolk Local Biodiversity Action Plan (LBAP) habitats will be considered within the EIA. Impacts upon these habitats have been avoided during the site selection process where possible. The following remaining impacts will be considered:

- Direct permanent loss of sensitive habitats located beneath the footprint of the cable relay station and substation;
- Direct temporary loss of sensitive habitats located beneath the footprint of the onshore cable route (including temporary works areas) and landfall site;
- Temporary habitat fragmentation of linear habitats (e.g. hedgerows) during construction of the onshore cable route (including temporary works areas) and landfall site; and
- Indirect damage to sensitive habitats arising from nitrogen deposition.

1115. **Impacts to legally protected and notable species**: Impacts upon all legally protected species will be considered within the EcIA. Impacts upon legally protected species have been avoided during the design process where possible. The following remaining potential impacts will be considered:

- Direct impacts upon great crested newt through direct killing or injuring and indirect impacts through terrestrial and aquatic habitat loss and fragmentation.
- Direct impacts upon reptiles (in particular common lizard *Zootoca vivipara* and slow

worm *Anguis fragilis*) through direct killing or injuring and indirect impacts through habitat loss and fragmentation.

- Direct impacts upon otter through direct killing or injuring and indirect impacts through habitat loss and fragmentation.
- Direct impacts upon water vole through direct killing or injuring and indirect impacts through habitat loss and fragmentation.
- Direct impacts upon badgers through direct killing or injuring and indirect impacts through habitat loss and fragmentation.
- Direct impacts upon bat species (in particular Western Barbastelle *Barbastella barbastellus*, Serotine *Eptesicus serotinu*s, *Myotis spp*., Daubenton's Bat *Myotis daubentonii*, Natterer's Bat *Myotis nattereri*, Lesser Noctule *Nyctalus leisleri*, Noctule Bat *Nyctalus noctula*, Pipistrelle *Pipistrellus pipistrellus*, Nathusius's Pipistrelle *Pipistrellus nathusii*, Soprano Pipistrelle *Pipistrellus pygmaeus*, Long-eared Bat species *Plecotus spp*., and Brown Long-eared Bat *Plecotus auritus*)) through direct killing or injuring and indirect impacts through habitat loss and fragmentation.
- Barrier impacts to fish and other aquatic organisms as a result of the use of temporary dams where trenching of river crossings is required for the onshore cable corridor.
- Direct impacts upon notable terrestrial and aquatic invertebrates (including the Desmoulin's land snail) and indirect impacts through habitat loss and fragmentation.
- Direct impacts upon the notable plant species holly-leaved naiad *Najas marina*.

1116. **Spread of invasive species**: The construction activities have the potential to cause the spread of non-native invasive species, if present, as construction vehicles and personnel would be operating in a number of locations across a large area of Norfolk.

3.6.2.2 Potential impacts during operation

1117. **Impacts to statutory and non-statutory designated sites**: Potential indirect impacts upon statutory and non-statutory designated sites could occur during the operation and maintenance phase, and will be considered in the EIA. Impacts may include changes to water quality, spread of invasive species or noise. Impacts to water resources and noise are considered in Sections 3.4 and 3.9.

1118. **Temporary loss of habitats and disturbance of fauna during maintenance activities:** Apart from occasional inspection of above ground elements of the cable route, there is no ongoing requirement to maintain the onshore cables following installation. As such, potential impacts arising during operation and maintenance activities would be minimal.

1119. Routine maintenance of the substation and cable relay station would take place, involving small local vehicles, which may give rise to localised disturbance effects during operation.

1120. **Disturbance of fauna due to operational lighting:** Site lighting for the substation and cable relay station would be required and therefore potential impacts may arise.

1121. Any potential planting which may be included as part of potential screening proposals could result in a beneficial impact.

3.6.2.3 Potential impacts during decommissioning

1122. No decision has been made regarding the final decommissioning policy for the substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. It is likely that the substation and cable relay station equipment would be removed and reused or recycled. It is expected that the onshore cables would be removed from ducts and recycled, with the transition pits and ducts left in situ.

1123. The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan would be provided.

1124. It is anticipated that the decommissioning impacts would be similar in nature to those of construction.

3.6.2.4 Potential cumulative impacts

1125. The approach to assessing cumulative impacts is detailed in Section 3.13.

1126. Other developments with potential to impact upon land use receptors will be considered. These are likely to include schemes that involve disturbance to designated sites, species and habitats in the onshore environment, or may lead to the spread of non-native invasive species such as through working in watercourses.

1127. Further consideration will be given to these potential cumulative scenarios as part of the EIA in combination with other projects, particularly in respect to the combined Norfolk Vanguard and Norfolk Boreas scenarios, and the cable route for the proposed Hornsea Project 3.

3.6.2.5 Summary of potential impacts

Table 3.13 Summary of impacts relating to onshore ecology

Potential impacts	Construction	Operation	Decommissioning
Impacts to statutory and non-statutory designated sites	✓	✓	✓

Potential impacts	Construction	Operation	Decommissioning
Permanent and temporary loss of habitats	✓	x	✓
Temporary habitat fragmentation and species isolation	✓	x	✓
Impacts to legally protected and notable species	✓	✓	✓
Spread of non-native invasive species	✓	x	✓
Impacts from lighting	✓	✓	✓
Cumulative impacts	✓	✓	✓

Scoped in (✓) and scoped out (x)

3.6.3 Mitigation

1128. Embedded mitigation is likely to include the following:

- Avoidance of impact through onshore cable corridor and cable route selection and micrositing where possible (e.g. avoiding designated sites or areas of important habitat, woodland areas, water bodies and agricultural ditches);
- Avoidance of impact through methodology selection (e.g. trenchless techniques at sensitive points);
- Ensure seasonal constraints in relation to specific species are adhered to where possible (e.g. undertaking vegetation clearance outside if bird nesting season);
- Development of species-specific mitigation based on the findings of ecological scoping surveys;
- To reduce the working width where appropriate (e.g. hedgerow crossings) to ensure minimal habitat removal, in accordance with EN-1 Overarching National Policy Statement for Energy;
- All habitats removed during construction to be reinstated upon completion of works where practical. For habitats that would be permanently lost as a result of the footprint of the electrical infrastructure, if practical new habitat may be created as part of the Landscape and Environmental Management Strategy (LEMS);
- Adherence to guidance in The Bat Conservation Trust and Institute for Lighting Engineers' *Bats and Lighting in the UK* guidelines (BCT and ILE, 2009)
- Development of an Invasive Species Management Plan;
- Development of a CoCP;
- Development of an EMP, including for protected habitats and species, non-native invasive species and pollution prevention measures. A draft or outline EMP will be provided with the DCO application; and
- A draft or outline LEMS will be provided with the DCO application. This outline LEMS will detail the ecological enhancements measures proposed during construction and operation of the Norfolk Boreas Offshore Wind Farm.

1129. Additional mitigation measures would be discussed and agreed with stakeholders depending on any potential impacts identified.

3.6.4 Approach to assessment and data gathering

1130. The approach to assessment and data gathering outlined below is informed by methodology discussed with regulators and stakeholders during the EPP consultations in connection with Norfolk Vanguard.

1131. This scoping assessment for Norfolk Boreas has been undertaken based on a desk-based assessment of available data. Detailed survey information is required to identify the potential impacts upon onshore ecology in relation to the scoping area. This includes an Extended Phase 1 Habitat Survey in line with JNCC guidance (JNCC 2010) of the onshore cable corridor followed by targeted species-specific surveys scoped by the findings of the Extended Phase 1 Habitat Survey. Table 3.14 sets out the ecological surveys required in relation to the project.

1132. In conjunction with Section 3.4, assessment will be made of any potential effects on hydrological processes including investigation of springs and seepages associated with the River Wensum SAC and any impacts to component SSSIs associated with the Norfolk Valley Fens SAC or Country Wildlife Sites with a hydrological focus.

1133. The ES will cross reference other relevant chapters, including water resource and flood risk, landscape, noise, vibration and air quality (including dust).

1134. All surveys listed below are being / will be undertaken in line with best practice guidance for each species concerned.

Table 3.14 Ecological scoping surveys required in relation to for the project

Survey title	Year of survey	Proposed Survey details
Extended Phase 1 Habitat Survey	2017	Currently being undertaken and will cover the majority of the scoping area including: the onshore cable corridor, landfall locations, cable relay station and substation zones plus a 50m buffer (500m buffer when searching for waterbodies' suitability to support great crested newts), -includes ground truthing of habitats identified using aerial data collected during 2016, -identification of all UK protected species potential and recommendations for targeted, species specific Phase 2 surveys,
Depending on the findings of the Extended Phase 1 Habitat Survey, the following targeted species-specific surveys may be required:		
Wintering bird surveys	Oct 2016 - March 2017 (one winter)	Currently being undertaken and will cover habitats identified in the Extended Phase 1 Habitat Survey which may support wintering birds, as identified during the ornithological desk-based assessment conducted during summer 2016.

Survey title	Year of survey	Proposed Survey details
GCN Presence/Absence Survey	2017	Will cover waterbodies identified in the Extended Phase 1 Habitat Survey as providing the suitability to support breeding populations of great crested newts within 250m of the onshore cable corridor and landfall (and within 500m of the substation and cable relay station sites) which may be affected by the project.
Badger bait marking survey	2017	Will cover badger setts identified in the Extended Phase 1 Habitat Survey which may be part of more than one territory, and which may be affected by the project.
Bat activity survey	2017	Will cover suitable commuting/foraging habitats and all potential bat roosts identified in the Extended Phase 1 Habitat Survey which may be affected by the project.
Water vole	2017	Will cover suitable aquatic habitats identified in the Extended Phase 1 Habitat Survey which may be affected by the project.
Reptile surveys	2017	Will cover suitable habitats identified in the Extended Phase 1 Habitat Survey which may support significant populations of reptiles and which be affected by the project.
Dormice	2017	Will cover suitable woodland habitats identified in the Extended Phase 1 Habitat Survey which may be affected by the project.
White-clawed crayfish	2017	Will cover suitable aquatic habitats identified in the Extended Phase 1 Habitat Survey which may be affected by the project.
National Vegetation Classification / rare flora surveys, incl. invasive species	2017	Will cover habitats identified in the Extended Phase 1 Habitat Survey which may contain designated habitat types or which may contain rare or notable flora which may be affected by the project.
Breeding bird surveys	2017	Will cover habitats identified in the Extended Phase 1 Habitat Survey which may support breeding birds, as identified during the ornithological desk-based assessment conducted during summer 2016.
Invertebrates surveys (terrestrial and aquatic)	2017	Will cover terrestrial and or aquatic habitats identified in the Extended Phase 1 Habitat Survey which may support rare or notable invertebrates and which may be affected by the project.

1135. The Ecological Impact Assessment (EcIA) will be undertaken following Chartered Institute of Ecology and Environmental Management's (CIEEM) *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal (Second Edition)* (2016).

1136. Risks to EPS will be detailed with the EcIA and any licences required will be identified.

1137. The approach to assessment and data gathering will be discussed and agreed as part of the EPP (detailed in Section 1.6.2) prior to commencement. Consultation will be undertaken at key stages throughout the EIA process.

3.7 Onshore ornithology

3.7.1 Baseline

1138. This section considers ornithological receptors associated with terrestrial and coastal habitats only. Potential impacts upon ornithological receptors arising from the project seaward of the coastal zone are considered in Section 2.9.

3.7.1.1 Data sources

1139. The data sources used to inform this scoping report and which also will be used to inform the EIA are shown in Table 3.15.

Table 3.15 Onshore Ornithology data sources

Data	Source	Date
European designated sites (SPA, SAC, Ramsar sites)	Joint Nature Conservation Committee (JNCC)	2016
UK designated sites (SSSI, NNR, LNR)	Joint Nature Conservation Committee (JNCC) Natural England	2016
Norfolk County Wildlife sites	Norfolk Biodiversity information Service (NBIS)	2016
UK Habitats of Principal Importance	Joint Nature Conservation Committee (JNCC)	2016
Onshore Winter/Passage Bird Survey Scoping Report	Royal HaskoningDHV	2016
Norfolk Vanguard Onshore Electrical Infrastructure: Wintering Bird Surveys – Interim Report	APEM	2017

1140. Any additional data sets relevant to the EIA for onshore ornithology will be identified through feedback from stakeholders following this Scoping Request and through the EPP process.

3.7.1.2 *Stakeholder consultation*

1141. During the Norfolk Vanguard scoping process (Vattenfall Wind Power Ltd, 2016), early stakeholder consultation was undertaken with regards to the Onshore Winter/Passage Bird Survey Scoping Report (Royal HaskoningDHV, 2016b) to allow the scope for wintering/passage surveys to be refined so that the targeted onshore ornithological surveys, that were required to inform the EIA with respect to the onshore scoping area, could commence in winter 2016/2017.

3.7.1.3 Designated sites

1142. Figure 3.11 shows all of the onshore internationally designated sites for nature conservation which are located within 5km of the onshore scoping area (see Section 1.1.4 for description and explanation of the onshore scoping area), and all other designated sites for nature conservation located within 1km of the scoping area (i.e. the 'survey area'). Table 3.16 lists all of these designated sites which contain ornithological interest features, indicating whether they are for passage or overwinter populations, or for breeding populations, and hence relevant to the onshore ornithology EIA. It should be noted that study areas for onshore ornithological receptors will be determined during the EIA and agreed with stakeholders through the EPP.

Table 3.16 International Designated sites for nature conservation within 5km of the onshore scoping area and other designated sites within 1km of the onshore scoping area.

Site name	Designation	Ornithological interest features (Y/N)		Approximate distance to onshore scoping area (km)
		During the breeding season	Passage / over winter	
River Wensum	SAC, SSSI	Y	N	crosses
Dereham Rush Meadow	SSSI	Y	Y	0.1
Dillington Carr, Gressenhall	SSSI	Y	N	adjacent
Booton Common	SSSI	Y	N	0.3
Broadland	SPA	Y	Y	3.8
Broadland	Ramsar	Y	Y	3.8

1143. Of the designated sites falling within the survey area, three contain ornithological interest features relating to passage and/or wintering birds and six contain ornithological interest features relating to breeding birds.

1144. More detailed information has been gathered in relation to passage/wintering birds and is presented within the Ornithological Desk-based Assessment. This information is summarised in the section below.

3.7.1.4 Ornithological interest features on passage/over winter

1145. There are three sites, listed in Table 3.12, which are designated as sites for nature conservation due to the bird species which they support either on passage or overwinter. These interest features are described below.

Broadland SPA

1146. Broadland SPA is located approximately 3.8km south of the onshore scoping area boundary. The site is designated for the following features:

Table 3.17 Qualifying features of the Broadland SPA (population counts are derived from the SPA citation)

This site qualifies under Article 4.1 of the Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive:
Over winter; Bewick's Swan Cygnus *columbianus bewickii*, 495 individuals representing up to 7.1% of the wintering population in Great Britain (5 year peak mean 1987/8-1991/2) Bittern *Botaurus stellaris*, 2-3 individuals representing up to 10-15% of the wintering population in Great Britain (5 year peak mean 1987/8-1991/2)
Hen Harrier *Circus cyaneus*, 22 individuals representing up to 3% of the wintering population in Great Britain (5 year peak mean 1987/8-1991/2)
Ruff *Philomachus pugnax*, 96 individuals representing up to 6.4% of the wintering population in Great Britain (5 yr peak mean 1987/8-1991/2)
Whooper Swan *Cygnus cygnus*, 121 individuals representing up to 2% of the wintering population in Great Britain (5 yr peak mean 1987/8-1991/2)
Marsh Harrier *Circus aeruginosus*, 16 individuals representing up to 16% of the wintering population in Great Britain (5 year peak mean 1987/8-1991/2)
This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of the following migratory species:
Over winter;
Gadwall *Anas strepera*, 486 individuals representing up to4.0% of the wintering Northwestern Europe population (5 yr peak mean 1987/8-1991/2)
Shoveler *Anas clypeata*, 675 individuals representing up to 1.7% of the wintering Northwestern Europe population (5 yr peak mean 1987/8-1991/2)
Wigeon *Anas penelope*, 8,966 individuals representing up to 1.2% of the wintering Northwestern Europe population (5 yr peak mean 1987/8-1991/2)
The following species was also included under the SPA Review (Stroud *et al.* 2001):
Pink-footed Goose *Anser brachyrhynchus*, 3,290 individuals representing up to 1.5% of the wintering Eastern Greenland/Iceland/UK population (5 yr peak mean 1994/5-1998/9)
Under the SPA Review (Stroud *et al*. 2001), the area also qualifies under Article 4.2 of the Directive (79/409/EEC) by regularly supporting at least 20,000 waterfowl
Over winter, the area regularly supports 22,603 individual waterfowl (RSPB, Count 99/00) including: Cormorant *Phalacrocorax carbo*, Bewick's Swan Cygnus, Whooper Swan, Ruff, Pink-footed Goose *Anser brachyrhynchus*, Gadwall, Bittern, Great Crested Grebe *Podiceps cristatus*, Coot *Fulica atra*, Bean Goose *Anser fabalis*, White-fronted Goose *Anser albifrons albifrons*, Wigeon, Teal *Anas crecca*, Pochard *Aythya ferina*, Tufted Duck *Aythya fuligula*, Shoveler *Anas clypeata*.

Broadland Ramsar site

1147. Broadland Ramsar site is located approximately 3.8km south of the onshore scoping area boundary. The site is designated for the following features:

Table 3.18 Qualifying features of the Broadland Ramsar site (population counts are derived from the Ramsar Information Sheet)

Ramsar criterion 6 – species/populations occurring at levels of international importance. Qualifying Species/populations (as identified at designation):
Species with peak counts in winter: Bewick's swan, NW Europe 196 individuals, representing an average of 2.4% of the GB population (5 year peak mean 1998/9- 2002/3)

Widgeon, NW Europe 6769 individuals, representing an average of 1.6% of the GB population (5 year peak mean 1998/9-2002/3)
Gadwall, NW Europe 545 individuals, representing an average of 3.1% of the GB population (5 year peak mean 1998/9- 2002/3)
Shoveler , NW & C Europe 247 individuals, representing an average of 1.6% of the GB population (5 year peak mean 1998/9- 2002/3)
Species/populations identified subsequent to designation for possible future consideration under criterion 6.
Species with peak counts in winter: Pink-footed goose , Greenland, Iceland/UK 4263 individuals, representing an average of 1.7% of the population (5 year peak mean 1998/9-2002/3)
Greylag goose, *Anser anser*, Iceland/UK, Ireland 1007 individuals, representing an average of 1.1% of the population (Source period not collated)

Dereham Rush Meadow SSSI

1148. Dereham Rush Meadow SSSI is located within the onshore scoping area boundary. The site is notified as a SSSI primarily for its wide range of grassland and woodland communities which are particularly unusual in Norfolk. The site is also of interest as its winter floods are periodically used by waterfowl.

Non-statutory designated sites

1149. A total of 78 non-statutory designated sites (CWS) have been identified within the 5km study area, 29 of which are within the onshore scoping area, as shown in Figure 3.11.

3.7.1.5 Birds of conservation concern 4 ‘Red list’ Species

1150. The Birds of Conservation Concern (BOCC) report uses a well-established approach, based on quantitative assessments against standardised criteria to place UK bird populations on ‘Red’, ‘Amber’ or ‘Green’ lists to indicate the level of conservation concern. Species listed on the Birds of Conservation Concern 4 - BoCC 4 (Eaton *et al.* 2015) ‘Red list’ are those identified by the UK’s leading bird conservation organisations as being of greatest national conservation concern, based on quantitative criteria including historical decline, trends in population and range, population size, localisation and international importance of each species as well as their global and European threat status. Data from the BTO UK Bird Atlas (2007-2011) has been accessed using the Bird Atlas online resource to identify those red-list species which are likely to be present within the onshore scoping area (Table 3.19) on passage and over winter. The EIA will consider these resources further to identify all species which may be affected by the project.

Table 3.19 BoCC4 Red List species likely to be present within the onshore scoping area

Species	Abundance within the onshore scoping area relative to the UK (based on visual assessment of the online Bird Atlas maps)
White-fronted goose	High
Pochard	High
Scaup	Moderate
Long-tailed duck	Low
Common scoter	Moderate (coast only)
Velvet scoter	Low (coast only)
Grey partridge	High
Shag	Low
Red-necked grebe	Low
Slavonian grebe	Low
Hen harrier	High
Lapwing	High
Ringed plover	Low (coast only)
Curlew	High (at coast)
Ruff	High
Woodcock	High
Arctic skua	Low (coast only)
Kittiwake	Low (coast only)
Herring gull	High
Lesser spotted woodpecker	Low
Merlin	Low
Willow tit	Low
Marsh tit	High
Skylark	High
Wood warbler	Low
Starling	Moderate
Ring ouzel	Low
Fieldfare	High
Song thrush	Moderate
Redwing	Moderate
Mistle thrush	Moderate
Black redstart	Low (coast only)
House sparrow	High
Tree sparrow	Low
Grey wagtail	Moderate
Hawfinch	Low
Linnet	High
Twite	Low (coast only)
Yellowhammer	High
Corn bunting	Low

3.7.1.6 UK Biodiversity Action Plan - Species of Principal Importance

1151. There are 49 UK bird Species of Principal Importance, all of which may be present within the onshore scoping area (Section 1.1.4). Under the NERC Act 2006, UK public bodies have a duty to take these species into consideration when performing any of their functions. Of these 49 species, there are 28 which are not BoCC 'Red list' species listed above. These 28 species are listed in Table 3.20 below.

Table 3.20 UK bird Species of Principal Importance excluding BoCC 'Red List' species

Species	
Aquatic Warbler	Greater Scaup
Balearic Shearwater	Lesser Redpoll
Bewick's Swan	Marsh Warbler
Bittern	Nightjar
Black Grouse	Red Grouse
Black-tailed Godwit	Reed Bunting
Bullfinch	Roseate Tern
Cirl Bunting	Savi`s Warbler
Common Cuckoo	Spotted Flycatcher
Corn Crake	Stone-curlew
Dark-bellied Brent Goose	Tree Pipit
Dunnock (Hedge Accentor)	Turtle Dove
European Greater White-fronted Goose	Wood Lark
Grasshopper Warbler	Yellow Wagtail

3.7.1.7 UK Biodiversity Action Plan -Habitats of Principal Importance

1152. UK Habitats of Principal Importance have been recorded within the onshore scoping area, as shown on Figure 3.12. Selected habitats provide important habitat for breeding, passage and wintering birds. The following habitats have been recorded within the onshore scoping area which have suitability to support important populations of breeding and passage/wintering bird species:

Breeding birds

- Coastal and floodplain grazing marsh;
- Coastal sand dunes;
- Deciduous woodland;
- Good quality semi-improved grassland;
- Lowland fens;
- Lowland heathland;
- Lowland meadows;
- Maritime cliff and slope;
- Traditional orchard;
- Good quality semi-improved grassland; and
- Reedbeds.

Passage/Wintering birds

- Reedbed;

- Lowland fen;
- Rivers and Lakes;
- Lowland heathland; and
- Coastal habitats.

1153. Farmland (pasture and arable), although not a UK Habitat of Principal Importance could also support breeding and passage/wintering bird species.

3.7.1.8 Onshore wintering bird surveys

1154. A suite of onshore wintering bird surveys in relation to the Norfolk Vanguard project were undertaken between October 2016, and March 2017.

1155. These surveys were identified by the Wintering / Passage Bird Survey Scoping assessment report that was produced for Norfolk Vanguard (Royal HaskoningDHV, 2016b). This survey scoping report used desk-based information to identify the appropriate onshore ornithological surveys that were likely to be required in order to provide sufficient baseline information to inform a robust EIA process for the onshore project elements of the Norfolk Vanguard project.

1156. The onshore survey scoping report was produced early on in the Norfolk Vanguard EIA process to enable the required passage and wintering bird surveys to commence in autumn / winter 2016, encompassing the required survey window. Natural England and Norfolk County Council both provided input to the survey scoping assessment and the subsequent surveys which commenced in October 2016.

1157. Natural England confirmed that the onshore wintering bird surveys should focus on those areas identified as being 'ornithological risk areas' (i.e. areas which may support birds associated with statutory designated sites over winter, either within the site boundaries themselves or within ex-situ habitats which may support interest features of statutory designated sites) within 1km of the onshore scoping area. As such the 2016/2017 wintering bird surveys focused on:

- Transect surveys along the North Walsham and Dilham Canal (disused) Mown Fen / Hundred Stream and surrounding habitats to identify whether waders and waterfowl which are qualifying features of the Broadland SPA are present within ex-situ habitats within 5km of the Broadland SPA, and if so in what numbers. These three transects have been identified as containing key Broadland SPA ex-situ wader and waterfowl habitat.
- Low tide count surveys along the North Norfolk coast to identify whether waders and waterfowl which are qualifying features of the Broadland SPA are present within ex-situ coastal habitats within 1km of the onshore scoping area.
- Transect surveys of Mattishall Moor SSSI to gather data on the current use of the

Mattishall Moor SSSIs by wintering snipe, a notified feature of the SSSI.

- Vantage point surveys at Westwick Lakes SSSI and Dereham Rush Meadows SSSI to gather data on the current use of the Westwick Lakes and Dereham Rush Meadows SSSIs by bird species which are notified features of the SSSIs over winter.
- Road transect surveys of agricultural fields in North Walsham District to gather data on the current use of agricultural land within 5km of the Broadland SPA by swan and geese SPA qualifying species over winter.

1158. Data from the end of October 2016 through to December 2016 has been made available to inform this scoping report (one visit to each survey site per month). Table 3.21 summarises the counts of focal species - i.e. notified overwintering species associated with SSSIs located within 1km of the Norfolk Vanguard onshore scoping area (Vattenfall Wind Power Limited, 2016), or qualifying species of the Broadland SPA and Ramsar site. The table covers all results obtained from October to December 2016.

Table 3.21 Interim onshore wintering bird survey results

Survey	Visit 1 – Oct / Early Nov 2016	Visit 2 – Late Nov 2016	Visit 3 – Dec 2016
Agricultural fields in North Walsham District (road transect)			
No focal species recorded			
Dereham Rush Meadows SSSI (Vantage point (VP) survey)			
Teal			3
Mallard	4		5
Mattishall Moor SSSI (transect survey)			
Snipe	1		
Mown Fen / Hundred Stream (transect survey)			
Gadwall			7
Shoveler			1
North Norfolk Coast between Eccles-on-Sea and Paston (VP survey)			
Cormorant	11		
Red-throated Diver	4	11	3
Common Scoter	14	25	
North Walsham and Dilham Canal (transect survey)			
Teal	1	3	
Cormorant	1		
Marsh harrier			1
Coot			1
Westwick Lakes SSSI (VP survey)			
Teal	14	8	12
Mallard	69	65	44
Shoveler	2	6	15

1159. Following further project design refinement work undertaken for the shared onshore electrical infrastructure of Norfolk Vanguard and Norfolk Boreas, the scope for the onshore wintering bird surveys was reduced geographically. In consultation with Natural England and Norfolk County Council it was agreed that no further wintering bird surveys would be undertaken at Westwick Lakes SSSI, Mattishall Moor SSSI and North Walsham and Dilham Canal.

1160. Natural England have highlighted to VWPL that there is a sand martin nesting site at Happisburgh. This will be considered further within the EIA particularly in relation to the HDD impacts associated with cable landfall.

3.7.2 Potential impacts

1161. Full details of the project description are provided in Section 1.5.

3.7.2.1 Potential impacts during construction

1162. The potential impacts associated with construction are discussed below.

1163. **Impacts to legally protected and notable species:** Impacts upon all legally protected species will be considered within the EcIA. Impacts upon legally protected species have been avoided during the design process where possible. The following remaining potential impacts will be considered:

- Direct impacts upon wintering and breeding birds through direct killing or injuring and indirect impacts through disturbance and habitat loss.

1164. **Temporary loss of habitat:** Temporary loss of habitat suitable for nesting, roosting and foraging birds along the onshore cable corridor and potential permanent loss of habitat at the construction site for the cable relay station and construction site for the substation. Habitats can be affected physically or from disturbance associated with the construction works.

1165. **Noise and visual disturbance:** Noise and visual disturbance to birds due to construction activities along the cable route, at the construction site for the cable relay station and construction site for the substation, and up to 500m from these boundaries. There is potential for increased levels of disturbance caused by the presence and movements of construction vehicles, equipment and personnel. Disturbance can have negative effects on nesting, roosting and foraging and may result in increased energy expenditure, reduced foraging efficiency and increased predation risk, potentially leading to reduced rates of survival or reproduction.

3.7.2.2 Potential impacts during operation

1166. The potential impacts associated with operation may include:

1167. **Operational noise and lighting associated with the relay and substations**: During operation there would be operational noise and lighting impacts (including vehicle movements) which have the potential to impact on birds through disturbance to adjacent habitats.

1168. **Temporary disturbance associated with site inspection/cable repair/maintenance**: It is likely that the junction boxes and transition pits, which would be positioned at the margins of fields, would require occasional access and inspection, probably on an annual basis. Inspection may result in a slight increase in disturbance to discrete areas associated with junction boxes.

1169. In the unlikely event of cable failure access to buried cables may be required. Maintenance and repair would have similar potential impacts to those set out above for cable installation however they are likely to be more localised and smaller in scale.

3.7.2.3 Potential impacts during decommissioning

1170. No decision has been made regarding the final decommissioning policy for the substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. It is likely that the substation and cable relay station equipment would be removed and reused or recycled. It is expected the onshore cables would be removed from ducts and recycled, with the transition pits and ducts left in situ.

1171. The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan would be provided.

1172. It is anticipated that the decommissioning impacts would be similar in nature to those of construction.

3.7.2.4 Potential cumulative impacts

1173. The approach to assessing cumulative impacts is detailed in Section 3.13.

1174. Other developments with potential to impact upon land use receptors will be considered. These are likely to include schemes that involve disturbance to designated sites, species and habitats in the onshore environment.

1175. Further consideration will be given to these potential cumulative scenarios as part of the EIA in combination with other projects, particularly in respect to the combined Norfolk Vanguard and Norfolk Boreas scenarios, and the cable route for the proposed Hornsea Project 3.

3.7.2.5 Summary of potential impacts

Table 3.22 Summary of impacts relating to onshore ornithology

Potential impacts	Construction	Operation	Decommissioning
Impacts to legally protected and notable species	✓	x	✓
Temporary and permanent loss of habitat suitable for nesting, roosting and foraging birds	✓	✓	x
Noise, vibration and visual disturbance to birds	✓	✓	✓
Cumulative impacts	✓	✓	✓

Scoped in (✓) and scoped out (x)

3.7.3 Mitigation

1176. Embedded mitigation is likely to include the following:

- Avoidance of sensitive habitats for birds through cable route selection where possible;
- Use of Best Practicable Means (BPM) to limit the impacts of noise at sensitive receptors (see Section 3.9);
- Timing of works with the aim of minimising disturbance to birds during most sensitive periods (e.g. breeding season);
- Development of a CoCP;
- Development of an EMP to include mitigation measures for birds;
- A draft or Outline LEMS will be provided with the DCO application. This draft or outline LEMS would detail the ecological enhancement measures proposed during construction and operation of the Norfolk Boreas Offshore Wind Farm; and
- If onshore infrastructure for Norfolk Boreas and Norfolk Vanguard were to be co-located the Applicant's preferred option would be to consent and develop any landscaping and planting schemes under the Norfolk Vanguard project (Scenario 1) to allow them to mature as soon as possible. To permit for the situation where Norfolk Vanguard is not built the Norfolk Boreas DCO application will also contain permissions to develop these.

3.7.4 Approach to assessment and data gathering

1177. The approach to assessment and data gathering outlined below is informed by methodology discussed with regulators during the EPP for Norfolk Vanguard.

1178. The Norfolk Boreas impact assessment will be undertaken using the CIEEM guidance for EcIA in the UK (CIEEM 2016).

1179. A desk based assessment of existing ornithological data will be undertaken. This will be informed by and build on the desk based assessment undertaken for the Norfolk

Vanguard project with additional data acquired for any areas of the Norfolk Boreas project which fall outside of the Norfolk Vanguard Red line Boundary. Wetland Bird Survey (WeBS), local or regional bird atlases and biological records centre data for the search areas will be obtained and assessed in relation to breeding birds and to supplement the data already gathered in relation to passage and wintering birds.

1180. As detailed in Section 3.6, an Extended Phase 1 Habitat Survey is underway which, will when complete will cover the onshore cable corridors, landfall zones, cable relay station zones, onshore project substation zone and National Grid extension zone plus a 50m buffer. This survey includes an initial appraisal of all habitats with suitability to support breeding birds, including trees, hedgerows, waterbodies, grazing marsh / fen, lowland heath and agricultural land. Together the desk assessment data and the outcome of this survey will inform the need for any further surveys including dedicated ornithological surveys of suitable breeding bird habitats and of functionally linked land which may support non-breeding birds of statutory designated sites of nature conservation.

1181. The Onshore Winter/Passage Bird Survey Scoping Report (Royal HaskoningDHV, 2016b) prepared for Norfolk Vanguard identified a need for further wintering bird surveys which were undertaken once per month between October 2016 and March 2017 (Section 3.7.1.8). Consultation will be undertaken on the results of these surveys to determine if any further surveys are required to inform the EIA.

1182. The Onshore Winter/Passage Bird Survey Scoping Report (Royal HaskoningDHV, 2016b) identified no need for further surveys in relation to passage species for Norfolk Vanguard, consequently it is anticipated that no further surveys will be required for Norfolk Boreas, however this will be determined through the EPP.

1183. The approach to assessment and data gathering will be discussed and agreed as part of the EPP (detailed in Section 1.6.2) prior to commencement. Consultation will be undertaken at key stages throughout the EIA process.

3.8 Onshore archaeology and cultural heritage

3.8.1 Baseline

3.8.1.1 Data sources

1184. The data and information sources used to inform this onshore archaeology and cultural heritage scoping chapter and the EIA are listed in Table 3.23 below.

Table 3.23 Onshore archaeology and cultural data sources

Source no.	Data	Source	Date
1	Locations of Conservation Areas within the onshore scoping area.	North Norfolk District Council website; Broadland District Council website; and Breckland District Council website.	2017
2	A list (spatial reference) of all designated heritage assets within the onshore scoping area.	Historic England	2017
3	Written Scheme of Investigation: Archaeological Desk Based Assessment (Terrestrial Archaeology) Norfolk Vanguard Offshore Wind Farm, draft of the document only	Royal HaskoningDHV	2017
4	Norfolk Vanguard Offshore Wind Farm EIA Onshore Archaeology and Cultural Heritage Method Statement, draft of the document only	Royal HaskoningDHV	2017
5	Proposed Norfolk Vanguard Offshore Wind Farm Scoping Opinion	Planning Inspectorate	2016
6	Norfolk Vanguard Offshore Wind Farm EIA Scoping Report	Royal HaskoningDHV	2016

1185. Additional data sets are known of (such as the Norfolk Historic Environment Record and Historic England’s National Record of the Historic Environment / Historic England Archive) and these will require significant scrutiny as part of next steps of data gathering and analysis following the scoping stage.

1186. Any further sources of data and information are likely to be identified through feedback from stakeholders following this Scoping Request, as well as from initial feedback and discussions already held and ongoing with respect archaeology and cultural heritage implications and considerations associated with the directly related and sister project to Norfolk Boreas, the Norfolk Vanguard Offshore Wind Farm.

1187. This section presents a very high level summary of the existing archaeological and cultural heritage baseline conditions recorded within, and in the immediate vicinity of, the onshore scoping area in relation to Norfolk Boreas. It focuses predominantly on designated heritage assets at this scoping stage. Non-designated heritage assets are to be fully considered as part of an Archaeological Desk Based Assessment (Terrestrial Archaeology) for Norfolk Vanguard Offshore Wind Farm, including appropriate study areas that will cover the key project elements of both the Norfolk

Vanguard and Norfolk Boreas projects. The offshore archaeology and cultural heritage baseline is set out in Section 2.12.

1188. For onshore archaeology the scoping area described in Section 1.1.4 is used to identify relevant features to the EIA.

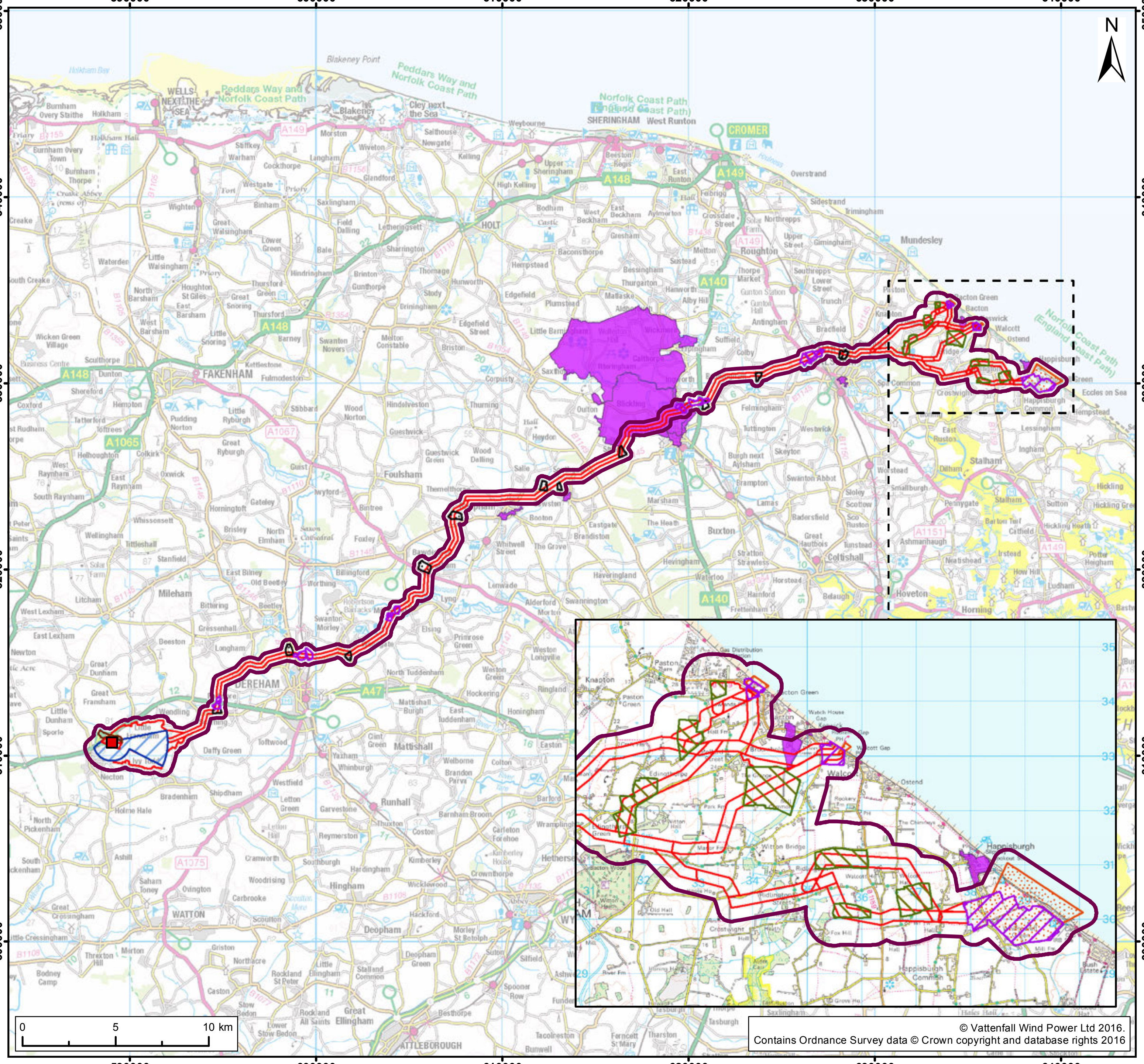
1189. There are no World Heritage Sites or Registered Battlefield sites within the onshore scoping area.

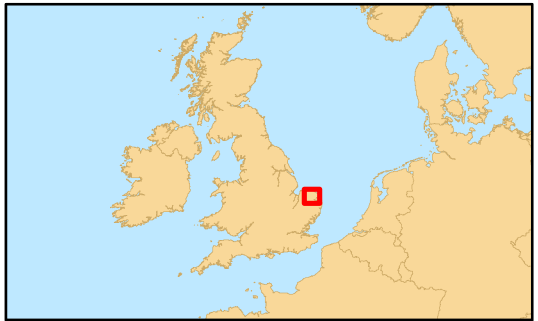
1190. The onshore cable corridor passes through and/or overlaps with Happisburgh, Bacton, Blickling and Aylsham Conservation Areas (see Figure 3.13). Cawston, Reepham and Necton Conservation Areas are also located in close proximity to the onshore scoping area.

1191. There are two Scheduled Monuments within the onshore scoping area; the ruins of Bromholm Priory between Bacton and Walcott, and a Moated site *c*. 430m south west of Bradenham Hall (see Figure 3.14). The site of Wendling Abbey is also in close proximity to the onshore scoping area, located broadly between Dereham and Necton.

1192. Within the onshore scoping area there are seven Grade I Listed Buildings, 5 Grade II* Listed Buildings and 48 Grade II Listed Buildings. These are predominantly focused at the Landfall and Cable Relay Station options as shown on Figure 3.14.

1193. Within the onshore scoping area there is one Grade II* and one Grade II Registered Park and Garden; Blickling Hall and Salle Park (see Figure 3.14). Happisburgh Manor, a Grade II Registered Park and Garden, is also located in close proximity to the onshore scoping area, located within Happisburgh, near the southern landfall option.





Legend:

- Onshore Scoping Area
- Existing Necton 400kV National Grid Substation

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
- Cable Relay Station Zone
- Landfall Zone
- Heritage Conservation Area

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Conservation Area Overview

Figure: 3.13 | Drawing No: PB5640-102-045

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	08/03/17	JE	DT	A4	1:300,000

Co-ordinate System: British National Grid **EPSG:** 27700

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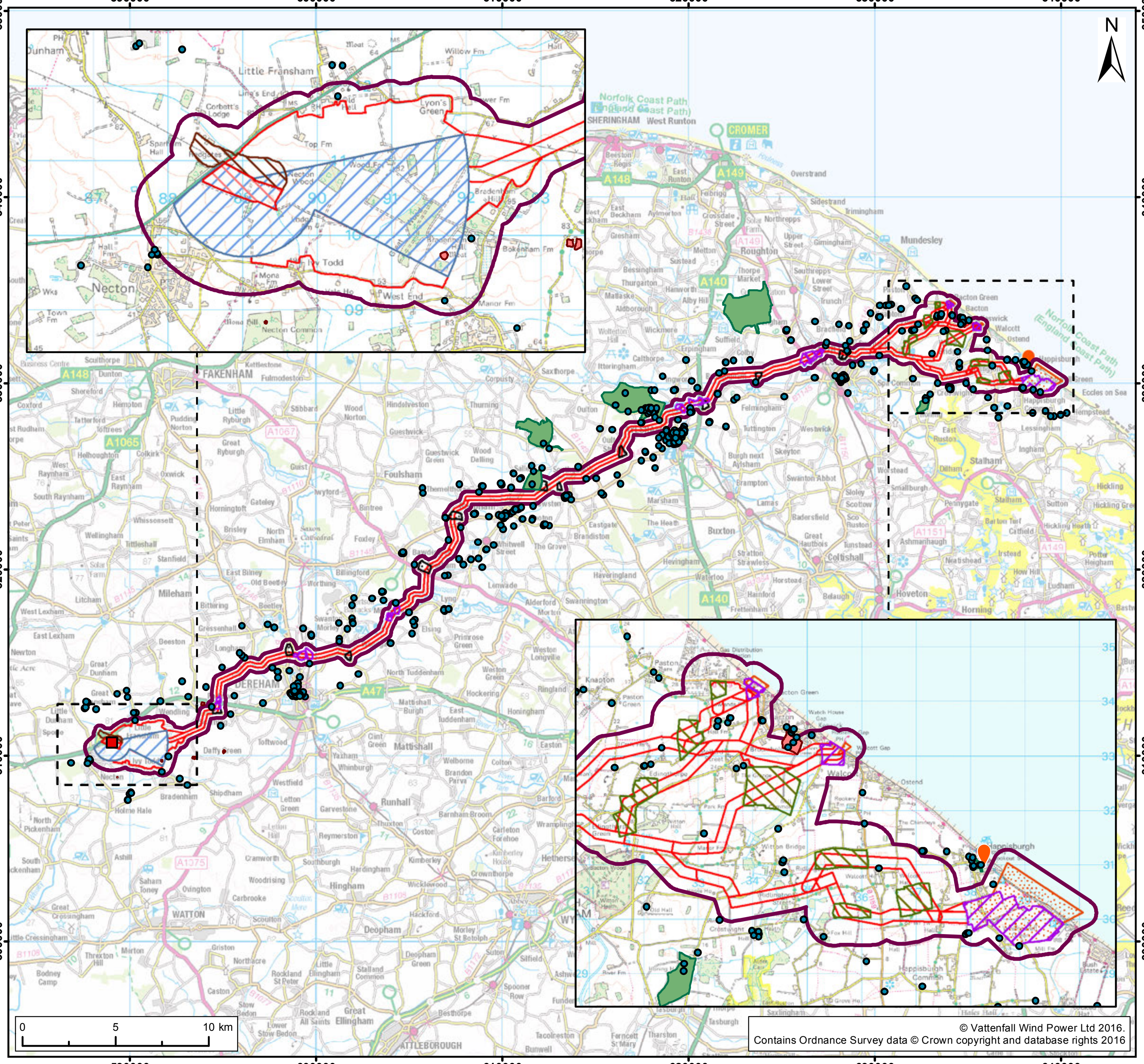

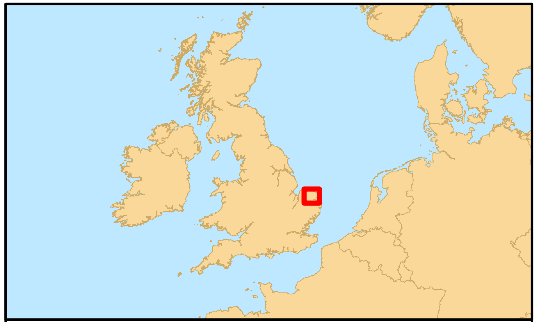

Legend:
- Onshore Scoping Area
- Existing Necton 400kV National Grid Substation

Norfolk Boreas Onshore Infrastructure
- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
- Cable Relay Station Zone
- Landfall Zone
- Scheduled Monument[1]
- Park And Garden[1]
- Listed Building[1]
- Happisburgh Footprints

[1] Historic England, 2017.

Project: Norfolk Boreas

Report: Environmental Impact Assessment Scoping Report

Title: Designated Heritage Assets within the Onshore Scoping Area

Figure: 3.14 Drawing No: PB5640-102-046

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	DT	A4	1:300,000
01	08/03/17	JE	DT	A4	1:300,000

Co-ordinate System: British National Grid **EPSG:** 27700

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1194. There are a large number of non-designated heritage assets recorded by the Norfolk Historic Environment Record (NHER) within and surrounding the onshore scoping area. These records provide evidence of human activity from early Prehistoric through to modern times.

1195. At Happisburgh, one of the potential landfall options, excavations between 2001 and 2005 uncovered evidence for the earliest human occupation site in north western Europe. The site, located on the foreshore, revealed evidence of lithic working and butchery (MNF 39512/MNF59819) dated to between 500,000 and 700,000 years ago. More recently very early footprints have also been discovered and recorded. The international importance of the 'Cromer Forest Bed Deposits' at Happisburgh have been flagged and initially discussed in consultation with the historic environment consultees, as part of the Norfolk Vanguard project, including initiating discussion with representatives from the Ancient Human Occupation of Britain (AHOB) Project.

1196. The Happisburgh landfall area will (if selected) form a central element of the archaeological assessment work for both the Norfolk Vanguard and Norfolk Boreas projects and a working group which includes relevant experts from the Natural History museum, the British Museum, Historic England, Queen Mary University of London, Norfolk County Council, North Norfolk District Council and Wessex Archaeology has been set up by the Applicant to maximise knowledge gained from project, minimise loss of archaeological information and to inform project design.

1197. The following paragraphs below provide a short, broad overview by way of brief archaeological and historical background to the wider location of the onshore scoping area and surrounds as a whole, and originally featured as part of the scoping level baseline information provided for the Norfolk Vanguard Project:

1198. Evidence for past human activity is often identified from surviving earthworks and cropmarks recorded from aerial photographs. Examples of this from within the vicinity and surrounds of the onshore scoping area include the Neolithic long barrow at Stow Heath (MNF31740), numerous Bronze Age barrows and burnt mounds, Billingford Roman town (MNF56528), multi-period field systems and deserted medieval villages.

1199. Evidence of human activity can also be mapped through the artefacts left behind and later retrieved through metal detecting or by field walking recently ploughed fields. At Salle, for example, a late Bronze Age hoard was discovered during metal detecting, which included seven copper alloy socketed axe heads (MNF47592 / MNF47358).

1200. Archaeological sites have also been discovered in advance of development and construction, for example Neolithic, Bronze Age and Iron Age features were recorded at Bittering Quarry (MNF15995), multi-period activity including an early Saxon cemetery at Beetley Quarry (MNF41404) and prehistoric and Roman features were recorded in advance of a quarry extension at Bittery (MNF46877).

1201. Within and surrounding the onshore scoping area, there is also a wealth of evidence dating back to the medieval and post-medieval periods in the form of settlements, agriculture, transport and communication links.

1202. During World War Two a whole series of defences were positioned around Norfolk's coastline, as well as inland. For example a decoy airfield was located at North Tuddenham (MNF15019) and a Radar Station and coastal Battery at Happisburgh (MNF 14147 and MNF18472, respectively), as well as stretches of associated WWII coastal defences.

1203. In addition to the known recorded heritage assets, there is a high potential of uncovering archaeological remains which are, at present, unknown. Other linear schemes, which cross and/or are near to the onshore scoping area, such as the Bacton to King's Lynn Transco Pipeline, the Bacton to Great Yarmouth Pipeline and Dudgeon Offshore Wind Farm, have identified numerous archaeological sites ranging in date from the Prehistoric to post-medieval/modern period that were not previously recorded.

1204. Significant archaeological discoveries have been made across Norfolk and there is a high potential for further archaeological remains to be discovered within the onshore scoping area, which will provide an opportunity to enhance and contribute to our understanding of past human activity, associated with Norfolk's historic environment.

1205. A related Written Scheme of Investigation (WSI)/specification has now been drafted (February 2017) to establish and confirm methodologies of a detailed desk based assessment (DBA) and targeted field reconnaissance survey (FRS), and other associated site visits, to be undertaken in association with the onshore elements of the Norfolk Vanguard Offshore Wind Farm.

1206. The Onshore Archaeological Desk Based Assessment (DBA) will constitute the fundamental initial baseline data and information gathering exercise, including full record searches of the Norfolk Historic Environment Record (NHER) and Historic England's National Record of the Historic Environment (NRHE)/Historic England Archive, as well as historic map, aerial photographic and LiDAR assessment (where possible and existing data is available). This assessment and reporting will also cover and be of direct relevance to the Norfolk Boreas Project.

1207. An assessment of the impact of the various elements of the proposed development(s) will also be undertaken with respect to the setting of heritage assets, which will be of particular relevance to the cable relay station and substation options.

3.8.2 Potential impacts

1208. Full details of the project description are provided in Section 1.5.

1209. The Norfolk Boreas Project has the potential to impact upon the archaeological and cultural heritage (historic environment) resource in a number of ways, through both direct physical changes (including hydrology) and indirect non-physical changes to the setting of heritage assets. Some impacts and changes would be temporary and others permanent, some confined to the construction stages and others more permanent during operation and the lifespan of the project, and subsequent decommissioning.

3.8.2.1 Potential impacts during construction

1210. **Direct impact on (permanent change to) buried archaeological remains:** The extent of any impact would depend on the presence, nature and depth of any such remains, in association with the depth of the proposed construction-related groundworks. Any adverse effects would likely be permanent and irreversible in nature.

1211. **Direct impact on (permanent change to) above ground archaeological remains – e.g. historic earthworks (including the historic landscape character):** The extent of any impact would depend on the presence and nature of any such remains. Any adverse effects may be permanent and irreversible in nature.

1212. **Indirect impact on the setting of heritage assets (designated and non-designated, including historic landscape character):** These types of impact would likely occur through the presence of machinery, construction traffic and general construction activities taking place within the onshore proposed development areas. The sight, noise and smell as well as any dust and vibration created during the construction phase could have an indirect (non-physical) impact upon heritage assets and their settings. Impacts on setting will also be considered within this assessment and cross reference be made to Section 4.2, including the use of associated toolkits such as Zones of Theoretical Visibility (ZTVs) and photomontages, where required and appropriate. Settings assessment will be undertaken following Historic England guidance.

1213. **Impact on potential geoarchaeological / palaeoenvironmental remains, potentially indicative of former land surfaces:** It is possible that elements of the scheme may effect below ground deposits over a wider area than that of the footprint of the infrastructure. For example through hydrological changes that may cause desiccation and drying out of wetland deposits and associated preserved waterlogged archaeological remains.

1214. A staged approach to identifying and assessing construction impacts will be undertaken commencing with the detailed Archaeological Desk Based Assessment (Section 3.8.4). It is intended that the Archaeological DBA will form the primary, underpinning technical supporting document to the archaeology and cultural heritage chapter of the PEIR and subsequent ES Chapter.

3.8.2.2 Potential impacts during operation

1215. There would be no physical impacts to buried archaeological remains or palaeoenvironmental deposits during the operation phase, as any such impacts would have occurred during or as a result of the construction phase.

1216. The presence of above ground infrastructure could have an ongoing impact on the setting of heritage assets following completion of construction through into the operation and maintenance phase; as a result of for example the presence of the cable relay station and substation within the landscape and their day to day uses.

1217. The operation of the onshore cable would not impact upon the setting of heritage assets or the historic landscape as this would be buried, and any required landscape reinstatement undertaken as part of the construction phase.

1218. A staged approach to identifying and assessing operation impacts will be undertaken commencing with the detailed Archaeological Desk Based Assessment (Section 3.8.4). It is intended that the Archaeological DBA will form the primary, underpinning technical supporting document to the archaeology and cultural heritage chapter of the PEIR and subsequent ES Chapter. Settings assessment following Historic England guidance will be undertaken, as part of the Archaeological DBA, using LVIA assessment tools such as ZTVs and photomontages, particularly in relation to above ground infrastructure such as the Cable Relay Station and Substation options.

3.8.2.3 Potential impacts during decommissioning

1219. **Direct impact on (permanent change to) buried archaeological remains and geoarchaeological / palaeoenvironmental remains, potentially indicative of former land surfaces**: The extent of any impact would depend on the presence, nature and depth of any such remains, in association with the depth of the proposed decommissioning-related groundworks. Any adverse effects would likely be permanent and irreversible in nature. It was noted by Historic England in their Scoping Opinion response with respect to the Norfolk Vanguard Project (the Planning Inspectorate, 2016b) that the demolition of buildings and infrastructure can have an impact greater than that of construction e.g. if grubbing out of foundations or remediation of contaminants is required.

1220. No decision has been made regarding the final decommissioning policy for the onshore cables and other onshore elements of the project. It is, however, likely that the onshore cables would be removed from the ducts and recycled, with the transition pits and ducts capped and sealed then left in situ. Possible impacts to buried archaeological remains associated with the decommissioning stage(s) will be further considered as part of the EIA.

1221. **Indirect impact on the setting of heritage assets (designated and non-designated):** These types of impacts would likely occur through the presence of machinery, decommissioning traffic and general decommissioning activities taking place within the onshore decommissioning areas. The sight, noise and smell as well as any dust and vibration created during the decommissioning phase could have an indirect (non-physical) impact upon heritage assets and their settings.

1222. A staged approach to identifying and assessing decommissioning impacts will be undertaken commencing with the detailed Archaeological Desk Based Assessment (Section 3.8.4). It is intended that the Archaeological DBA will form the primary, underpinning technical supporting document to the archaeology and cultural heritage chapter of the PEIR and subsequent ES Chapter.

1223. It is also anticipated that a full EIA would be carried out ahead of any decommissioning works to be undertaken.

3.8.2.4 Potential cumulative impacts

1224. Cumulative impacts may arise in relation to the setting of designated and non-designated heritage assets and as a result of groundworks resulting in cumulative impacts on above ground or buried archaeological remains or on geoarchaeological / palaeoenvironmental remains, potentially indicative of former land surfaces.

1225. Further consideration will be given to this potential cumulative scenario as part of the EIA, particularly in respect to the combined Norfolk Vanguard and Norfolk Boreas scenarios, and the cable route for the proposed Hornsea Project 3.

3.8.2.5 Summary of potential impacts

Table 3.24 Summary of potential impacts relating to onshore archaeology and cultural heritage

Potential impacts	Construction	Operation	Decommissioning
Direct impact on (permanent change to) buried archaeological remains	✓	x	✓
Direct impact on (permanent change to) above	✓	x	✓

Potential impacts	Construction	Operation	Decommissioning
ground archaeological remains – e.g. historic earthworks (including the historic landscape character)			
Indirect impact on the setting of heritage assets (designated and non-designated, including historic landscape character)	✓	✓	✓
Impact on potential geoarchaeological / palaeoenvironmental remains, potentially indicative of former land surfaces	✓	x	✓
Cumulative impacts	✓	✓	✓

Scoped in (✓) and scoped out (X)

3.8.3 Mitigation

1226. The information obtained from the desk-based assessment and certain non-intrusive and intrusive evaluation stages would inform the EIA process and beyond, and mitigation would be embedded in the design and siting of the onshore infrastructure areas (both temporary and permanent) in order to, as far as possible, avoid impacts to known heritage assets. Where impacts upon known heritage assets are unavoidable, a series of mitigation measures would be put in place to reduce the scale of the impact.

1227. Likely mitigation requirements could entail a combination of the following recognised standard approaches:

- Set-piece (open-area) Excavation. Including subsequent post-excavation assessment, and analysis, publication and archiving (where appropriate). Usually undertaken in advance of construction.
- Preservation in-situ (avoidance/micrositing/re-routing/ trenchless techniques). An approach which can be applicable in advance of, at and during construction.
- Strip, Map and Record (or Sample) Excavation. Including subsequent post-excavation assessment, and analysis, publication and archiving (where appropriate). Usually undertaken at/during construction, dovetailing with the construction programme.
- Watching Brief (targeted and general). Including subsequent post-excavation assessment, and analysis, publication and archiving (where appropriate). Undertaken at/during construction, dovetailing with the construction programme.

3.8.4 Approach to assessment and data gathering

1228. In terms of the information and data that will directly inform the Onshore Archaeology and Cultural Heritage PEIR and subsequent ES Chapter, this may be limited to information and data from predominantly desk-based approaches, as well as some targeted field surveys at sensitive locations as identified by the detailed DBA. Reassurances will be made in an Outline WSI for onshore archaeology and cultural heritage to be submitted as part of the ES providing commitments to undertake and/or complete (and associated details) any required and outstanding non-intrusive and intrusive evaluation surveys, and subsequent outline detail on proposed mitigation responses and approaches.

1229. The DBA and subsequent PEIR and ES Chapters will be undertaken in accordance with and with specific reference to:

- CIfA (2014) Standards and guidance for historic environment desk-based assessment;
- Historic England (2015) The Setting of Heritage Assets: Historic Environment Good Practice Advice in Planning Note 3;
- The National Planning Policy Framework and associated Planning Practice Guidance (2012 / 2014); and
- English Heritage (2008) Conservation Principles: Policy and Guidance for the Sustainable Management of the Historic Environment.

1230. The approach to assessment and data gathering outlined below is informed by methodology discussed with regulators (the historic environment consultees) during the EPP for Norfolk Vanguard. Norfolk Boreas will also follow this agreed approach.

1231. The methodology for each of the staged (phased) assessment and survey approaches outlined below (whether undertaken in-part or in-full, pre or post-consent) will be set out in separate 'survey-specific' Written Schemes of Investigation (WSIs) and agreed and approved in consultation with the Heritage Steering Group/historic environment consultees (predominantly the primary contacts, as per the Norfolk Vanguard Project, within Norfolk County Council Historic Environment Service and Historic England).

1232. The Archaeological Desk Based Assessment (ADBA) will be one of the main technical appendices to the PEIR / later ES Chapter for Onshore Archaeology and Cultural Heritage (Historic Environment). This is essentially a desk based baseline data and information gathering exercise, to include: searches and scrutiny of all available records, historic maps, aerial photographs, LiDAR data (where available/applicable) and targeted site walkover(s)/site visits, where possible. An assessment of the impact of the various elements of Norfolk Boreas will also be undertaken with respect to the setting of heritage assets, which will be of particular relevance to the cable relay station and substation options.

1233. A WSI / specification has now been prepared for Norfolk Vanguard, and is subject to consideration and approval by the historic environment consultees (Norfolk County

Council Historic Environment Service and Historic England). The document provides details and methodologies of a desk based assessment (DBA) and targeted field reconnaissance survey (FRS) and site visits, to be undertaken in association with the onshore elements of Norfolk Vanguard, the results and findings of which will be directly relevant to Norfolk Boreas.

1234. Regular and ongoing consultation with the historic environment consultees with respect to onshore archaeology and cultural heritage will be an important and central element to the archaeology and heritage assessment, survey and evaluation work undertaken as part of the EIA process and beyond.

1235. It is envisaged that it will be necessary to undertake a number of surveys (in part or in full) in conjunction with Norfolk Vanguard. The requirements and timings of these will be reviewed following the outcomes of the desk based assessment. Survey programmes will be highly dependent on landowner access, as well as specific programme requirements and associated project risk.

1236. These surveys may include (if justified and required):

- Geophysical Survey (generally a standard detailed magnetometry technique for linear schemes);
- Archaeological Metal Detecting Survey will be undertaken of targeted areas;
- Archaeological Fieldwalking Survey will be undertaken of targeted areas;
- Earthwork Condition (GPS/topographic) Survey;
- Geoarchaeological Assessment / Palaeoenvironmental Survey; and
- Archaeological Trial Trenching.

1237. Archaeological Watching Brief / Geoarchaeological Monitoring of Ground / Site Investigation works (being undertaken for geotechnical purposes for instance) will be an important component of both the Norfolk Boreas and Norfolk Vanguard projects. This will feed into a wider geoarchaeological assessment / palaeoenvironmental survey (see above). Plans are underway to investigate integrating opportunities for combined engineering, archaeological and geoarchaeological data collection within a proposed programme of terrestrial and intertidal geotechnical and engineering site investigation planned to be undertaken in 2017.

3.9 Onshore noise and vibration

3.9.1 Baseline

3.9.1.1 Data sources

1238. The following data set has been used to inform this desk-based assessment and will be used to inform the EIA:

Table 3.25 Onshore noise data sets

Source no.	Data	Source	Date
1	Existing available Aerial Photography	Google Maps	2017

1239. A conservative study area at this stage for noise and vibration would encompass a 2km buffer around landfall zones, the cable relay station zones and onshore project substation zone, and a 400m buffer around the onshore cable corridor during construction. The construction phase study area would also include any traffic routes affected by increased construction traffic (Section 3.10). During operation, the study area would encompass a 2km buffer around the onshore project substation and the cable relay station.

1240. The landfall zones are located on the North Norfolk Coast between Bacton Green and Eccles-on-Sea and the cable relay zones are located inshore of the landfall sites as far as North Walsham (Figure 1.3) These locations are predominantly rural with small villages and isolated residential properties which are likely to experience low ambient noise levels presently. The main noise sources in this area are likely to be local roads and the industrial area around the Bacton Gas terminal at Paston.

1241. The onshore project substation zone, overhead line modification zone and National grid substation extension zone are located to the north and east of the village of Necton to the west of the larger town of Dereham. Noise in this area is likely to be dominated by road traffic on the A47 with some noise generated by the existing Dudgeon offshore wind farm substation. The area is generally rural in nature with the village of Necton containing the largest concentration of residential properties. Smaller villages such as Bradenham and isolated residential properties are also located within or close to the onshore project substation zone and onshore scoping area.

1242. The onshore cable corridor is again predominantly rural in nature. The largest settlements within the area are at North Walsham, Aylsham, Dereham and Reepham. The Robertson Barracks at Swanton Morley and smaller villages and isolated residential properties are also present throughout the area. The main noise sources within the area are likely to be:

- The A47 and the A1067 roads in the west of the area;
- The A140 and the A149 roads in the east of the area;
- The Norwich to Holt railway line in the east of the area;
- The railway line at Dereham;
- Industrial areas at North Walsham, Aylsham and Dereham; and

- The Robertson Barracks and Swanton Morley Airfield.

3.9.2 Potential impacts

1243. Full details of the project description are provided in Section 1.5.

1244. The assessment would consider the impacts of the proposed onshore elements of the project on noise and vibration, including impacts on ecological and other sensitive receptors from construction and operational activities.

3.9.2.1 Potential impacts during construction

1245. The potential temporary impacts of construction noise may arise from:

- Activities carried out on the surface along the onshore cable corridor (mainly earth moving and excavation);
- Construction activities at the onshore project substation, National Grid substation (including overhead line modification) and cable relay station zones including any potential landscaping;
- Directional drilling activities;
- Cable laying and pulling activities along the onshore cable route and at the shoreline (including noise from cable laying vessels working close to the shore);
- Heavy goods vehicles servicing the onshore cable corridors, cable relay station and onshore project substation, delivering or removing materials (including spoil and fill) and plant; and
- Vibration will only be considered as an issue where significant piling works are required.

1246. **Change in Noise Level at Human Receptors**: There is the potential for activities associated with the construction of the project to temporarily increase the noise levels experienced at identified receptors throughout the study area. Specifically during the construction of the following phases:

- Landfall area,
- Cable relay station,
- Cable route,
- Onshore project substation, and
- Extension to the Necton National Grid substation including overhead line modification.

1247. BS5228 details the “ABC method”, which specifies a construction noise limit based on the existing ambient noise level and for different periods of the day. The predicted construction noise levels will be assessed against noise limits derived from advice within Annex E of BS 5228.

1248. **Construction Phase Road Traffic Emissions Assessment**: Following the methodology contained in Design Manual for Roads and Bridges (DMRB), Volume 11, Section 3, Chapter 3, an initial screening assessment will be undertaken to assess whether there would be any significant changes in traffic volumes and composition on surrounding local roads as a result of Norfolk Boreas. Any road links with a predicted increase in traffic volume of 25%, or a decrease of 20%, will be identified. Such changes in traffic volume would correspond to a 1dB(A) change in noise level at the relevant road link. A change in noise level of less than 1dB(A) is regarded as imperceptible and, therefore, of negligible significance. If there are no increases greater than 25% or a decrease of 20% or greater, then the DMRB guidance indicates that no further assessment needs to be conducted.

1249. Details of the road network study area for the Construction phase traffic assessment will be provided by the traffic consultants as AAWT 18hr flows, % HGVs and Speed data to gain an understanding of the noise climate both with and without the project to determine any impacts from increased traffic.

1250. For links where the thresholds are exceeded, the significance of any predicted change in noise level will then assessed in accordance with the criteria contained in the DMRB.

1251. **Construction Vibration:** Ground-borne vibration can result from construction works and may lead to perceptible levels of vibration at nearby receptors, which at higher levels can cause annoyance to residents. In extreme cases, cosmetic or structural building damage can occur, however vibration levels have to be very high for this effect to be manifested and such cases are rare. High vibration levels generally arise from 'heavy' construction works such as piling, deep excavation, or dynamic ground compaction. The use of piling during the construction of the project may be required.

1252. Section 3.29 of DMRB considers the effect of ground-borne vibration. DMRB states:

1253. "*People often express concern that vibrations they feel will cause structural damage to their dwelling. However, it has been shown that vibrations that can be felt indoors and which often cause occupants anxiety are an order of magnitude smaller than would be needed to activate pre-existing strains and cause cracks to propagate. "*

1254. DMRB provides context of perceived impacts:

1255. "*PPVs in the structure of buildings close to heavily trafficked roads rarely exceed 2 mm/s and typically are below 1 mm/s. Normal use of a building such as closing doors, walking on suspended wooden floors and operating domestic appliances can generate similar levels of vibration to those from road traffic."*

1256. Nevertheless, consideration will be given to all potential sources of vibration associated with the construction phase particularly those in proximity to residential and other sensitive receptors.

1257. Guidance on the human response to vibration in buildings is found in BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings, Part 1, Vibration sources other than blasting. For construction vibration from sources other than blasting, the vibration level and effects will be adopted based on Table B-1 of BS 5228-2. These levels and effects are based on human perception of vibration in residential environments.

1258. **Noise and vibration impacts to ecological receptors:** Noise and vibration during construction activities may cause disturbance to wildlife, including protected species and designated sites.

3.9.2.2 Potential impacts during operation

1259. There are unlikely to be any noise and vibration impacts relating to operational or maintenance vehicular traffic. It is therefore proposed that noise impacts arising from maintenance vehicular traffic should be scoped out from further consideration within the EIA.

1260. Noise impacts during the operational phase of the Norfolk Boreas project are most likely to arise from the operation of equipment within the onshore project substation and cable relay station (e.g. reactors and transformers). An assessment would be undertaken to determine the likely environmental and health impacts due to operational noise emissions on identified sensitive receptors. The potential permanent impacts of operational noise from the onshore project substation and cable relay station may arise from:

- The inherent operational noise from Norfolk Boreas, and its characteristics;
- The proximity of Norfolk Boreas to noise sensitive premises (including residential properties) and noise sensitive areas (including PRoW and the Norfolk Broads National Park);
- The proximity of Norfolk Boreas to quiet places and other areas that are particularly valued for their acoustic environment or landscape quality; and
- The proximity of Norfolk Boreas to designated sites where noise may have an adverse impact on protected species or other wildlife.

1261. **Noise from Fixed and Mobile Plant – Cable Relay Station and Onshore Project Substation:** Operation noise may occur from the cable relay station and onshore project substation. Where there are noise sources such as fixed plant associated with industrial operations, the most appropriate assessment guidance is BS

4142:2014. The guidance describes a method of determining the level of noise of an industrial noise source and the existing background noise level.

1262. **Operational vibration from the Onshore Project Substation Site:** Transformers and other electrical equipment vibrate at twice the power frequency i.e. 100Hz and associated harmonic frequencies e.g. 200Hz, 300Hz, however the effects are negligible and are countered by the use of industry standard mitigation techniques such as the use of vibration isolation pads to prevent transmission of ground borne vibration. Embedded mitigation in the form of anti-vibration mounts would be used at the operational substations, which is likely to result in a negligible source of ground borne vibration.

1263. There are considered to be no other significant sources of vibration associated with the operational scheme and operational vibration impacts. It is therefore proposed that this impact should be scoped out from further consideration within the EIA.

1264. **Operational Phase – Low Frequency Noise (LFN):** Operational transformer and shunt reactor noise is typically constant, with a 'low frequency hum' occurring at harmonics of the supply frequency; usually 100Hz and 200Hz components are dominant. Transformers generally run continuously except for occasional maintenance and fault outages.

1265. Department of Energy & Climate Change (2011); Overarching National Policy Statement for Energy (EN-1), The Stationery Office, London states that any distinctive tonal and low frequency characteristics of the noise should be identified. The Low Frequency Noise element will be considered as part of the operational assessment in accordance with relevant guidance.

3.9.2.3 Potential impacts during decommissioning

1266. No decision has been made regarding the final decommissioning policy for the onshore project substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. It is likely that the onshore project substation and cable relay station equipment would be removed and reused or recycled. It is expected the onshore cables would be removed from ducts and recycled, with the transition pits and ducts left in situ.

1267. The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan would be provided.

1268. It is anticipated that the decommissioning impacts would be similar in nature to those of construction, but would be more limited in geographical extent and timescale.

3.9.2.4 Potential cumulative impacts

1269. The approach to assessing cumulative impacts is detailed in Section 3.13.

1270. The potential cumulative impact at noise sensitive receptors could arise through concurrent construction phases associated with Norfolk Boreas and Norfolk Vanguard, through concurrent construction of the cable route, the substations and, depending on the option chosen for connection to the grid, at cable relay stations. However the extent of the cumulative impact is dependent on the eventual scheduling along the onshore cable corridor and on the onshore project substation/cable relay station locations.

1271. There is a potential for a cumulative impact associated with construction phase road traffic to occur during the project construction in conjunction with other proposed schemes. Further details will be contained within the Traffic and Transport Method Statement.

1272. It is anticipated that a construction noise and vibration assessment would be undertaken, in accordance with BS 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites (British Standards Institute 2014), to specify best-practice mitigation to reduce the impacts at nearby receptors.

1273. Mitigation measures will also be specified to reduce construction noise and vibration impacts of the development. It is therefore considered that, with the adoption of Best Practice Measures (BPM), cumulative impacts of construction noise and vibration would not be significant.

1274. Operational noise impacts, particularly of the onshore project substation, will be considered in conjunction with the consented Dudgeon Offshore Wind Farm substation, the Hornsea THREE Offshore Wind Farm onshore works and other potential proposed developments, subject to the location of the onshore infrastructure.

3.9.2.5 Summary of potential impacts

Table 3.26 Summary of impacts relating to onshore noise and vibration

Potential impacts	Construction	Operation	Decommissioning
Noise affecting human and ecological receptors	✓	✓	✓
Vibration affecting human and ecological receptors	✓	x	✓
Cumulative impacts	✓	✓	✓

Scoped in (✓) and scoped out (x)

3.9.3 Mitigation

1275. The construction works would use BPM to limit the impacts of noise at sensitive receptors. Those measures would be set out in the CoCP.

1276. Operational mitigation measures likely to be considered as part of this scheme would involve:

- Locating the onshore project substation and cable relay station away from noise sensitive receptors where possible;
- Selection of quieter equipment;
- Installation of acoustic enclosures;
- Installation of acoustic barriers;
- Screening substations further by the construction of a landform/embankment around the site may also provide up to 10dB attenuation;
- Silencing of exhausts/outlets for air handling/cooling units;
- Locating equipment to take advantage of screening inherent in the design, i.e. from the substation hall(s) or control room buildings; and
- Monitoring of noise related complaints.

1277. Potential impacts caused by noise barriers, enclosures or embankments on landscape and visual or ecology receptors will be considered in Sections 4.2 and 3.6.

3.9.4 Approach to assessment and data gathering

The approach to the Norfolk Boreas assessment and data gathering outlined below is informed by methodology discussed with regulators during the EPP for Norfolk Vanguard.

1278. Noise and vibration issues associated with the onshore elements of the Norfolk Boreas construction works including cable installation, onshore project substation, cable relay station, works to the National Grid extension and access roads construction would be assessed using the guidance contained in BS 5228:2009+A1:2014, which defines the accepted prediction methods and source data for various construction plant and activities.

1279. The following data sources will be used in the EIA:

- Ordnance Survey mapping;
- Topographical data;
- On-site noise monitoring data;
- Traffic data;
- Construction data;
- DWG/DFX drawings;

- Noise modelling and propagation calculations; and
- Consultation with all relevant local authorities.

1280. Measurements of the existing ambient noise level will be required to be taken at locations considered representative of nearby noise sensitive receptors that have the potential to be affected by the construction and operation of the project.

1281. A baseline survey will be necessary to quantify existing noise levels at sensitive receptor locations close to potential noise generating activities associated with the project, specifically during the construction and operational phases:

- Cable landfall;
- Cable relay station;
- Cable route;
- Onshore project substation; and
- Extension to the Necton National Grid substation.

1282. Baseline survey measurements will be conducted in accordance with current guidance, including BS4142:2014 Method for Rating and Assessing Industrial and Commercial Sound, and BS 7445-2:1991 Description and measurement of environmental noise.

1283. Construction noise impacts would be based on the likely construction programme and associated activities, including cable laying and directional drilling works, construction traffic and access routes.

1284. The type of vehicles and plant required for construction will be detailed and the main sources of noise from onshore infrastructure will be identified. The assessment will consider 'worst case' receptors i.e. that within the application site the vehicles and plant are located at the closest possible point to a receptor.

1285. The spatial scope of the construction noise assessment would include the following geographic coverage:

- 400m from the onshore cable corridor where significant activities could affect noise sensitive receptors (including PRoW); and
- Traffic routes and routes subject to significant changes in traffic flows (and/or percentage HGV) associated with the construction of the project.

1286. Potential noise disturbance at night or other unsocial hours (i.e. weekends and public holidays) will be addressed.

1287. Operational impacts would include noise impacts associated with the onshore project substation and cable relay station. The guidance and methodology contained in BS 4142:2014 would be used to assess noise impacts arising from the onshore project substation and cable relay station.

1288. The tasks required to progress the assessment will include:

- Initial liaison with the local authorities and the Environment Agency to agree approach, methodology and criteria to be used for the noise assessment;
- Shorter term (daily), baseline noise surveys along the onshore cable corridor consisting of daytime and night-time attended noise measurements at locations representative of sensitive receptors;
- Longer term (up to a week) baseline surveys in the area of the onshore project substation consisting of unattended, continuous noise measurements at locations representative of sensitive receptors;
- Noise assessment for the cable laying activity (including at the cable landfall) and the construction of the cable relay station and onshore project substation;
- (If required) construction vibration impacts (e.g. where piling may be required);
- Assess construction and operational noise impacts on any nature conservation areas in the vicinity of the onshore cable corridor, the cable relay station and the onshore project substation;
- Assess construction traffic noise impacts of the project; and
- Assess operational noise impacts (including low frequency noise) of the onshore project substation and cable relay station.

1289. The approach to assessment and data gathering will be discussed and agreed as part of the EPP (detailed in Section 1.6.2) prior to commencement. Consultation will be undertaken at key stages throughout the EIA process.

3.10 Traffic and transport

3.10.1 Baseline

1290. A review of the baseline conditions has been undertaken; including the consideration of the following desk based information sources:

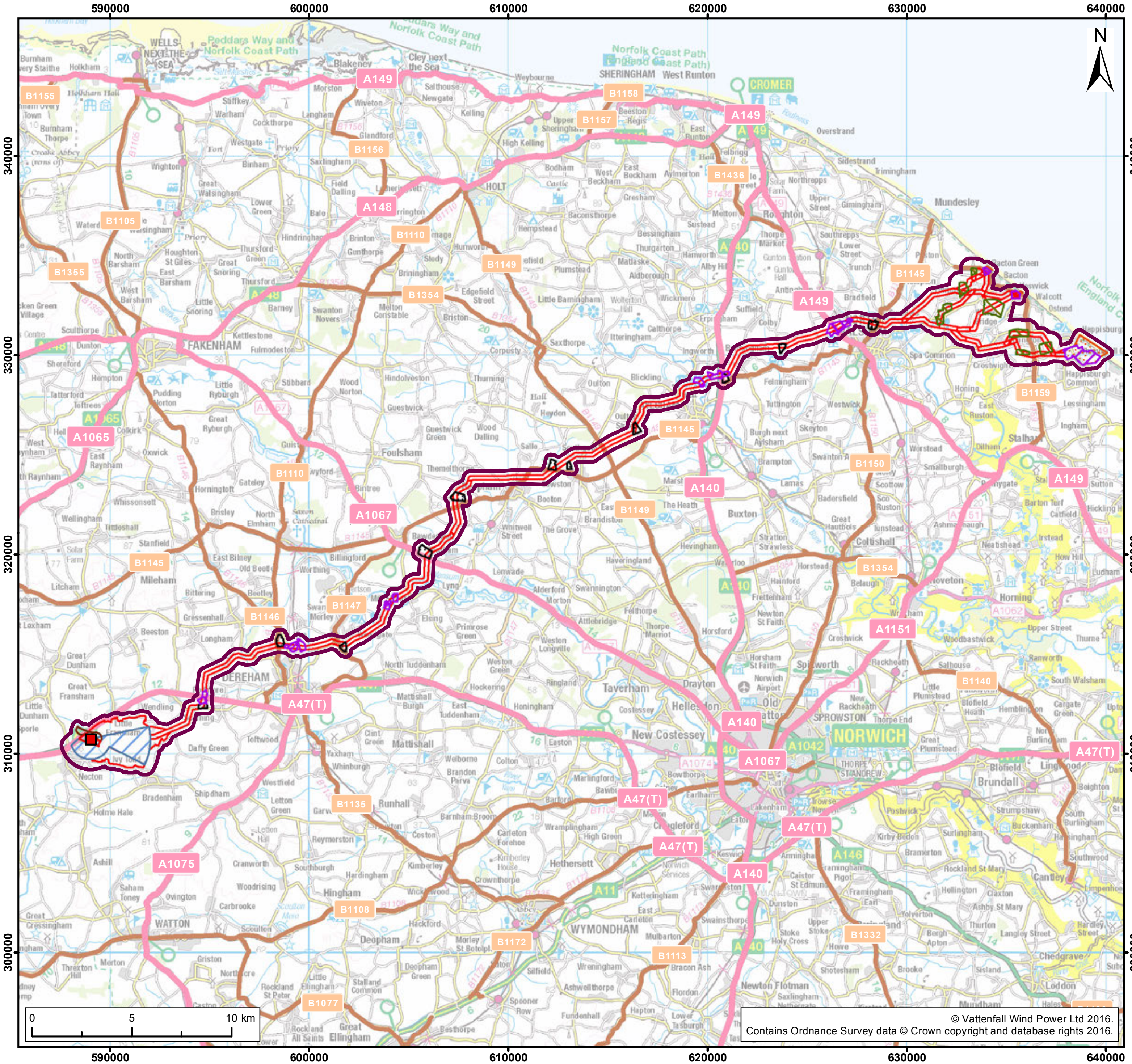
Table 3.27 Traffic and transport data sources

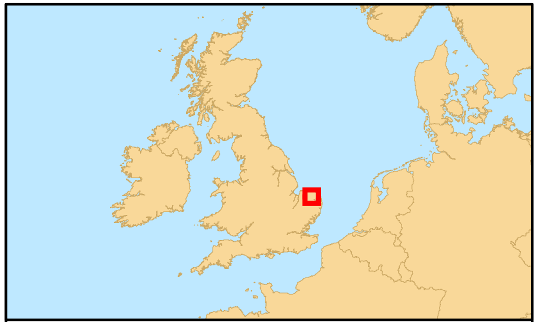
Source no.	Data	Source	Date
1	Traffic counts	Department for Transport	2017
2	Local highway network	Norfolk County Council	2017

1291. Norfolk has one of the largest highway networks in the country at over 6,000 miles. Within the onshore scoping area the principal highway network (managed by Norfolk County Council Highways) includes the A149, A140, and the A1067 whilst the A47 forms part of the strategic road network managed by Highways England (see Figure 3.15).

1292. The A47 is identified in the Norfolk County Council (2011) Local Transport Plan (NCC LTP) as one of Norfolk's key strategic connections, forming part of the Trans-European Transport Network, providing the main east west road connection and route to the Midlands and north of England. Local to the onshore scoping area the A47 provides a key link between Norwich to the east and King's Lynn and then Peterborough to the west. In the vicinity of the proposed onshore project substation the A47 carries in the region of 15,380 vehicles per day of which 10.1% are HGVs.

1293. The A47 is predominately single carriageway road, however around the major urban areas (Norwich, Dereham, Swaffham and King's Lynn) the road widens to dual carriageway. Highways England have identified a number of schemes along the A47 to address congestion hotspots; these works are programmed to commence construction in 2020 and include the proposed widening of the A47 to dual carriageway between North Tuddenham and Easton.





Legend:

- Onshore Scoping Area
- Necton National Grid Substation

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
- Cable Relay Station Zone
- Landfall Zone
- A Road
- B Road

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Strategic Road Network

Figure: 3.15 | Drawing No: PB5640-102-047

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	20/03/17	JE	DT	A4	1:275,000
01	08/03/17	JE	DT	A4	1:275,000

Co-ordinate System: British National Grid **EPSG:** 27700

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1294. Within the onshore scoping area the A149 runs south from Cromer to North Walsham and is predominantly rural single carriageway carrying in the region of 10,560 vehicles per day of which 3.7% are HGVs. The A149 then continues south towards Great Yarmouth.

1295. To the south of Cromer the A140 has a priority junction with the A149. The A149 is a predominantly rural single carriageway that runs south towards Aylsham carrying in the region of 11,725 vehicles per day of which 4.5% are HGVs. The A149 then continues south towards Norwich.

1296. Within the onshore scoping area the A1067 runs generally west to east between Fakenham and Norwich. The Cromer Road is a rural single carriageway carrying in the region of 9,140 vehicles per day of which 5.0% are HGVs.

1297. The Norfolk Coast Transport Strategy published by Norfolk County Council (2006), identifies that:

"*Traffic is one of the main threats to peace and tranquillity of the Norfolk Coast; the area's chief attraction. Traffic problems are largely associated with seasonal influx of visitors to the area, with traffic flows highly seasonal.*

1298. *The major route for through traffic is the A148 and A149 from Kings Lynn via Cromer to Great Yarmouth…*"

1299. With regards to sustainable transport options NCC LTP notes that

"*… significant numbers of people have to travel relatively long distances to access everyday facilities, often with the added challenge of variable quality public transport.*

The rural nature of Norfolk means that many people are forced to be reliant on the car as their primary form of transport. A significant minority of people however, do not have a car and thus are reliant on local service provision, walking, cycling or public transport availability. "

1300. A review of the collision rates provided by Department for Transport (2015) shows that the rate of people killed or seriously injured per billion vehicles miles in Norfolk is 73. This rate is higher than the average for the East of England (67) but lower than for England as a whole (80).

1301. The NCC LTP also raises concerns with regard to road safety, noting that:

"*Despite some real achievements, road safety continues to be a major public concern and is reflected in our conversations with residents*."

1302. An initial study area has been developed by identifying the most probable routes for traffic, for both the movement of materials and employees, during both construction and operational phases of Norfolk Boreas.

1303. The initial study area will form the basis for the impact assessment and will be refined down when detailed traffic assignment is undertaken.

1304. The initial study area is illustrated in Figure 3.15 and would potentially include the following roads as detailed in Table 3.28, Table 3.29 and Table 3.30.

Table 3.28 Main Routes ('A' Roads) to Onshore Destinations

Potential Quantity of Links	Road	Source	Total Annual Average Daily Traffic Range
7	A47	DfT traffic counts	15,380 – 42,551
2	A12	DfT traffic counts	23,061 – 33,788
5	A140	DfT traffic counts	11,725 – 29,064
1	A146	DfT traffic counts	11,947
3	A148	DfT traffic counts	9297 – 11,404
8	A149	DfT traffic counts	6,276 – 34,323
1	A1042	DfT traffic counts	26,996
2	A1065	DfT traffic counts	4,866 – 6,754
5	A1067	Dft traffic counts	7,698 – 16,067
1	A1074	DfT traffic counts	21,564
3	A1151	DfT traffic counts	9,148 – 15,610
3	North Distributor Road	DCO Planning Application	TBD

Table 3.29 Potential Routes ('B' Roads) to Onshore Destinations

Potential quantity of Links	Road	Source	Total Annual Average Daily Traffic Range
1	B1110 – Holt Road	Potential survey required	TBD
6	B1145	Potential survey required	TBD
2	B1146	Potential survey required	TBD
2	B1147	Potential survey required	TBD
3	B1149	Potential survey required	TBD
2	B1159	Potential survey required	TBD
1	B1436	Potential survey required	TBD

Table 3.30 Potential Minor Routes to Onshore Destinations

Potential Quantity of Links	Road	Source	Total Annual Average Daily Traffic Range
1	Cromer Road - Ingworth	Potential survey required	TBD
1	Elsing Lane	Potential survey required	TBD
1	Mill Common Lane	Potential survey required	TBD
1	North Walsham Road – Edingthorpe Green	Potential survey required	TBD
1	Northgate – from junction with B1146 (Holt Road)	Potential survey required	TBD
1	Unnamed road adjacent to Glebe Crescent	Potential survey required	TBD

3.10.2 Potential impacts

1305. The project details are described in Section 1.5.

3.10.2.1 Potential impacts during construction

1306. The construction phase would result in a requirement for the import/export of materials and plant to the landfall zone, onshore cable route, onshore project substation, cable relay station, Nection National Grid extension and overhead line modification. At this stage, initial first draft material and workforce schedules have been used as an approximation of traffic generation for Norfolk Boreas.

1307. Table 3.31 sets out the Project's infrastructure parameters and represents initial forecast traffic generation for Norfolk Boreas Scenario 2 (Section 1.5.4).

Table 3.31 Initial forecast traffic generation.

Onshore Electrical Infrastructure	Total two-way vehicle movements		Notes
	HGVs	Construction personnel[2]	
Landfall Zones			
NB HVDC	646	2,000	20 construction personnel per day - 10 week[1] programmes for drilling.
NB HVAC	646	6,000	20 construction personnel per day - 30 week[1] programmes for drilling
Cable Relay Station Options*			
NB HVAC	1,689	14,400	20 construction personnel per day - 18 month[1] programme for construction
Onshore Cable Route			

Onshore Electrical Infrastructure	Total two-way vehicle movements		Notes
NB HVDC	64,499	249,600	260 construction personnel per day (20 construction personnel per 13 work fronts (7 Primary Mobilisation Zone and 5 Secondary Mobilisation Zones)) - 24 month[1] programme for construction
NB HVAC	104,275	249,600	
Onshore Project Substation Zone			
NV HVDC	7,201	36,000	50 construction personnel per day - 18 month[1] programme for construction
NV HVAC	7,201	36,000	
Existing National Grid Substation Extension			
NB HVDC	2,488	36,000	50 construction personnel per day - 18 month[1] programme for construction
NB HVAC			
NB HVAC	**188,645**	**629,600**	

Key	
(shaded)	Worst case vehicle generation per Onshore Electrical Infrastructure
*	Required for HVAC cable only
1	Assumes a 5 day working week
2	Personnel movements with no reduction for car share or mode choice (mini-bus, public transport etc.)

1308. From Table 3.31 it can be observed that the maximum traffic generators would be the following combination:

- Norfolk Boreas HVAC landfall;
- Norfolk Boreas HVAC cable relay station;
- Norfolk Boreas HVAC onshore cable route;
- Norfolk Boreas onshore project substation; and
- Existing National Grid Substation Extension.

1309. Adopting the ‘Rochdale Envelope’ principle it is proposed to assess the traffic impact of this parameter combination, safe in the knowledge that this represents the maximum traffic generation.

1310. To ensure that minor omissions and uncertainties in design can be accommodated within future assessed flows, an appropriate level of contingency would be applied to all material quantities.

1311. A review of the baseline situation outlined in Section 3.10.1 indicates potential impacts resulting from additional traffic fall in to the following two broad categories:

1) Increasing traffic congestion impacting upon commuters and seasonal tourist

traffic with associated effects including:

- Driver delay;
- Severance;
- Impacts on pedestrians and cycle amenity (i.e. PRoW and cycle networks); and
- Impacts on air quality, noise and vibration (considered in Sections 3.3 and 3.9)

2) Road safety

- Construction traffic impacting sites with a history of existing road safety issues;
- Introducing new risks with the formation of new construction accesses; and
- Suitability of access and delivery routes for HGVs, light vehicles, plant and abnormal loads.

3.10.2.2 Base Port

1312. In addition to considering the onshore impacts there is also the potential for impacts associated with employee and HGVs movements for the offshore construction phase via the primary base port.

1313. At this stage no final decision has been made upon which port would be used, however it is noted that this may be a facility on the Norfolk coast. The traffic impacts of the primary base port will be assessed when the actual site has been announced in context with any port operating permissions.

3.10.2.3 Abnormal Indivisible Loads

1314. The importing of large Abnormal Indivisible Loads (AILs) may lead to delays on the highway network. The quantum of AIL deliveries has not been established at this stage; when components have been established an AIL routing study will be undertaken to inform the management measures required.

3.10.3 Potential impacts during operation

1315. During the operational phase, traffic movements would be limited to those generated by the daily operation and periodic maintenance at the cable relay station and onshore substation and at link boxes/test pits along the onshore cable route.

1316. Along the onshore cable route, periodic access to installed link boxes and test pits may be required for inspection, estimated to be annually. These test pits would be accessible from ground level and would be located close to existing access routes where possible. Access to the cable easement would be required to conduct emergency repairs if necessary.

1317. The cable relay station and onshore project substation would not be manned; however access would be required periodically for routine maintenance activities, estimated at an average of one visit per week for each of the cable relay station and onshore project substation.

1318. As with the construction phase, in addition to considering the onshore impacts there is also the potential for impacts associated with employee and HGV movements to the primary port base for the offshore wind farm operations and maintenance activities.

1319. The assessment for the operational phase is likely to consider the impacts of localised driver delay (e.g. port traffic) and road safety impacts relating to providing any new permanent points of access to the cable relay station, onshore project substation and base port.

3.10.4 Potential impacts during decommissioning

1320. No decision has been made regarding the final decommissioning policy for the onshore project substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. However, the onshore project substation and cable relay station equipment would likely be removed and reused or recycled. It is expected the onshore cables would be removed from ducts and recycled, with the transition pits and ducts left in situ.

1321. The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan would be provided.

1322. It is anticipated that the decommissioning impacts would be similar in nature to those of construction.

3.10.5 Potential cumulative impacts

1323. The approach to assessing cumulative impacts is detailed in Section 3.13.

1324. Other developments with potential to impact upon land use receptors will be considered. A select number of major cumulative projects may be required to assess within the worst case scenario due to their associated traffic generation, location of project and development time period. These include the Hornsea Project Three Offshore Windfarm and the A47 improvement corridor programme.

1325. To take account of sub-regional growth in housing and employment, light vehicle flows would be factored to the future year baseline traffic demand using the Department for Transport Trip End Model Presentation Programme (TEMPro) Version 7.0 with data set 7.0 for Norfolk geographical areas and HGV's would be factored up with National Trip End Model (NTEM) factors.

1326. In additional to TEMPro growth, it would be necessary to quantify and assign traffic demand from identified significant committed developments within the study area.

3.10.6 Summary of potential impacts

Table 3.32 Summary of impacts relating to traffic and transport

Potential impacts	Construction	Operation	Decommissioning
Driver delay	✓	x	✓
Severance	✓	x	✓
Pedestrian/cycle amenity	✓	x	✓
Road safety	✓	✓	✓
Abnormal loads	✓	x	✓
Cumulative impacts	✓	x	✓

Scoped in (✓) and scoped out (X)

3.10.7 Mitigation

1327. The environmental assessment will determine the requirement for the implementation of mitigation measures to reduce the significance of the impact to transport receptors.

1328. The following 'embedded or designed in' mitigation informs the traffic assignments to be included in the environmental assessment:

- Suitable access points and identification of optimum routes for construction traffic to use (minimising the impact on sensitive receptors);
- Reducing points of access through the adoption of a running track;
- Consolidating HGV and employee movements at mobilisation zones to reduce vehicle movements along more sensitive local routes; and
- Committing to the development of a Construction Traffic Management Plan (CTMP) to manage employee and HGV movements to avoid sensitive times, use of only

defined routes, compliance with maximum HGV ‘caps’ and strategies to continually monitor and enforce.

3.10.8 Impact assessment methodology

1329. Two key guidance documents will be utilised for the assessment of Norfolk Boreas and are listed below;

- DfT Circular 02/2013 entitled ‘The Strategic Road Network and the Delivery of Sustainable Development’
- Institute of Environmental Assessment - Guidelines for the Environmental Assessment of Road Traffic’ (GEART)

3.10.8.1 DfT Circular 02/2013

1330. The DfT Circular 02/2013 entitled ‘The Strategic Road Network and the Delivery of Sustainable Development’ was published in September 2013 replacing circular 02/2007 ‘Planning and the Strategic Road Network’. It sets out the ways in which Highways England will engage with communities and developers to deliver sustainable development and, thus economic growth, whilst safeguarding the primary function and purpose of the Strategic Road Network.

3.10.8.2 GEART

1331. The principle guidelines for the assessment of the environmental impacts of road traffic associated with new developments are the ‘Guidelines for the Environmental Assessment of Road Traffic’ (GEART) published by the Institute of Environmental Assessment in January 1993. The guidance provides a framework for the assessment of traffic borne environmental impacts, such as pedestrian severance and amenity, driver delay, accidents and safety; and noise, vibration and air quality.

3.10.9 Potential effects

The following effects (adopted from GEART) are detailed below.

3.10.9.1 Impact: Driver delay

1332. GEART recommends the use of proprietary software packages to model junction delay and therefore estimate increased vehicle delays. However, it is noted that vehicle delays are only likely to be significant when the surrounding highway network is at, or close to, capacity.

1333. During consultation with the highway authorities, sensitive junctions will be identified that require an assessment of potential delays for drivers during peak hours.

1334. The assessment therefore seeks to disaggregate the peak hour traffic movements on to these junctions to facilitate an assessment of the potential significance of driver delays.

1335. The use of trenchless crossing techniques for all rail crossings and certain public highways, rather than more conventional cut and cover techniques would mitigate the potential for additional driver delay.

3.10.9.2 Impact: Severance

1336. Severance is the perceived division that can occur within a community when it becomes separated by a major traffic artery. The term is used to describe a complex series of factors that separate people from places and other people. Severance may result from the difficulty of crossing a heavily trafficked road or a physical barrier created by the road itself. It can also relate to quite minor traffic flows if they impede pedestrian access to essential facilities. Severance effects could equally be applied to residents, motorists, cyclists or pedestrians.

1337. GEART suggests that changes in total traffic flow of 30%, 60% and 90% are considered to be slight, moderate and substantial respectively. The GEART criteria will be used in the impact assessment.

3.10.9.3 Impact: Pedestrian/Cycle amenity

1338. Pedestrian and cycling amenity is broadly defined as the relative pleasantness of a journey, and is considered to be affected by traffic flow, traffic composition and pavement width and separation from traffic. This definition also includes pedestrian and cyclist fear and intimidation, and can be considered to be a much broader category including consideration of the exposure to noise and air pollution, and the overall relationship between pedestrians, cyclists and traffic.

1339. GEART suggests that a threshold of a doubling of total traffic flow or the HGV component may lead to a negative impact upon pedestrian amenity. The GEART criteria will be used in the impact assessment.

3.10.9.4 Impact: Road safety

1340. The salient GEART guidance on road safety is a follows:

"*Where a development is expected to produce a change in the character of traffic* *(e.g. HGV movements on rural roads), then data on existing accident levels may not be sufficient. Professional judgement will be needed to assess the implications of local circumstances, or factors which may elevate or lessen the risk of accidents, e.g. junction conflicts*."

1341. An examination of the existing collisions occurring on the roads contained within the initial study area will be undertaken to identify any areas of the highway with concentrations of collisions. These areas are considered to be sensitive to changes in traffic flows (sensitive receptors) and therefore a more detailed analysis of significance will be undertaken by a qualified Road Safety Auditor.

3.10.10 Magnitude

1342. Table 3.33 details the assessment framework for magnitude thresholds adapted from GEART. These thresholds are guidance only and provide a starting point by which transport data will inform a local analysis of the impact magnitude.

Table 3.33 Magnitude of effects

Magnitude	Definition			
Effects	Very Low	Low	Medium	High
Severance	Changes in total traffic flows of less than 30%	Changes in total traffic flows of 30 to 60%	Changes in total traffic flows of 60 to 90%	Changes in total traffic flows of over 90%
Pedestrian and cycling amenity	Change in traffic flows (or HGV component) less than 100%	Greater than 100% increase in traffic (or HGV component) and a review based upon the quantum of vehicles, vehicle speed and pedestrian footfall.		
Highway Safety	Informed by a review of existing collisions patterns and trends based upon the existing personal injury collision records and the forecast increase in traffic			
Driver Delay	Informed by projected traffic increases through sensitive junctions within the study area.			

3.10.11 Sensitivity of road Links

1343. The magnitude of effect would then be combined with the sensitivity of each discrete highway link within the study area to determine the overall impact of the project's traffic.

1344. The sensitivity of a road can be defined by the type of user groups who may use it. A sensitive area may be a village environment or where pedestrians or cyclist activity may be high, for example in the vicinity of a school. Table 3.34 provides broad definitions of the different sensitivity levels.

Table 3.34 Example Definitions of the Different Sensitivity Levels for a Highway Link

Sensitivity	Definition
Low	Few sensitive receptors and / or highway environment can accommodate changes in volumes of traffic.
Medium	A low concentration of sensitive receptors (e.g. residential dwellings, pedestrian desire lines, etc.) and limited separation from traffic provided by the highway environment.
High *	High concentrations of sensitive receptors (e.g. hospitals, schools, areas with high tourist footfall etc.) and limited separation provided by the highway environment.
Negligible	Links that fall below GEART Rule 1 and 2 screening thresholds.
*High sensitivity links are considered to be 'specifically sensitive areas' for the purposes of GEART Rule 2.	

1345. A desktop exercise augmented by site visits would be undertaken to identify the sensitive receptors in the study area utilising the definitions outlined in Table 3.34.

3.10.12 Significance

1346. Table 3.35 sets out the assessment matrix which combines the initial impact assessment derived from the assessment framework presented in Table 3.35 with the sensitive receptor value to determine the magnitude of impact.

Table 3.35 Impact Significance Matrix

		Magnitude			
		High	Medium	Low	Negligible
Sensitivity	High	*Major*	*Major*	*Moderate*	*Minor*
	Medium	*Major*	*Moderate*	*Minor*	*Minor*
	Low	*Moderate*	*Minor*	*Minor*	*Negligible*
	Negligible	*Minor*	*Negligible*	*Negligible*	*Negligible*

1347. Note that for the purposes of the EIA, **major** and **moderate** impacts are deemed to be significant. In addition, whilst **minor** impacts are not significant in their own right, it is important to distinguish these from other non-significant impacts as they may contribute to significant impacts cumulatively or through interactions.

1348. In addition, all proposed delivery routes will be assessed for their suitability to accommodate forecast HGV traffic and abnormal loads.

1349. Once more detail of the proposed traffic demand is known a more detailed transport scoping note will be prepared and submitted to the highway authorities (Norfolk County Council and Highways England) as part of the EPP to confirm the scope of impact assessment included in the EIA.

3.10.13 Other impacts

1350. Traffic-borne noise and vibration effects and air quality effects will be informed by the traffic data outlined within the Traffic and Transport assessment and will be addressed in the noise and air quality assessments undertaken as part of the EIA process.

3.10.14 Data gathering

1351. To facilitate the impact assessment, the following data will be obtained predominately via data gathering and surveys undertaken for Norfolk Vanguard. The data that will be directly relevant to Norfolk Boreas will be shared across the two projects. This includes the three potential landfall locations, the cable relay station zones, the onshore cable corridor, the onshore project substation zone and the National Grid extension works.

1352. Additional data collection may be required at non shared locations, such as at new access routes or mobilisation zones required for construction of Norfolk Boreas.

1353. The shared/obtained data will include the following data sets:

- Baseline traffic flow data within the study area, including seasonal traffic fluctuations;
- Details of sensitive receptors (such as district centres, schools, leisure facilities etc.) within the study area;
- Collison data within the study area;
- Existing pedestrian/cycle/bus routes serving the study area;
- Detail of abnormal load routes; and
- Details of extant permissions and permitted movements of traffic at the preferred port location.

1354. The approach to assessment and data gathering will be discussed and agreed as part of the EPP (detailed in Section 1.6.2) prior to commencement. Consultation will be undertaken at key stages throughout the EIA process.

3.11 Health

1355. Human health will be considered within the relevant onshore chapters of the ES, including flood risk, air quality, noise and vibration, traffic and transport, tourism and recreation, and socio-economics. However, in order to provide a single overview of this topic, a review of the health interactions of the project and those in the receiving environment will be included within the ES.

3.11.1 Baseline

1356. The Health Impact Review (HIR) will identify potential impacts on the health of the local population in relation to Norfolk Boreas. The review will only consider the onshore components of the project, including landfall, as there are no human health receptors that would be affected by offshore aspects of the project.

1357. The onshore areas associated with the landfall and onshore cable route are predominantly rural in nature typified by small villages and isolated residential properties. The northern tip of the Norfolk Broads National Park is also adjacent to potential project areas. The onshore project substation zone is in a rural area located around the village of Necton to the west of the larger town of Dereham.

1358. Receptors that are sensitive to potential health impacts will be identified within the topic specific ES chapters, and a review of these will be presented within the HIR. The review will consider settlements/residents; key sensitive receptors include demographic groups such as the young, elderly, and those with underlying health issues. The HIR review will also identify specific sensitive receptors such as schools, nurseries, care homes and hospitals.

3.11.2 Potential impacts

1359. Full details of the project description are provided in Section 1.5.

3.11.2.1 Potential impacts during construction

1360. Potential health related impacts that may result from construction will be defined in the topic specific chapters of the ES, but are expected to include:

1361. **Accidental / Incidental Chemical Spills / Leaks / Releases during Transport**: The accidental spillage or leak of chemicals transported during construction or within the equipment being installed could have potential health risks

1362. Emissions to Water: Emissions of contaminants to water (surface, coastal, and groundwater) could, through these liquid pathways, be ingested by and impact on human health. As there would be no planned chemical discharges this impact crosses over with the accidental spillage or leaks considered earlier.

1363. Emissions to Soil: Emissions of contaminants to soil could be ingested by, and impact on, human health, for example if they occur in areas used for agriculture or if ground gas is created. As there would be no planned chemical discharges this impact crosses over with the accidental spillage or leaks considered above.

1364. **Emissions to Air:** Emissions from plant, machinery and road transport can impact on air quality, particularly in relation to particulates and other chemicals such as nitrogen oxides, ozone, sulphur dioxide, carbon dioxide, and carbon monoxide. Similarly dust during construction can result in significant increases in airborne particulates. These all can result in temporary or permanent respiratory health risks in particular to vulnerable receptors (i.e. the young, old, or those with existing related health issues). Elevated dust levels can also represent a significant nuisance impact to many receptors.

1365. **Waste Disposal and Transport:** Project waste would be disposed of through licenced waste transport provider to the appropriately licensed disposal sites. As these are licenced, the impacts of receiving and managing the waste have already been considered and form part of the site's operation and management regime. Consequently, there is no further consideration for this element.

1366. The transport of the waste will be considered in line with the assessment method in relation to the Accidental / Incidental Chemical Spills / Leaks / Releases during transport as described earlier. However, there will be less certainty over the nature of the waste material, though similar risk avoidance and mitigation measures will be identified.

1367. **Transport Related Accidents:** Increased heavy goods and other vehicle movements during construction could result in increased risk of accidents with both vehicles and other road users (pedestrians, equestrians, and cyclists). This impact will be considered as part of the traffic impact assessment element of the EIA.

1368. **Severance of access to Public Open Space**: Severance to public open space or disincentive to use open spaces due to disturbance etc. could impact on health related benefits. Of less concern during construction (unless cumulative) but potentially of greater scale and significance during operation particularly if in-combination with other project impacts. This impact will be considered as part of the traffic impact assessment element of the EIA.

1369. **Community Anxiety and Stress:** It is recognised that large scale industrial projects can result in increased anxiety and stress across receptor communities particularly with respect to the lack of information that is often provided and uncertainties over how they would be affected. There is no established methodology for quantifying community anxiety or stress. Communities that are within a zone of influence / disturbance (i.e. noise, air, transport, water, and visual) that could arise will be identified. Focussed information will be provided to the Norfolk Boreas communications team regarding the nature of the disturbance activities that could impact on those communities (essentially a summary of each of the particular impacts and their scale alongside the description of activities and programme). The project is committed to regular community consultation and engagement through a range of media and events. These public fora and consultation tools will provide an indication regarding the level of community stress or anxiety associated with Norfolk Boreas. Elements of the engagement material will be tailored to seek feedback from the consultees.

3.11.2.2 Potential impacts during operation

1370. Potential health related impacts that may result from operation will also be defined in the topic specific chapters of the ES, but are expected to include:

1371. **EMF Electromagnetic Fields:** The effects of long-term exposure to electromagnetic fields (EMF) associated with electricity cables and related infrastructure has been considered on most modern power generation and transmission projects.

1372. The Norfolk Boreas project will be designed and locations for electricity cables and infrastructure selected to ensure that the relevant ICNIRP (2009) guidelines will be fully met. EMF issues will be considered further within the EIA process.

1373. **Increased Transport Related Accidents:** Increased heavy goods and other vehicle movements during operation could result in increased risk of accidents with both vehicles and other road users (pedestrians, equestrians, and cyclists). This impact will be considered as part of the traffic impact assessment element of the EIA.

1374. **Severance of access to Public Open Space:** Severance of access to public open space or disincentive to use open spaces due to disturbance etc. could impact on health related benefits. This would be more significant during operation particularly if in-combination with other project impacts or other projects. This impact will be considered as part of the traffic impact assessment element of the EIA.

1375. **Community Anxiety and Stress**: It is recognised that large scale industrial projects can result in increased anxiety and stress across communities particularly if there is a lack of information provided by the developer. This is particularly in relation to information about:

- Noise disturbance in the proximity of the operational onshore project substation and cable relay station;
- Electromagnetic Fields (EMFs) generated above the buried cable route;
- Increase in local population due to construction workers; and
- Increase in traffic.

3.11.2.3 Potential impacts during decommissioning

1376. No decision has been made regarding the final decommissioning policy for the onshore project substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. The onshore project substation and cable relay station equipment would likely be removed and reused or recycled. It is expected the onshore cables would be removed from ducts and recycled, with the transition pits and ducts left in situ.

1377. The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan would be provided.

It is anticipated that the decommissioning impacts would be similar in nature to those of construction.

3.11.2.4 Potential cumulative impacts

1378. The approach to assessing cumulative impacts is detailed in Section 3.13.

1379. Other developments with potential to impact upon health receptors will be considered.

1380. Further consideration will be given to these potential cumulative scenarios as part of the EIA in combination with other projects, particularly in respect to the combined Norfolk Vanguard and Norfolk Boreas scenarios, and the cable route for the proposed Hornsea Project 3.

3.11.2.5 Summary of potential impacts

Table 3.36 Summary of impacts relating to health

Potential impacts	Construction	Operation	Decommissioning
Accidental / Incidental Chemical Spills / Leaks / Releases during Transport	✓	x	✓
Emissions to air (including dust)	✓	x	✓
Waste Disposal and Transport	✓	x	✓
Transport related accidents	✓	✓	✓

Potential impacts	Construction	Operation	Decommissioning
Severance of access to Public Open Space	✓	✓	✓
Community stress and anxiety as a result of increased pollution (water) risk, flood risk, noise, visual, heavy traffic, or crime due to in-migrant workers	✓	✓	✓
EMF	x	✓	x
Cumulative	✓	✓	✓

Scoped in (✓) and scoped out (x)

3.11.3 Mitigation

1381. All relevant permits required under the Environmental Permitting Regulations 2010 would be identified and obtained ensuring that the project complied with these regulations.

1382. Where health related impacts are identified in individual ES chapters' measures to avoid or reduce these effects will be identified and reported within the chapters of the ES and collated within the HIR. This will include consultation with communities and relevant stakeholders, and completion of a CoCP.

3.11.4 Approach to assessment and data gathering

1383. The approach to assessment and data gathering outlined below is informed by methodology discussed with regulators during the EPP for Norfolk Vanguard.

1384. There are no specific guidelines which inform the management or assessment of health impacts. The Overarching National Policy Statement for Energy (EN-1) (DECC, 2011d) states that where Norfolk Boreas has an effect on human beings, the ES should assess these effects for each element of the project, identifying any adverse health impacts, and identifying measures to avoid, reduce or compensate for these impacts as appropriate.

1385. EN-1 indicates that direct impacts on health may include:

- Increased traffic;
- Air or water pollution;
- Dust;
- Odour;
- Hazardous waste and substances;
- Noise;

- Exposure to radiation; and
- Increases in pests.

1386. New energy infrastructure may also affect the composition, size and proximity of the local population, and in doing so have indirect health impacts, for example if it in some way affects access to key public services, transport or the use of open space for recreation and physical activity.

1387. In line with good practice, the assessment process will include the identification and review of the potential public health impacts of the full life-cycle (i.e. construction, operation and decommissioning) of the project's features, including their emissions. The findings will be taken from individual chapters from the ES and collated in the HIR. In addition feedback will be sought from consultees on potential health impacts, with particular reference to the Health and Safety Executive and Public Health England.

1388. Data sources relating to human receptors are discussed in the following chapters:

- Marine water and sediment quality;
- Ground conditions and contamination;
- Air quality;
- Onshore noise and vibration;
- Traffic and transport;
- Water resources and flood risk;
- Landscape and visual; and
- Socio-economics (including tourism and recreation).

1389. Other data sources include:

- ONS and Neighbourhood statistics regarding Health and Care for local, County, and regional data, in particular focussing on general health.
- OS maps combined with ONS data for lower level super output areas to identify detailed community and population data at relevant spatial locations.

1390. No additional survey is planned as it is considered that appropriate data will be obtained as detailed in the relevant chapters listed in Section 3.11.4 above.

3.12 Onshore inter-relationships

1391. The EIA will identify the full range of inter-relationships which are likely to result from the construction, operation and decommissioning of Norfolk Boreas. The inter-relationships relevant to the onshore environment are outlined in Table 3.37.

Table 3.37 Onshore inter-relationships

Onshore topics	Inter-relationships
Ground Conditions and Contamination	Would have effects on: • Land use • Onshore ecology • Water Resources and Flood Risk
Air Quality	Would be affected by: • Traffic and transport Would have effects on: • Health • Onshore Ecology • Onshore Ornithology
Water Resources and Flood Risk	Would be affected by: • Ground conditions and contamination • Land use Would have effects on: • Health • Onshore Ecology • Onshore Ornithology
Land Use	Would be affected by: • Ground conditions and contamination • Traffic and transport • Socio-economics Would have effects on: • Water resource and flood risk
Onshore Ecology	Would be affected by: • Water resources and flood risk • Air quality • Noise and vibration • Ground Conditions and Contamination
Onshore Ornithology	Would be affected by: • Water resources and flood risk • Air quality • Noise and vibration
Onshore Archaeology and Cultural Heritage	Is affected by: • Landscape and visual • Noise and vibration
Onshore Noise and Vibration	Would be affected by: • Traffic and transport Would have effects on: • Onshore Ecology • Onshore Ornithology • Onshore Archaeology and Cultural Heritage • Health
Traffic and Transport	Would have effects on: • Noise and vibration • Air quality • Land Use • Health
Health impacts	Would be affected by: • Water resources and flood risk • Air quality

Onshore topics	Inter-relationships
	• Noise and vibration • Traffic and transport • Tourism and recreation • Socio-economics

1392. The approach to onshore inter-relationships will be discussed with relevant stakeholders during the EPP.

3.13 Cumulative impacts summary

1393. Onshore cumulative impacts will be considered as part of the EIA process. Any other project with the potential to result in impacts that may act cumulatively with Norfolk Boreas will be identified during consultation as part of the Scoping process and following a review of available information and as set out in the Planning Inspectorate's Advice Note 11 (Planning Inspectorate, 2012e). These projects will then be included in the CIA and therefore are scoped into the assessment. The list of cumulative developments to be considered will be consulted upon and agreed with statutory consultees.

1394. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Boreas in the context of other developments that are existing, consented or at application stage, or as part of the development plan.

1395. As discussed in Section 1.2, Vattenfall are seeking to minimise cumulative impacts between Norfolk Boreas and Norfolk Vanguard through the alignment of onshore cable route and the preference for Norfolk Vanguard to pre-install ducts and undertake other enabling works for Norfolk Boreas (Scenario 1 described in Section 1.5.4). Any cumulative impacts between the two sister projects will be assessed within the Norfolk Boreas EIA.

1396. Potential projects may include offshore wind farms, coastal defence projects (such as the Bacton sandscaping scheme) road or large infrastructure projects (including the dualling of the A47, Sizewell Nuclear Power Station and the Norwich Northern Distributor Road) which have a potential to act together with the construction, operation or decommissioning phases of Norfolk Boreas in a cumulative way. In particular, Vattenfall are committed to working with DONG Energy on identifying the potential interactions between the Norfolk Boreas and Norfolk Vanguard onshore cable corridor with the Hornsea Project 3 Offshore Wind Farm onshore cable route, and assessing and mitigating and cumulative effects.

1397. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Boreas in the context of other developments that are existing, consented or at application stage.

1398. Cumulative impacts as a result of the works required for Norfolk Boreas and Norfolk Vanguard at the Necton National Grid Substation will be included as part of this assessment.

1399. Table 3.38 collates the scoping of onshore cumulative impacts discussed in Sections 3.2 to 3.11.

Table 3.38 Summary of onshore cumulative impacts

Potential impacts	Construction	Operation	Decommissioning
Ground Conditions and Contamination	✓	✓	✓
Air Quality	✓	x	✓
Water Resources and Flood Risk	✓	✓	✓
Land Use	✓	✓	✓
Onshore Ecology	✓	✓	✓
Onshore Ornithology	✓	✓	✓
Onshore Archaeology and Cultural Heritage	✓	✓	✓
Onshore Noise and Vibration	✓	✓	✓
Traffic and Transport	✓	x	✓
Health	✓	✓	✓

Scoped in (✓) and scoped out (x)

4 PART 4: WIDER SCHEME ASPECTS

4.1 Introduction

1400. The onshore project design has been jointly developed for both Norfolk Vanguard and Norfolk Boreas through a process of constraints mapping, informed by desk based research, and consultation (Section 1.2 provides further detail). This process has therefore been informed by the Scoping Process and Evidence Plan Process (EPP) for Norfolk Vanguard and the following chapters are informed by the Scoping Opinion and the EPP Method Statements for that project.

4.1.1 Worst case scenario for onshore infrastructure

1401. Worst case scenarios will be developed and agreed through the EPP for Norfolk Boreas and updated for the PEIR.

1402. Details of the current project description are provided in Section 1.5. The potential impacts discussed below are based on a worst case scenario that all works for Norfolk Boreas are completed during the construction of Norfolk Boreas (Scenario 2, Section 1.5.4). Under this scenario, impacts would potentially occur for the following:

- HDD at landfall;
- Trenchless techniques (including HDD and micro-siting) at sensitive locations;
- Construction of cable relay station (if required);
- Construction of the onshore project substation;
- Trenching along the onshore cable corridor, installation of ducts and pull through of cables;
- Creation of jointing pits;
- Creation of temporary haul road;
- Creation of mobilisation zones;
- Extension to the National Grid substation;
- Modification of the overhead power lines; and
- Planting and landscaping schemes.

1403. Should the Norfolk Vanguard project include works for Norfolk Boreas (Scenario 1), the potential construction impacts for the majority of receptors would be less than the worst case scenario presented here. The ES will contain an assessment of impacts against both scenarios for all receptors.

4.1.2 Definition of the onshore scoping area

1404. The Norfolk Boreas, onshore scoping area (Section 1.1.4) includes the footprint of all onshore infrastructure as well as an area 250m around temporary infrastructure and 500m around permanent infrastructure, to allow for receptor identification and the undertaking of environmental surveys. In line with best practice and standard guidelines, the following chapters may identify and describe a different scoping area relevant to their particular potential issues.

4.1.3 Data sharing between Norfolk Vanguard and Norfolk Boreas

1405. As much of the footprint of the onshore construction works is shared between Norfolk Boreas and its sister project, Norfolk Vanguard, much of the data gathering and surveys undertaken for Norfolk Vanguard will be directly relevant to Norfolk Boreas and will therefore be shared across the two projects. Additional data collection may be required at non shared locations, such as at access routes or mobilisation zones specific to the construction of Norfolk Boreas.

4.1.4 Questions

1406. The following questions are suggested for consideration while reviewing each onshore section and providing responses for inclusion in the Scoping Opinion:

We have taken account of the Norfolk Vanguard Scoping Opinion within this scoping report, however if you have any further responses to the questions below we would be very grateful to receive them.

Q1. Please tell us about further data sources that could be reviewed as part of the site characterisation for each topic?

Q2. Tell us about any other relevant potential impacts for each topic?

Q3. Please tell us whether you believe that that the data collected in 2017 as described in this section will be relevant and suitable to the Norfolk Boreas EIA.

Q4. Do you agree with the potential impacts that have been scoped out for each topic? If not, please provide details.

Q5. Have the relevant potential cumulative impacts been identified? If not, please provide details

Q6. Do you agree the proposed approach to assessing each impact is appropriate? If not, please provide details.

Q7. Is there any further guidance relating to each topic that we should be aware of? Please provide any detail.

4.2 Landscape and visual

4.2.1 Baseline

4.2.1.1 Study areas for landscape and visual impact assessment (LVIA)

1407. The onshore scoping area is shown in Figure 1.2. The study areas for the LVIA will differ from the onshore scoping area. '*Guidelines for Landscape and Visual Impact Assessment Third Edition*' (GLVIA3) provides the following guidance; '*The study area should include the site itself and the full extent of the wider landscape around it which the proposed development may influence in a significant manner.*' GLVIA3 requires that the study area be agreed with the competent authority, albeit with recognition that the study area may change through the course of a project in response to findings of fieldwork or changes in the project description.

1408. In line with this guidance, the indicative extent of the study areas is presented as part of this Scoping Report, with the aim that these be reviewed through the consultation process and amended where and when necessary.

1409. The following factors can be applied to define the appropriate extent of the study areas;

- The extent of study areas agreed for the LVIAs of similar developments;
- Feedback presented in the Scoping Opinion for Norfolk Boreas' sister project, Norfolk Vanguard;
- The extent of theoretical visibility as indicated by Zone of Theoretical Visibility (ZTV) mapping;
- The extent of actual visibility as verified through fieldwork; and
- The scale of the construction and decommissioning works and the scale of the components during the operational phase.

1410. In the East Anglia THREE ES (EATL 2015) a 5km radius was applied around the site of the substation and a 500m extent on either side of the centre line of the onshore cable route and landfall. A cable relay station did not form part of this proposal.

1411. An Environmental Impact Assessment Scoping Report was produced for Norfolk Vanguard in October 2016 (Royal HaskoningDHV, 2016a), and in the subsequent Scoping Opinion comment was made by the Secretary of State in respect of using ZTV mapping to inform the extent of the study area. The Scoping Opinion requested a clear justification for the definition of the study areas, specifically asking that the onshore cable route study area be measured from the outer edge of the working width and not the centre line.

1412. While ZTV mapping will provide a useful tool in the refinement of the study areas, the relatively flat and low-lying nature of the landform will mean that theoretical visibility will be notably more extensive than actual visibility, particularly in relation to low components of the onshore infrastructure. This is largely due to the extent of woodland and hedgerows (which are not taken into consideration with ZTV mapping) throughout the rural landscape which will screen visibility from parts of the surrounding landscape receptors and many of the surrounding visual receptors. Fieldwork will be required to verify actual visibility and this will be carried out in the course of the EIA for the project.

1413. From the Project Description of Norfolk Boreas presented in Section 1.5, the works undertaken so far for Norfolk Boreas and the ES's of similar offshore wind farm developments in the region, the relative scale of the construction and decommissioning works can be ascertained, as well as the scale of the components which would have a presence during the operational phase. This information helps to define the appropriate extent of the study areas. The scale of works and associated infrastructure with the landfall and onshore cable route would be notably smaller than those associated with the substation and, to a lesser extent, the cable relay station. The study area also reflects the three options for the landfall site, seven options for the cable relay station site and location options within the substation search zone.

1414. Taking all these factors into consideration, indicative study areas for the onshore components would be a 5km radius around each substation site, a 3km radius around the cable relay station sites, a 1km radius around the landfall sites and 500m either side of the onshore cable route (beyond the outer edge of the working width).

4.2.1.2 Scope of landscape assessment

1415. The assessment of effects on landscape will consider the effects on landscape elements, effects on landscape character and effects on landscape planning designations.

4.2.1.3 Landscape elements

1416. The physical effects on landscape elements, are the direct effects on the site, such as the removal of vegetation to facilitate construction of the onshore infrastructure. Physical effects are found only on the site, where existing landscape elements may be removed or altered by Norfolk Boreas. The LVIA will consider the effects of the Norfolk Boreas on the removal of hedgerows, tree cover, agricultural land and other types of land cover. The LVIA will refer to the findings of the ecological assessment.

4.2.1.4 Landscape character

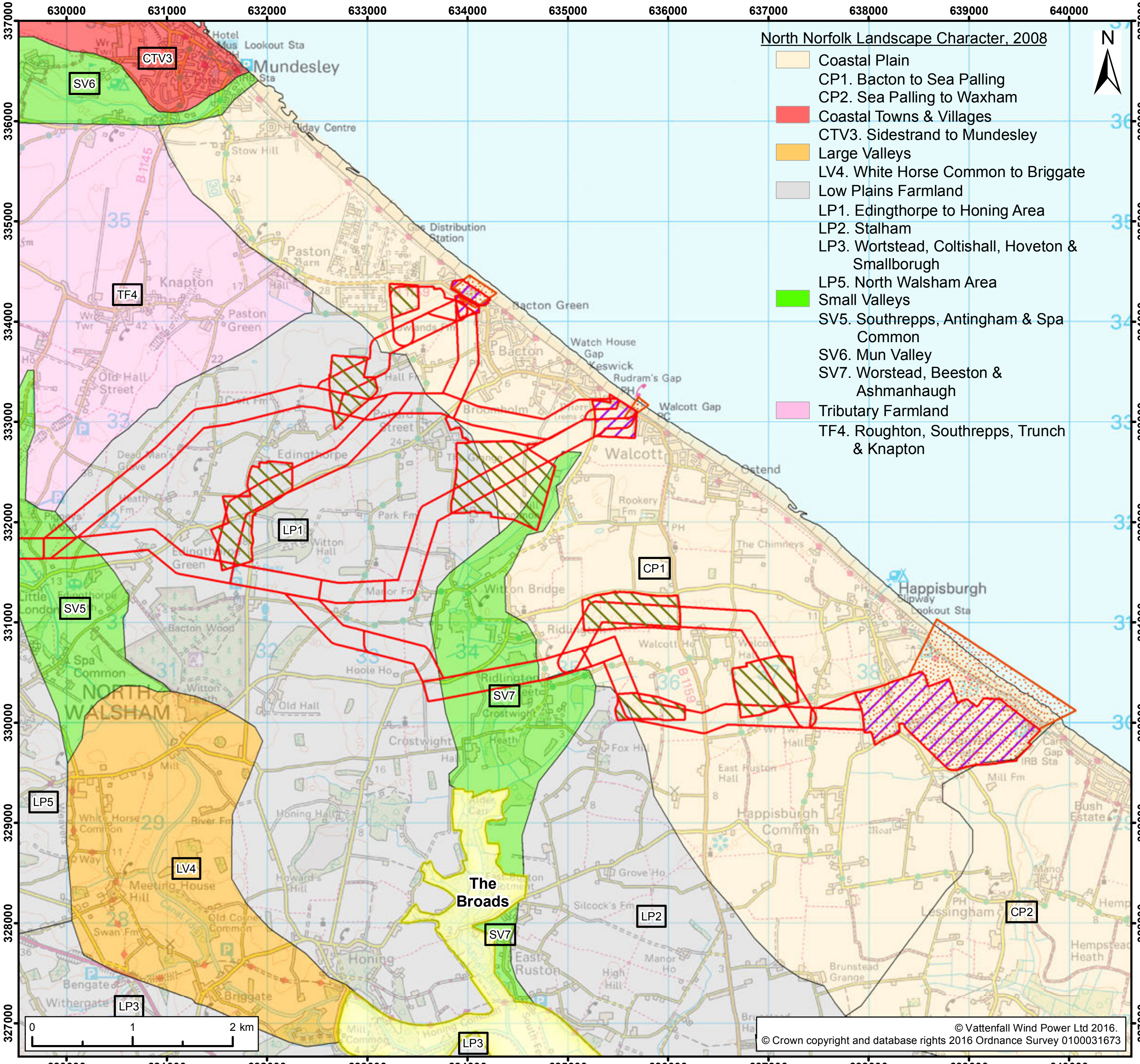
1417. The relevant Landscape Character Assessments which cover the onshore study area are as follows:

- North Norfolk Landscape Character Assessment (2009);
- Broadland Landscape Character Assessment (2013); and
- Breckland Landscape Character Assessment (2007).

1418. These documents classify the different Landscape Character Types (LCTs) in each area. They describe the landform, hydrology, land cover and land uses that combine to characterise each LCT. As LCTs often occur more than once, the sub-areas are referred to as Local Landscape Character Areas (LLCAs) and typically given a specific geographic prefix. The LCAs will be used as the basis of the assessment of effects on landscape character, supplemented with information collected during fieldwork.

1419. The distribution of the LLCAs within the potential study areas of the onshore infrastructure is shown in Figure 4.1 and Figure 4.2. This shows that the coastal LLCAs relating to the landfall and cable relay station search zone would include *Coastal Plain, Low Plains Farmland* and *Small Valleys*, and the inland LLCAs relating to the substation zone would include *Settled Tributary Farmland* and *Plateau Farmland*.

1420. The assessment will prepare a baseline assessment of the relevant LLCAs and assess the potential impacts of the onshore infrastructure on these LLCAs as landscape receptors.



Legend:

Norfolk Vanguard Onshore Infrastructure

- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Cable Relay Station Zone
- Landfall Zone
- National Park [1]

[1] Natural England, 2016

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title: Local Landscape Character Areas - Landfall/ Cable Relay Station

Figure: 4.1 Drawing No: PB5640-102-051

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	21/02/17	TH	JP	A4	1:55,000

Co-ordinate System: British National Grid **EPSG:** 27700

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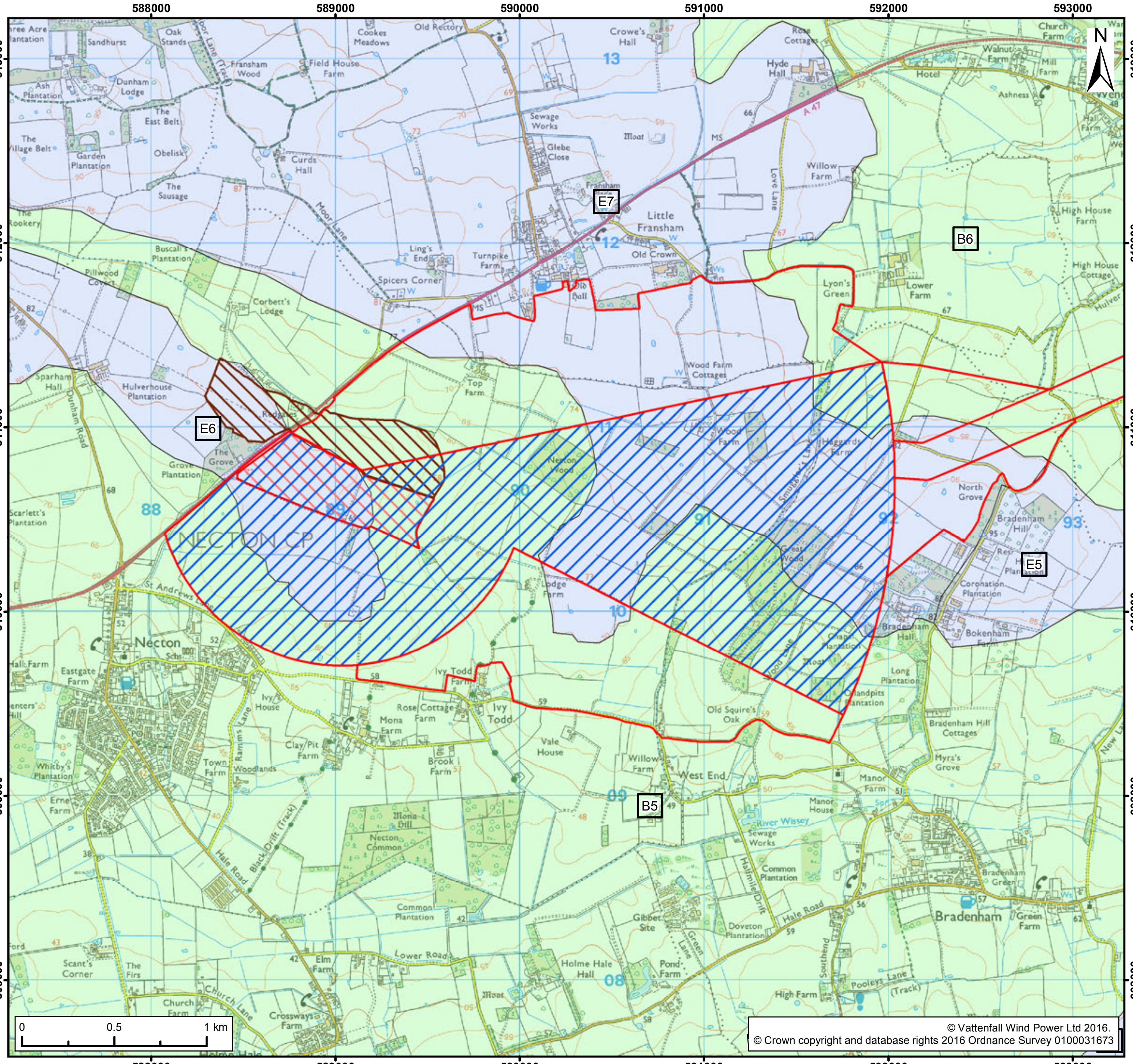

Legend:

Norfolk Vanguard Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor

Breckland Landscape Character, 2007

- Settled Tributary Farmland
  - B5. River Wissey Tributary Farmland
  - B6. River Wensum & Tud Tributary Farmland
- Plateau Farmland
  - E5. Central Breckland Plateau
  - E6. North Pickenham Plateau
  - E7. Beeston Plateau

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Local Landscape Character Areas - Substation

Figure: 4.2 Drawing No: PB5640-102-052

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	21/02/17	TH	JP	A4	1:30,000

Co-ordinate System: British National Grid **EPSG:** 27700

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4.2.1.5 Landscape designations

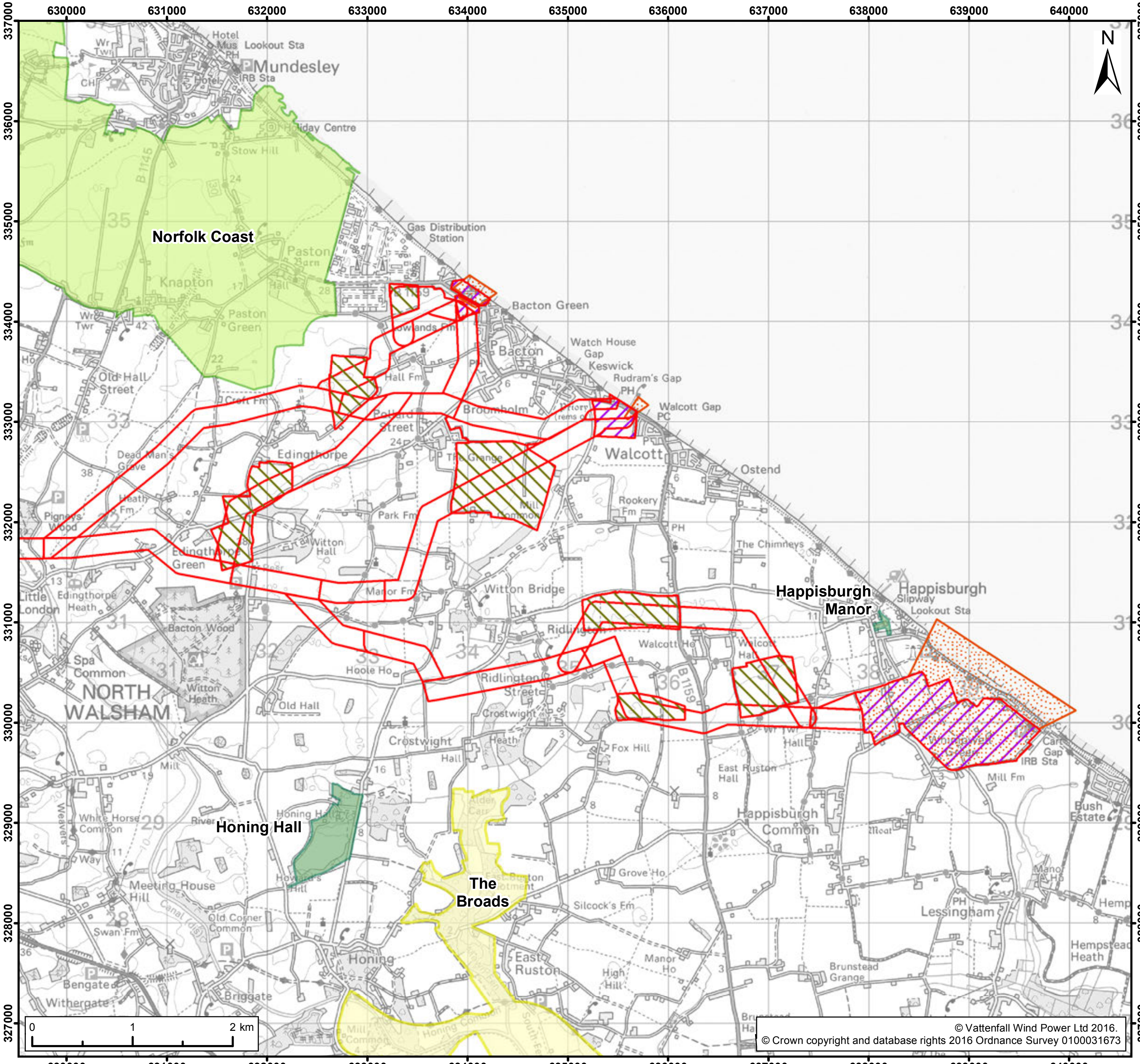
1421. There are three types of landscape designation which are of relevance to the LVIA.

- Areas of Outstanding National Beauty (AONBs);
- National Parks (NPs); and
- Registered Parks and Gardens.

1422. The distribution of the landscape designations within the potential study areas of the onshore infrastructure is shown in Figure 4.3 and Figure 4.4 although no landscape designations occur in the substation study area.

1423. AONBs are designated by Natural England and collectively represented by the National Association for AONBs. In general, they remain the responsibility of the local authority by means of a special committee and a dedicated AONB Officer. Their purpose is to conserve and enhance the natural beauty of the landscape. NPPF (2012) states that AONBs have the same status as NPs in the planning system when it comes to landscape issues. Management plans set out the key issues and strategy for conservation and enhancement.

1424. The Norfolk Coast AONB is the only AONB in the study area. It lies to the north of the landfall zone. The 2014-2019 Norfolk Coast AONB Management Plan sets out the special qualities of this area, along with the strategy for its protection. The potential impacts on the special qualities of the Norfolk Coast AONB will be considered in the assessment.



Legend:

Norfolk Vanguard Onshore Infrastructure

- Onshore Cable Corridors
- Horizontal Directional Drilling (HDD) Zone
- Cable Relay Station Zone
- Landfall Zone
- National Park [1]
- Registered Park and Garden [2]
- Area of Outstanding Natural Beauty (AONB) [1]

[1] Natural England, 2016

[2] English Heritage, 2016

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title: Landscape Designations - Landfall/Cable Relay Station

Figure: 4.3 Drawing No: PB5640-102-053

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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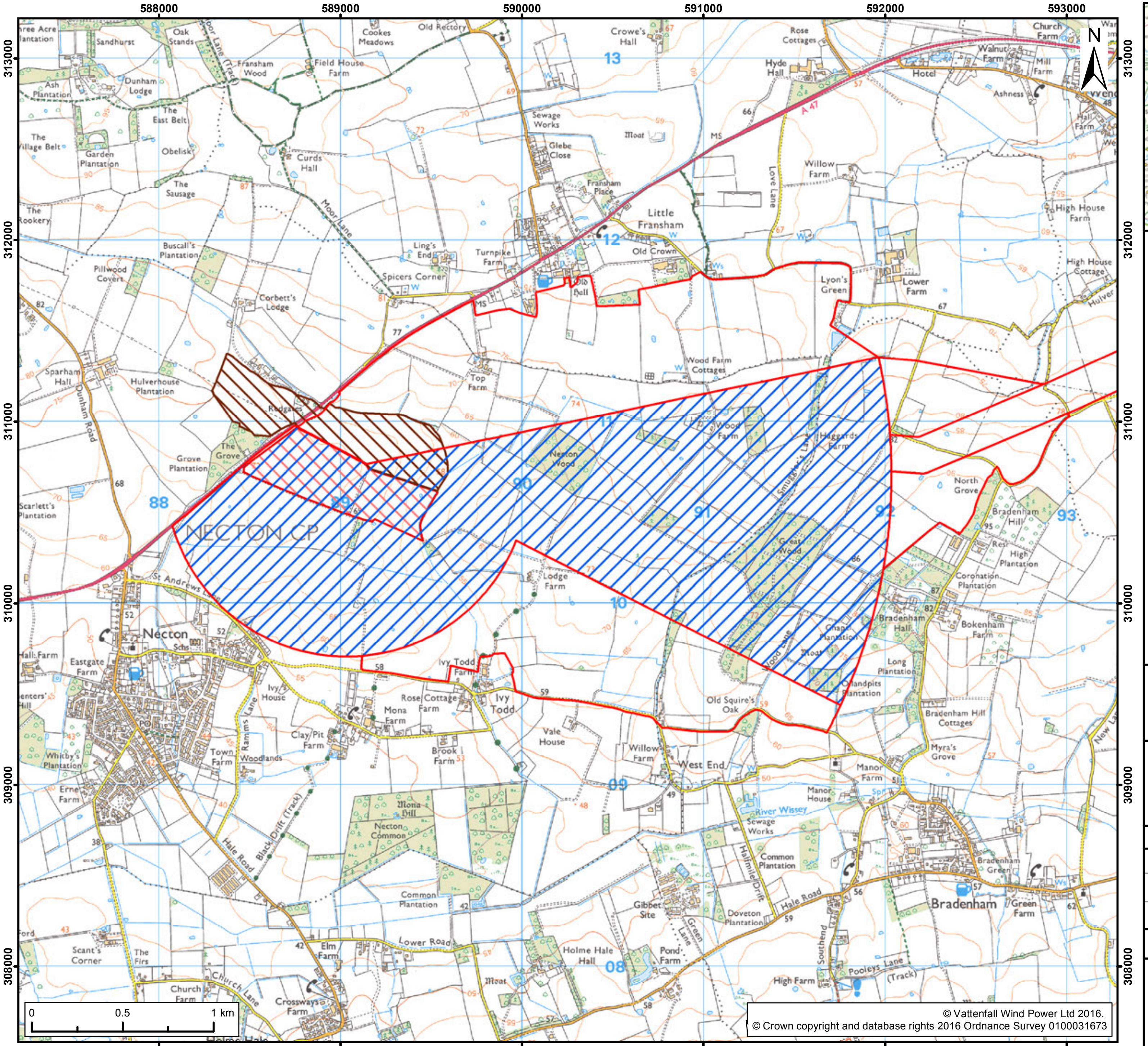

Legend:

Norfolk Vanguard Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor

Note:
No landscape designations are found within the substation search zone

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Landscape Designations - Substation

Figure: 4.4 | Drawing No: PB5640-102-054

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	21/02/17	TH	JP	A4	1:30,000

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1425. National Parks (NPs) are managed by National Park Authorities whose role is to carry out the two main objectives:

- To conserve and enhance the natural beauty, wildlife and cultural heritage of the area; and
- To promote opportunities for the understanding and enjoyment of the parks' special qualities by the public.

1426. The only NP in the study area is The Broads, which lies to the immediate south of the landfall zone. The Broads differs from the other NPs in that it was set up by the separately constituted Broads Authority enabled by a special act of parliament. The potential impacts on the special qualities of The Broads NP will be considered in the assessment.

1427. The Register of Parks and Gardens is compiled and managed by Historic England. It presents an inventory of all the protected sites in England and Wales. These are of national significance, and most are associated with stately homes, although many parks or cemeteries are also listed.

1428. There are two registered Parks and Gardens in the study areas associated with the landfall and cable relay station zones, namely Happisburgh Manor and Honing Hall. There are none in the study area associated with the substation zone. The onshore cable corridor also passes close to Blickling Estate. The potential impacts on the landscape character of the registered Parks and Gardens will be considered in the assessment.

4.2.1.6 Scope of visual assessment

1429. The assessment of effects on visual amenity and will consider the effects on principal visual receptors and effects on representative viewpoints.

4.2.1.7 Principal visual receptors

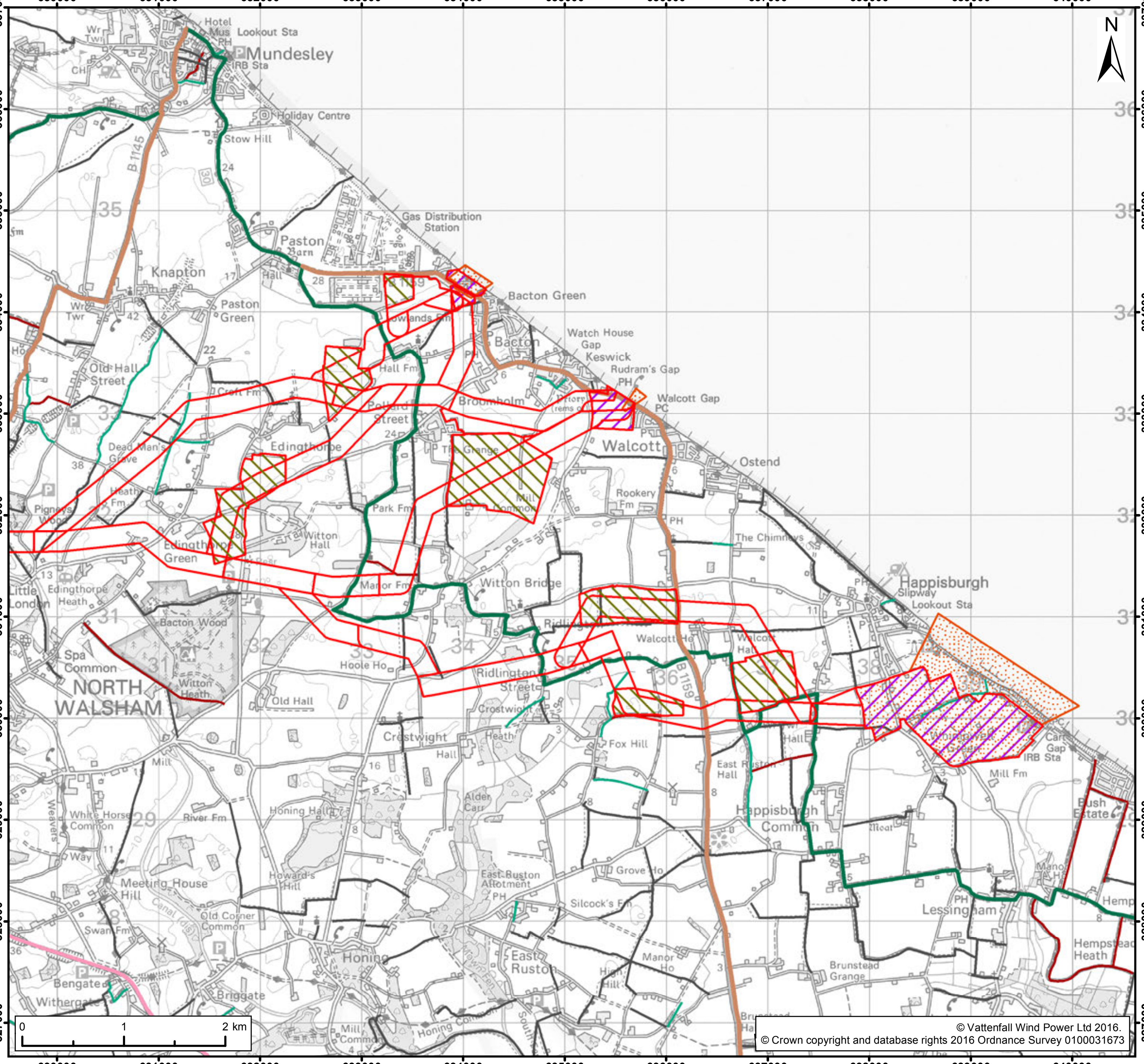
1430. The study areas associated with Norfolk Boreas cover a coastal and rural landscape in which agriculture is the predominant land use, but in which also settlements and roads are evident. Settlements are typically small in scale, occurring as villages and towns along the Norfolk coast, and then more intermittently across the landward landscape, with a finer network of small clusters of properties and isolated farmsteads characterising the rural area.

1431. In respect of the landfall zone, the principal visual receptors would include the coastal settlements of Bacton, Walcott and Happisburgh. The extent to which these settlements would be affected would depend on their proximity to the final site selected. There would also be the potential for impact on road-users of the rural roads which access the coastline and walkers on rural PRoWs, including the Norfolk Coast Path.

1432. The cable relay station zone and onshore cable route would have the potential to impact on the small settlements, minor roads and PRoWs that occur across the rural landscape, as well as the A and B class roads which occur more intermittently. The principal visual receptors associated with the cable relay station zone include the settlements of Bacton, Walcott, Happisburgh, Eccles-on-Sea, Pollard Street, Riddlington and Happisburgh Common, as well as the B1159 and network of surrounding minor roads and PRoWs, which are shown in Figure 4.5.

1433. In respect of the onshore project substation and works at the National Grid, the principal visual receptors would be road-users on the A47, the main trunk road between Peterborough and Great Yarmouth via Norwich, and the residents of the villages and smaller settlements within the substation zone, in particular nearby Necton. Within the surrounding rural landscape, the potential impacts on residents, road-users, workers, walkers and horse-riders would also be considered. The principal visual receptors associated with the substation zone are shown in Figure 4.6.

1434. The LVIA would include a baseline assessment of the relevant principal visual receptors and assess the potential impacts of the onshore infrastructure in respect of the different types of viewers.



Legend:

Norfolk Vanguard Onshore Infrastructure

- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Cable Relay Station Zone
- Landfall Zone
- A Road
- B Road
- National Cycle Route 30: Norfolk Coast Cycleway [1]
- Bridleway [2]
- Footpath [2]
- Restricted Byway [2]

[1] Sustrans UK National Cycle Routes Dataset, 2016
[2] Norfolk County Council, 2016

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Visual Receptors - Landfall/Cable Relay Station

Figure: 4.5 Drawing No: PB5640-102-055

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01	21/02/17	TH	JP	A4	1:55,000

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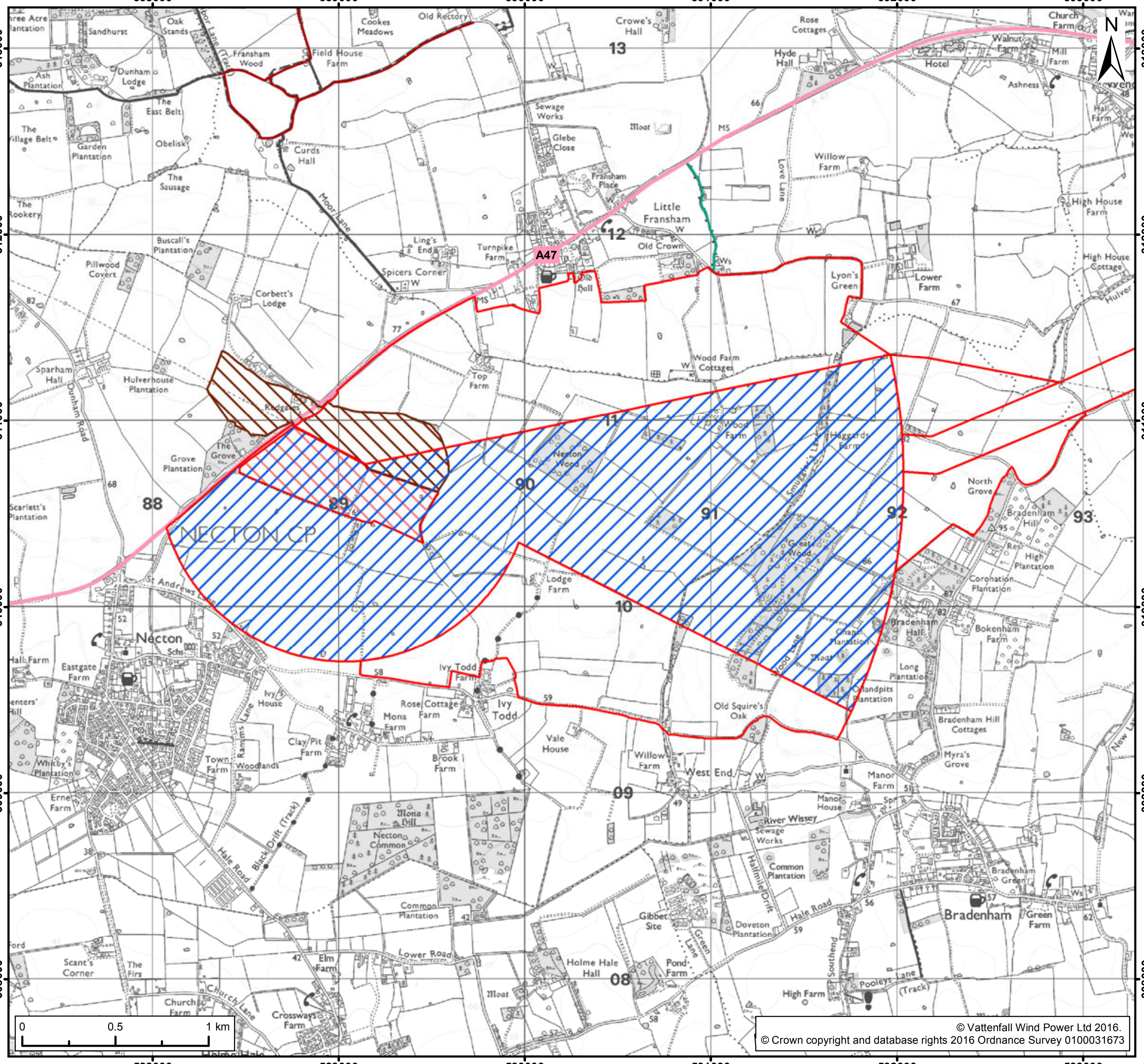

Legend:

Norfolk Vanguard Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- A Road
- Bridleway [1]
- Footpath [1]
- Restricted Byway [1]

[1] Norfolk County Council, 2016

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Visual Receptors - Substation

Figure: 4.6 Drawing No: PB5640-102-056

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	21/02/17	TH	JP	A4	1:30,000

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4.2.1.8 Viewpoints

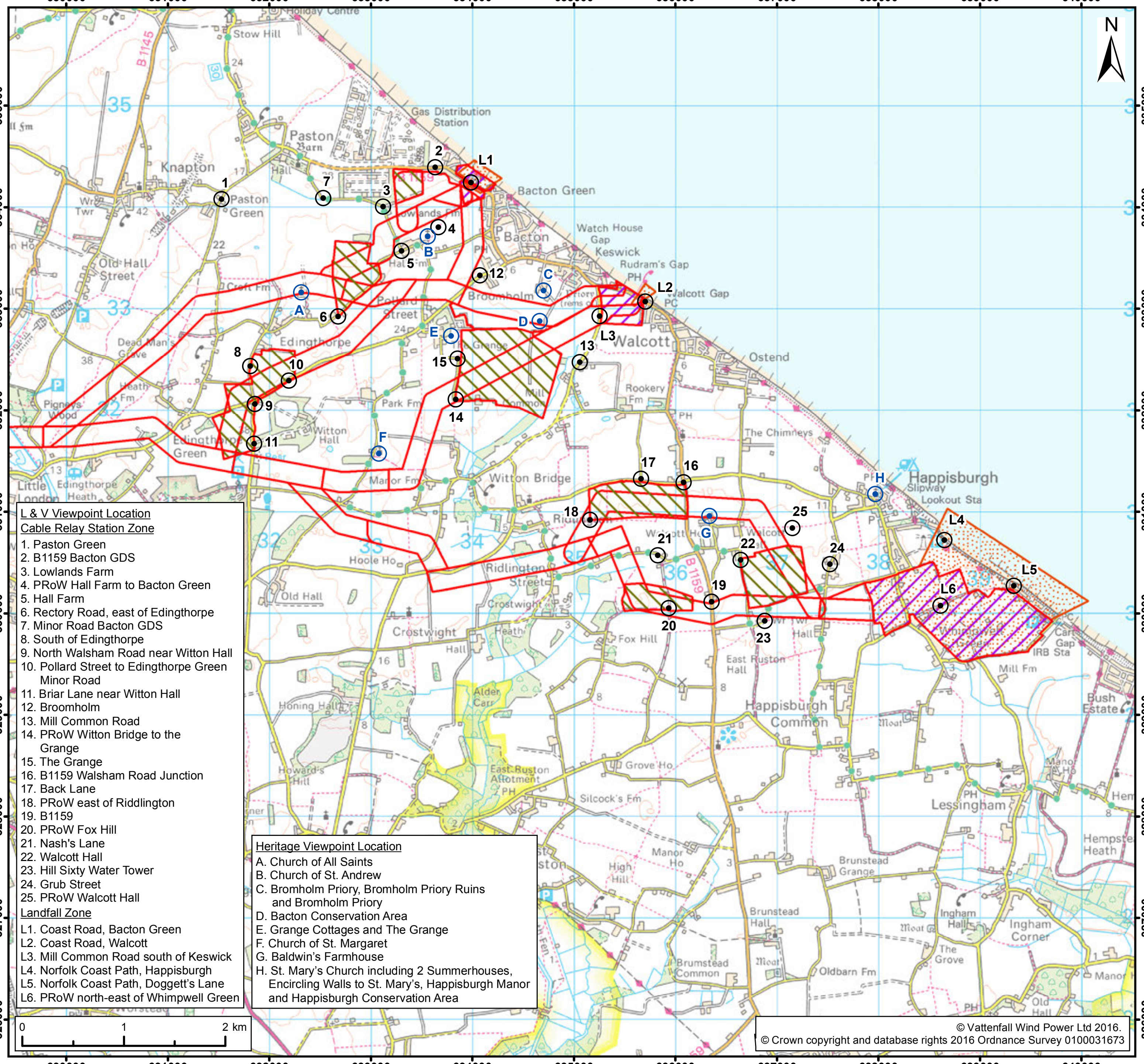
1435. A preliminary viewpoint list is shown in Table 4.1 below. The locations of the viewpoints are shown in Figure 4.7 and Figure 4.8. This list has been compiled to represent sensitive visual receptors with the potential to undergo significant effects. It has been based on an understanding of the potential visual effects of the proposed onshore infrastructure, coupled with a knowledge of potential viewpoints gained through fieldwork. It ensures that all seven potential sites in the cable relay station zone, and the substation zone are fully represented in the assessment. The viewpoints will also be used to inform the landscape assessment and cumulative assessment. The final list will be established through the scoping process and in agreement with the statutory consultees.

1436. The LVIA would include a baseline assessment of the agreed viewpoints and assess the potential impacts of the onshore infrastructure on these in respect of the different types of viewers.

Table 4.1 Indicative Viewpoint List for Cable Relay Station Zone

Representative Viewpoints for Cable Relay Station Zone	Onshore Infrastructure	Representative
1. Paston Green	Cable relay station 2	Road-users on minor road Residents in rural properties (Norfolk AONB)
2. B1159 east of Bacton GDS	Cable relay station 1	Road-users on B1159 Residents on N edge of Bacton Green
3. Minor road near Lowlands Farm	Cable relay station 1 and 2	Road-users on minor road Residents at Lowlands Farm
4. PRoW Hall Farm to Bacton Green	Cable relay station 1	Walkers on PRoW
5. Hall Farm	Cable relay station 2	Road-users on minor road Residents at Hall Farm
6. Rectory Road east of Edingthorpe	Cable relay station 2	Road-users on minor road Residents in rural properties
7. Minor road south-west of Bacton GDS	Cable relay station 2	Road-users on minor road
8. Minor road south of Edingthorpe	Cable relay station 3	Road-users on minor road
9. North Walsham Road junction	Cable relay station 3	Road-users on minor road
10. North Walsham Road north of Witton Hall	Cable relay station 3	Road-users on minor road
11. Briar Lane near Witton Hall	Cable relay station 3	Road-users on minor road
12. Broomholm	Cable relay station 4	Road-users on minor road Residents in rural properties

Representative Viewpoints for Cable Relay Station Zone	Onshore Infrastructure	Representative
13. Mill Common Road	Cable relay station 4	Road-users on minor road Residents in rural properties
14. PRoW Witton Bridge to The Grange	Cable relay station 4	Walkers on PRoW
15. The Grange	Cable relay station 4	Road-users on minor road Residents in rural properties
16. B1159 / North Walsham Road Junction	Cable relay station 5	Road-users on minor road Residents in rural properties
17. Back Lane / North Walsham Road Junction	Cable relay station 5	Road-users on minor road
18. PRoW east of Ridlington	Cable relay station 5	Walkers on PRoW
19. B1159 north of Hall Lane junction	Cable relay station 6	Road-users on minor road Residents in rural properties
20. PRoW Munn's Lane	Cable relay station 6	Walkers on PRoW
21. Nash's Lane west of B1159	Cable relay station 5 and 6	Road-users on minor road Residents in rural properties
22. Walcott Hall	Cable relay station 7	Road-users on minor road Residents in rural properties
23. Hill Sixty Water Tower	Cable relay station 7	Road-users on minor road Residents in rural properties
24. Grub Street	Cable relay station 7	Road-users on minor road Residents in rural properties
25. PRoW Walcott Hall to Happisburgh	Cable relay station 7	Walkers on PRoW



Legend:

Norfolk Vanguard Onshore Infrastructure

- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Cable Relay Station Zone
- Landfall Zone
- Heritage Viewpoint Location
- L&V Viewpoint Location

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title: Viewpoint Locations - Landfall/Cable Relay Station

Figure: 4.7 Drawing No: PB5640-102-057

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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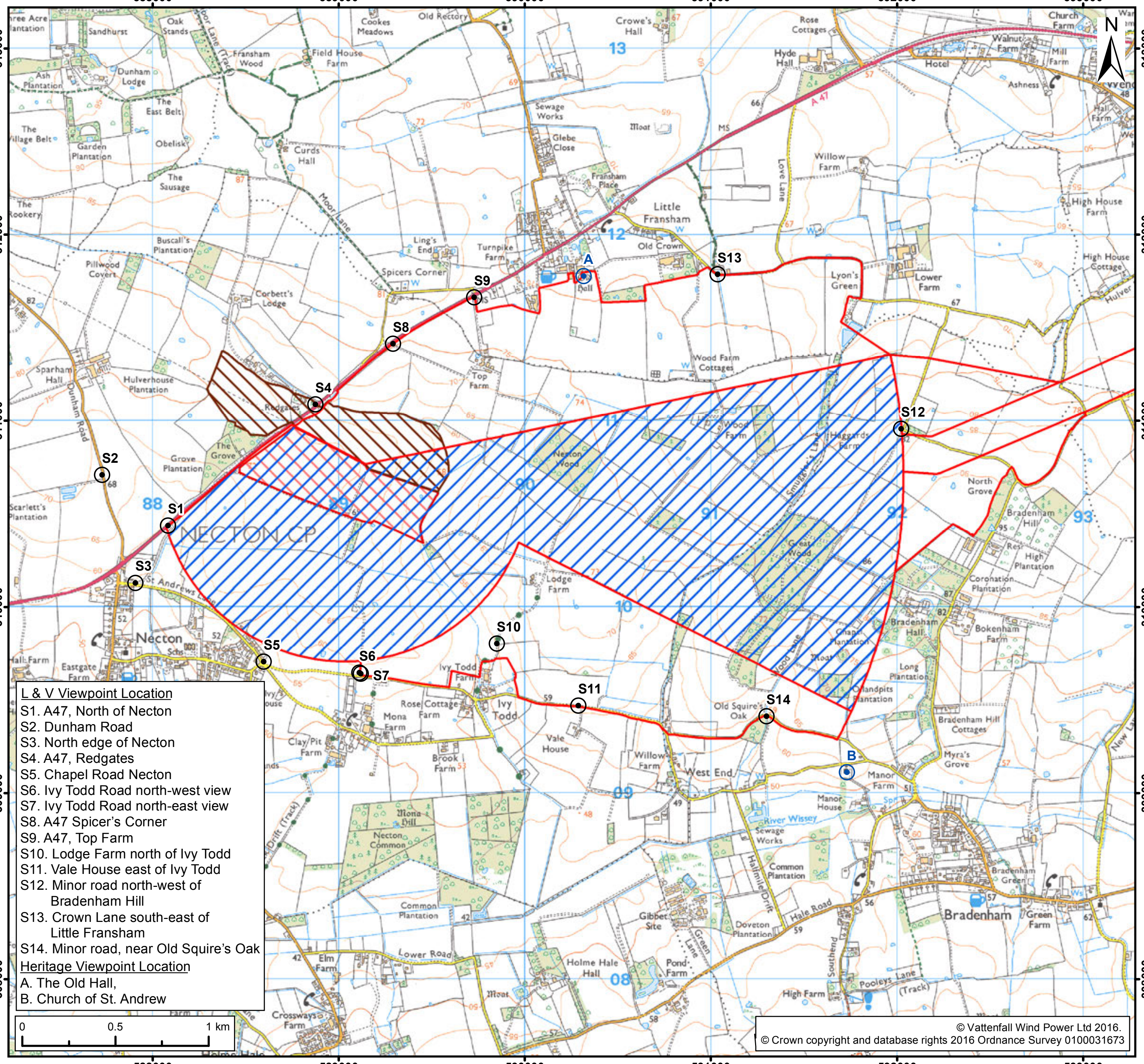

Legend:

Norfolk Vanguard Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- Heritage Viewpoint Location
- L & V Viewpoint Location

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Viewpoint Location - Substation

Figure: 4.8 | Drawing No: PB5640-102 -058

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	21/02/17	TH	JP	A4	1:30,000

Co-ordinate System: British National Grid **EPSG:** 27700

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Table 4.2 Indicative Viewpoint List for Landfall Zone

Representative Viewpoints for Landfall Zone	Onshore Infrastructure	Representative
L1. Coast Road, Bacton Green	Bacton landfall	Road-users on minor road Residents on north edge of Bacton Green
L2. Coast Road, Walcott	Walcott landfall	Road-users on B1159 Residents on N edge of Bacton Green
L3. Mill Common Road south of Keswick	Walcott landfall	Road-users on minor road Residents at Lowlands Farm
L4. Norfolk Coast Path, Happisburgh	Happisburgh landfall	Walkers on PRoW
L5. Norfolk Coast Path, Doggett's Lane	Happisburgh landfall	Road-users on minor road Residents at Hall Farm
L6. PRoW north-east of Whimpwell Green	Happisburgh landfall	Road-users on minor road Residents in rural properties

Table 4.3 Indicative Viewpoint List for Substation Zone

Representative Viewpoints for Substation Zone	Onshore Infrastructure	Representative
S1. A47 north of Necton	Substation Zone National Grid Substation Extension Zone Overhead Line Modification Zone	Road-users on A47
S2. Dunham Road	Substation Zone National Grid Substation Extension Zone Overhead Line Modification Zone	Road-users on minor road
S3. North edge of Necton	Substation Zone National Grid Substation Extension Zone Overhead Line Modification Zone	Road-users on minor road Residents on north edge of Necton
S4. A47 Redgates	Substation Zone National Grid Substation Extension Zone Overhead Line Modification Zone	Road-users on A47
S5. Chapel Road, Necton	Substation Zone National Grid Substation Extension Zone Overhead Line Modification Zone	Road-users on minor road Residents on north-east edge of Necton
S6. Ivy Todd Road north-west view	Substation Zone National Grid Substation Extension Zone Overhead Line Modification Zone	Road-users on minor road Residents in rural properties
S7. Ivy Todd Road north-east view	Substation Zone National Grid Substation Extension Zone Overhead Line Modification Zone	Road-users on minor road Residents in rural properties

Representative Viewpoints for Substation Zone	Onshore Infrastructure	Representative
S8. A47 Spicer's Corner	Substation Zone National Grid Substation Extension Zone Overhead Line Modification Zone	Road-users on A47
S9. A47 Top Farm	Substation Zone National Grid Substation Extension Zone Overhead Line Modification Zone	Road-users on A47 Residents in rural properties
S10. Lodge Farm north of Ivy Todd	Substation Zone National Grid Substation Extension Zone Overhead Line Modification Zone	Walkers on PRoW Residents in rural properties
S11. Vale House east of Ivy Todd	Substation Zone National Grid Substation Extension Zone Overhead Line Modification Zone	Road-users on minor road Residents in rural properties
S12. Minor road north-west of Bradenham Hill	Substation Zone National Grid Substation Extension Zone Overhead Line Modification Zone	Road-users on minor road
S13. Crown Lane south-east of Little Fransham	Substation Zone National Grid Substation Extension Zone Overhead Line Modification Zone	Road-users on minor road Residents on south-east edge of Little Fransham
S14.Minor road, near Old Squire's Oak	Substation Zone National Grid Substation Extension Zone Overhead Line Modification Zone	Road users on minor road

4.2.2 Potential impacts

4.2.2.1 Potential offshore impacts

1437. This scoping report proposes that the offshore impacts of Norfolk Boreas be scoped out of the LVIA. The Scoping Report produced for Norfolk Vanguard (Royal HaskoningDHV, 2016a), proposed this approach which was accepted through the Scoping Opinion response made by the Secretary of State, except for the requirement to include consideration of the effect of construction vessels on the visual amenity of the coastline during the construction period. The reasoning behind this approach is presented below.

1438. The potential for significant impacts to arise in respect of the offshore components during construction, operation and decommissioning would be limited by the distance of the offshore wind farm sites from onshore landscape and visual receptors which, in turn, would limit the magnitude of change. '*Guidance on the Assessment of the Impact of Offshore Wind Farms*' produced by the Department for Trade and Industry (DTI) in 2005 identifies the limit of visual significance of an offshore wind farm to be 35km. The guidance also considers the visual influence of navigational lighting associated with the offshore turbines to be contained within relatively short distances.

1439. The UK Offshore Energy SEA3 states '*Reflecting the previous conclusions and recommendations of OESEA and OESEA2, and the relative sensitivity of multiple receptors in coastal waters, OESEA3 recommends that the bulk of new OWF generation capacity should be sited away from the coast, generally outside 12 nautical miles.'*

1440. As Norfolk Boreas would be located an approximate distance of 72km (closest point) from the coast, this would be more than double the 35km limit of visual significance identified in DTI guidance and more than three times the recommended distance in OESEA3. Although there is a theoretical possibility that blade tips may be visible from elevated points onshore, the actual possibility is extremely remote considering the very small scale of the tips seen from a range of 72km and beyond. The offshore wind farm would have a negligible impact on onshore receptors and therefore these potential impacts would not be assessed in the LVIA.

1441. It is proposed that the potential impacts of construction, operation and decommissioning of the offshore wind farm on offshore receptors should also be scoped out from further consideration within the EIA. There would be few receptors with potential to undergo impacts other than seascape character areas, and sailors and passengers of water-borne vessels. The relative sensitivity of the seascape character areas would be limited and the views of sailors and passengers would be temporary and relatively short in duration. There is already an influence on the seascape character from the existing features of the nearby gas rigs and their service vessels. In Figure 2.16, a cluster of gas rigs is shown located to the north west of the offshore wind farm sites, with some along the western boundary and some on the site.

1442. The additional vessel traffic generated by Norfolk Vanguard would occur in the context of one of the busiest shipping channels between south east England and mainland Europe. Flood-lighting during construction and decommissioning, and navigational lighting during the operation of the OWF sites would have a negligible impact on onshore receptors owing to a combination of the distance of 72km between the coast and the offshore wind farm and the curvature of the earth over this distance.

1443. Therefore, it is considered unlikely that significant effects would arise. This would be consistent with the findings and approach set out in the East Anglia THREE ES (EATL, 2015) in which no significant effects were identified in respect of the offshore components. East Anglia THREE is a similar scale of project, within a similar coastal environment and receptors to Norfolk Boreas and has recently completed its examination.

1444. There would be potential temporary impacts relating to the presence of vessels associated with the construction of offshore cables close to the coast. These potential impacts would be assessed in respect of onshore and coastal receptors.

4.2.2.2 Potential onshore impacts

1445. The potential impacts of the onshore infrastructure are based on a combination of information contained in Section 1.5 and knowledge of the study area through fieldwork. The Project Description contains information which is fixed, and information which is variable. The latter gives rise to a degree of uncertainty in terms of the final design and layout of Norfolk Boreas. To identify the potential impacts of Norfolk Boreas, it has been necessary to establish a series of potential scenarios which cover all potential variables.

1446. The following onshore infrastructure will be considered:

- Landfall employing HDD and associated compounds;
- Cable relay station if required (HVAC only) within the cable relay station search zones;
- Onshore cable corridor (with associated construction compounds and mobilisation zones);
- Onshore project substation (within the onshore project substation zone (see paragraph 31); and
- Extension to the existing Necton National Grid Substation, including overhead line modification.

1447. Two electrical solutions are being considered for Norfolk Boreas, a HVAC and a HVDC option. The decision as to which option would be used for the project would be made post consent and would depend on availability, technical considerations and cost. Both electrical solutions would have implications on the required onshore infrastructure and both will be considered in the LVIA.

1448. Two scenarios are to be assessed in respect of the construction of the Norfolk Boreas project onshore cable route, as discussed in Section 1.5.4.

1449. Other notable variables relate to the selection of the landfall site and cable relay station site. At this stage, the LVIA will consider three potential sites for the landfall and seven for the cable relay station and alternative linking cable routes between the two as shown in Figure 4.7, with refinement expected prior to the submission of the PEIR and DCO application.

4.2.2.3 Potential onshore impacts during construction

1450. Potential impacts during construction would relate to a combination of the emerging presence of the onshore infrastructure, the presence of the associated plant, materials and other temporary structures, and the activity associated with the construction process. Generally, the potential impacts associated with the larger components of the substation and the cable relay station would be greater than those associated with the predominantly underground components of the landfall and onshore cable route. Although the impacts of the latter would be over a much greater extent, the phasing of construction works would mean only sections would be affected at any one time and this would shorten the duration of the potential effect.

Landfall

1451. The Norfolk coastline is sensitive owing to the scarcity of the cliffs and the difficulty to implement restoration measures. Despite the limited depth of the cliffs, they are an important feature in the definition of the wider landscape character. The coast is visible from surrounding visual receptors where there is a lack of hedgerow or woodland enclosure. Where enclosure occurs and where the low-lying and level landform lacks elevated vantage points, visibility of the coast rapidly reduces with distance.

1452. While the construction works would be relatively small in scale, contained in extent short term and temporary, there is the potential that they would impact on the sensitive coastline, especially if access for construction plant is required onto the beach. There is also the potential that construction vessels associated with the landfall connection between the offshore and onshore cable route would have a short-term visual influence along the coastline over the course of construction works.

1453. The scale of the landfall in respect of the scale of the LLCAs means it would be unlikely to alter the character of the LLCA in which, and adjacent to which, the landfall would be located. The potential for the designated areas of the Norfolk Coast AONB, The Broads NP, Happisburgh Manor and Honing Hall designed landscapes could be affected, would be limited by the relatively low-lying level of the works and landfall components and the distance of the designated areas from the landfall zones. It is proposed that the effect of the landfall on landscape character and landscape designations should be scoped out from further consideration within the EIA.

1454. The visual receptors susceptible to potential impacts would include nearby residents of Bacton, Walcott or Happisburgh (depending on final site selection), pedestrians on the Norfolk Coast Path and other PRoW and public footpaths, road-users, including cyclists, on nearby residential and rural roads, and people spending time on the beach, all whose views have the potential to be affected. The value of these visual receptors combined with their susceptibility to Norfolk Boreas would be assessed to determine the overall sensitivity.

1455. Assessment will be made on site to determine the potential impact of the landfall, considering the size and extent of the layout and the construction processes that would be undertaken. Mapping showing the extent and layout of the landfall components, associated construction compound and access roads, would be considered on site to understand the potential magnitude of the influence on each landscape and visual receptor, considering the screening effect of existing built form, landform, vegetation and any proposed mitigation planting. This would be combined with the rating for sensitivity to determine the significance of the effect on each receptor.

Cable relay station

1456. A cable relay station would be required for the HVAC but not for the HVDC option. It is envisaged that the cable relay station for Norfolk Boreas would be located in one of seven potential zones, possibly co-located with the cable relay station for Norfolk Vanguard. The cable relay station would primarily comprise an outdoor compound of up to 150m by 75m, encompassing reactors and with an indicative maximum height of 8m.

1457. The cable relay station would be located in the hinterland to the Norfolk coast. The potential impact of the construction of the cable relay station would relate to the extent of the site, the emerging presence of the electrical equipment, the scale of the equipment, the construction of an access road into the site and the general activity and presence of plant on the site as well as storage of materials, provision of welfare buildings and vehicular parking.

1458. The scale of the cable relay station (150m x 75m in footprint, 8m in height) in respect of the scale of the LLCAs means it would be unlikely to alter the character of the LLCA in which, and adjacent to which, the cable relay station would be located. Similarly, it would be unlikely for the cable relay station to alter the character of the designated landscapes, including Norfolk Coast AONB, The Broads NP, Happisburgh Manor and Honing Hall owing to their separation distance from the cable relay station sites. It is proposed that the effects of the cable relay station on landscape character and landscape designations should be scoped out from further consideration within the EIA.

1459. The visual receptors susceptible to potential impacts would include residents in nearby villages and towns such as Bacton, Eddingthorpe, Pollard Street, Walcott, Happisburgh and Witton Bridge, and in rural properties and farmsteads, pedestrians and horse-riders using PRoWs and other paths, and road-users on residential and rural roads. The effect on their visual amenity would be assessed.

1460. Assessment will be made on site to determine the potential impact of the seven cable relay station zones, considering the location of each layout, its size and extent and the construction processes that would be undertaken. Mapping showing the extent and layout of the cable relay station, associated construction compound and access roads, would be considered, along with initial visualisations and ZTVs using the maximum parameters of the electrical equipment. This information would be used to understand the potential magnitude of the influence on each landscape and visual receptor, considering the screening effect of existing built form, landform, vegetation and any proposed mitigation planting. This would be combined with the rating for sensitivity to determine the significance of the effect on each receptor.

Onshore cable route

1461. The assessment of the potential impacts of the onshore cable route construction would be undertaken considering two scenarios:

- Under Scenario 1 it is assumed that ducts would be installed for the Norfolk Boreas export cables during construction of Norfolk Vanguard. These would be installed along the entire length of the onshore cable route and all trenchless technique operations (apart from those at cable landfall) would be undertaken as part of the Norfolk Vanguard construction. It is also assumed that all accesses to jointing pit locations would also have been established.
- Under Scenario 2 there would be no pre-installed ducts and Norfolk Boreas would have to install the ducts along the entirety of the onshore cable route by open cut trenching and trenchless techniques where required.

1462. As no trenching work or haul road would be required under Scenario 1, the effect on landscape and visual receptors would be considerably less than those associated with Scenario 2, in which existing roads would be upgraded and new access roads constructed. The LVIA will consider the effects of the roads and how mitigation can reduce these effects through the removal and reinstatement of landcover (including hedgerows) as well as screen planting.

1463. The HVAC and HVDC options for both these Scenarios will be assessed. The HVAC and HVDC options would follow the same route. The route options have been selected to ensure key landscape features are avoided. The HVAC option would require up to 18 cables in up to six trenches, compared to up to four cables in up to two trenches for the HVDC option. The trenches would be approximately 1.5m deep and 1m wide.

1464. The maximum corridor widths would be 50m for the HVAC option and 35m for the HVDC option, except for short sections at major crossings and engineering constraints where both options may be wider. This would mean the removal of landcover and vegetation along the length of the selected onshore cable route, albeit with reduced widths applied where hedgerows and other sensitive features occur. Temporary mobilisation zones would be required for welfare, parking and storage. Additional areas of construction activity would be required at crossing sites. This would require further removal of landcover and vegetation.

1465. The landscape receptors susceptible to potential impact would include the LLCAs, within which the onshore cable route would be located and those which occur within the study area. In considering the 63km length of the route, a diversity of LLCAs will be assessed. The potential effect on the Norfolk Coast AONB, The Broads NP and Happisburgh Manor and Honing Hall designed landscapes would be limited by the scale of the construction works and their distance from these designated areas. It is therefore proposed that the potential effects of the onshore cable route on the designated areas should be scoped out from further consideration within the EIA.

1466. The visual receptors susceptible to potential impacts would include residents in nearby villages and towns and in rural properties and farmsteads, pedestrians and horse-riders using PRoWs and other paths, and road-users on residential and rural roads, whose views have the potential to be affected by the temporary removal of vegetation or the presence of construction plant and activity.

1467. Assessment will be made on site to determine the potential impact of the onshore cable route, considering the location and width of the cable corridor, the location, size and content of the mobilisation zones and the construction processes that would be undertaken. Mapping showing the extent and layout of the onshore cable route components, associated construction compound and access roads, would be considered on site to understand the potential magnitude of influence on each landscape and visual receptor, considering the screening effect of existing built form, landform, vegetation and any proposed mitigation planting. This would be combined with the rating for sensitivity to determine the significance of the effect on each receptor.

Onshore project substation and National Grid substation extension

1468. A substation is required to be sited near to the existing Necton National Grid Substation to enable connection to the National Grid. The substation would be a fenced compound encompassing buildings and outdoor equipment. The area of the compound would be approximately 300m x 250m, based on the maximum parameters of a HVDC and HVAC substation. The maximum height of the HVDC buildings would be approximately 25m. This would form a notable feature in the landscape with the potential to effect local visual amenity. The majority of the HVAC equipment would be 6m or less in height, but some items would be up to 10m, and this would reduce its visual influence compared to the HVDC option.

1469. An extension to the Necton National Grid substation would be required regardless of whether the HVAC or HVDC electrical solution is selected. The extension would be in an east west direction with the National Grid substation extension zone shown in Figure 1.4. Some minor re-configuration of overhead lines including the addition of a 67m tower located within the overhead line modification zone also shown in Figure 1.4 would also be required. This will be applied for as part of the Norfolk Vanguard DCO application, however, as that project will not yet have been built; Norfolk Boreas will also need to seek permissions to carry out this work.

1470. During construction of onshore project substation and the extension to the Necton National Grid Substation, perimeter and site lighting would be used during winter months to enable construction activities and lower levels of light may be used overnight for security purposes. Landform constructions around the substation, including proposals for acoustic enclosures and other types of barrier would be included as part of Norfolk Boreas. The effect of these features on landscape and visual receptors will be considered in the LVIA.

1471. While the landscape is relatively well contained, the scale and extent of Norfolk Boreas would lead to potential effects on landscape character and visual amenity and the area within which this may occur would be determined through the assessment.

1472. The landscape receptors susceptible to potential impact would include the LCTs within which the substation would be located. There are no designated landscapes within the study area of the onshore project substation zone.

1473. The visual receptors susceptible to potential impacts would include residents in nearby villages and towns such as Necton, Little Fransham, Bradenham and Little Dunham and in rural properties and farmsteads, pedestrians and horse-riders using PRoWs and other paths, and road-users on residential, rural and main roads. The effect on their visual amenity would be assessed.

1474. Assessment will be made on site to determine the potential impact of the substation considering the detailed location and layout of the converter halls or electrical equipment, the location, size and content of the mobilisation zones and the construction processes that would be undertaken. Mapping and visualisations showing the extent and layout of the substation, associated construction compound and access roads, would be considered on site to understand the potential magnitude of the influence on each landscape and visual receptor, considering the screening effect of existing built form, landform, vegetation and any proposed mitigation planting. This would be combined with the rating for sensitivity to determine the significance of the effect on each receptor.

4.2.2.4 Potential Impacts during operation

1475. The potential impacts during the operational and maintenance phase would be largely limited to the presence of the above ground onshore components and their influence on landscape and visual receptors.

1476. The underground location of most of the landfall and onshore cable route, means that their potential impact on landscape and visual receptors would be very limited. Visible components would be limited to signage, link boxes for the HVAC connection and possibly test units for the HVDC connection. The potential impact of the landfall and onshore cable route would be very limited for both the HVAC or HVDC options.

1477. In line with the Scoping Opinion on Norfolk Vanguard, it is proposed that the operational impacts of the landfall and onshore cable route should be scoped out from further consideration within the EIA, but that consideration will be required of the impact of vegetation loss and the mitigation measures which would take place through replanting.

1478. The potential cable relay station, onshore project substation and Necton National Grid substation extension would have a greater potential impact during operation and maintenance phases owing to the presence of the components and their large scale relative to the predominantly rural context. These would have an influence on landscape character and visual amenity. This influence would differ in respect of the HVAC and HVDC options as the type, size and layout of the components would differ.

1479. A cable relay station would be needed in respect of the HVAC option but not in respect of the HVDC option. There would therefore be no operational impact in respect of the HVDC option. For the HVAC option, the presence of the cable relay station would be considered in respect of visual amenity but not landscape character or landscape designations, as its scale and, therefore, extent of influence, would be insufficient to alter the character of these much broader LLCAs or more distant landscape designations.

1480. The key visual receptors with potential to be affected by the cable relay station would include residents of surrounding rural properties and farmsteads, road-users on the surrounding minor roads and walkers and horse-riders on surrounding PRoWs and other paths. During the operational and maintenance phase, the effect of existing and mitigation planting as it matures will be considered.

1481. The presence of the Norfolk Boreas substation, Necton National Grid substation extension and associated compound, access and perimeter fencing would have an influence on the LLCA it occupies, as well as other LLCAs in the study area. Susceptibility would relate to the existing influence of the Necton National Grid substation and additional influence of consented Dudgeon Substation. The visual influence of Norfolk Boreas substation could be ascertained using ZTVs but would need to be verified on site where built form, existing and proposed planting may reduce actual visibility. There are no landscape designations within the study area of the substation that could be affected.

4.2.2.5 Potential impacts during decommissioning

1482. No decision has been made regarding the final decommissioning policy for the onshore project substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. It is likely that the substation and cable relay station equipment would be removed and reused or recycled. It is expected the onshore cables would be removed from ducts and recycled, with the transition pits and ducts left *in situ*.

1483. The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan would be provided.

1484. It is anticipated that the decommissioning impacts would be similar in nature to those of construction, but would be more limited in geographical extent and timescale.

1485. Decommissioning would include potential impacts on the landscape character and visual amenity of the sites and surrounding area. The impacts would relate principally to the decommissioning process, associated plant, materials, infrastructure and temporary structures, as well as the presence of dismantled structures, where they would be visible above ground.

4.2.2.6 Potential cumulative impacts

1486. The approach to cumulative assessment is detailed in Section 4.5.

1487. The potential cumulative impacts of the substation and cable relay station would relate to their association with other large scale developments, located either in, or close to their study areas. In respect of the landfall and cable installation, the relatively localised impacts of the construction and decommissioning operations would limit the potential for significant cumulative impacts to arise.

1488. The potential impacts in respect of the substation and cable relay station would be assessed in relation to a cumulative context comprising all other relevant large scale developments located/proposed within 5km and 3km radii of the substation and cable relay station zones respectively.

1489. Other developments with potential to impact upon land use receptors will be considered. These are likely to include schemes that involve disturbance to designated sites, species and habitats in the onshore environment.

1490. Further consideration will be given to these potential cumulative scenarios as part of the EIA in combination with other projects, particularly in respect to the combined Norfolk Vanguard and Norfolk Boreas scenarios, and the cable route for the proposed Hornsea Project 3.

4.2.2.7 Summary of potential impacts

Table 4.4 Summary of impacts relating to landscape and visual impacts

Potential impacts	Construction	Operation	Decommissioning
Landscape, visual and cumulative impacts of offshore components	x	x	x
Landscape and visual impacts of landfall	✓	x	x
Landscape and visual impacts of cable relay station	✓	✓	✓
Landscape and visual impacts of onshore cable route	✓	x	x
Landscape and visual impacts of substation	✓	✓	✓
Cumulative impacts of landfall	x	x	x
Cumulative impacts of cable relay station	✓	✓	✓
Cumulative impacts of onshore cable route	✓	x	x
Cumulative impacts of substation	✓	✓	✓

Scoped in (✓) and scoped out (x)

4.2.3 Mitigation

1491. Embedded mitigation would involve the careful siting of the onshore infrastructure during site selection to ensure potential impacts are reduced. The iterative site selection process would consider environmental and technical constraints, as well as constraints relating to landscape character and visual amenity. The sensitivity of the surrounding landscape, and of residents, road-users, workers and recreational users of the landscape, will be a key consideration in the final location of the onshore infrastructure.

1492. The capacity of the landscape would be determined by the natural screening afforded by landform and mature woodlands, trees and hedgerows. There would also be additional and replacement tree planting in relation to the landfall, cable relay station, onshore cable route, onshore project substation and National Grid extension works, which would add to the overall mitigation of the Norfolk Boreas. If onshore infrastructure for Norfolk Boreas and Norfolk Vanguard were to be co-located the Applicant's preferred option would be to consent and develop any landscaping and planting schemes under the Norfolk Vanguard project (Scenario 1) to allow them to mature as soon as possible. To permit for the situation where Norfolk Vanguard is not built the Norfolk Boreas DCO application will also contain permissions to develop these.

1493. The Scoping Opinion response for Norfolk Vanguard highlighted the potential benefits of advanced planting in the mitigation of potential effects. This approach will be considered in the iterative design process for Norfolk Boreas.

1494. Mitigation measures would be set out in the LVIA and considered in the assessment of potential impacts, with consideration given to the growth rate of new planting and suitable species selection, and how this would affect impacts over time.

4.2.4 Approach to assessment and data gathering

4.2.4.1 Data gathering

1495. The Applicant will be undertaking consultation with relevant consultees as part of the Scoping process, including Norfolk County Council, the Broads Authority and Natural England, in order to define the scope of the LVIA required for the Norfolk Boreas. This would be based on those landscape and visual receptors considered relevant to the assessment, which are broadly outlined in Section 0 above.

1496. The assessment would be undertaken in accordance with the methods outlined in the following best practice guidance documents:

- The Landscape Institute with the Institute of Environmental Management and Assessment (2013). Guidelines for the Assessment of Landscape and Visual Impacts. Third Edition;
- Landscape and Seascape Character Assessments published by Natural England and the Department for Environment, Food and Rural Affairs (2014);
- An Approach to Landscape Character Assessment (2014). Natural England;
- Scottish Natural Heritage (2012). Assessing the Cumulative Impact of Onshore Wind

Energy Developments;

- Scottish Natural Heritage (February 2017). Visual Representation of Wind Farms: Version 2.2; and
- The Landscape Institute (2011). Landscape Institute Advice Note 01/11, Photography and photomontage in landscape and visual impact assessment.

1497. Data would be gathered from official, reliable and the most up-to-date sources. This would include Ordnance Survey map based data, as well as data on landscape characterisation, landscape designations and other Governmental and local authority data of relevance.

1498. Planned data collection would include the collection of the following data presented in Table 4.5 below.

Table 4.5 Planned data collection for LVIA

Data	Year	Coverage	Data Confidence	Notes
Ordnance Survey 25,000 Raster from Vattenfall	2016	Mapping information	High	n/a
Ordnance Survey 250,000 Raster from OS OPEN data	2016	Mapping information	High	n/a
North Norfolk Landscape Character Assessment	2009	Classification of North Norfolk landscape into character types	High	Based on Countryside Agency Guidelines
Broadland Landscape Character Assessment	2013	Classification of Broadland landscape into character types	High	Based on Natural England Guidelines
Breckland Landscape Character Assessment	2007	Classification of Breckland landscape into character types	High	Based on Countryside Agency Guidelines
Norfolk Coast AONB	2016	Identification of a landscape of national importance	High	Data downloaded from Natural England
The Broads National Park	2016	Identification of a landscape of national importance	High	Data downloaded from Natural England
Register of Historic Parks and Gardens	2016	Listing of protected Historic Parks and Gardens in England	High	Designation undertaken by Historic England with process set out on website
Norfolk Vanguard Scoping Report and Consultation Comments	2016	Defining scope of Norfolk Vanguard project	High	Feedback provided by statutory and other consultees on scope of EA.

Data	Year	Coverage	Data Confidence	Notes
Consultation with Norfolk County Council	Ongoing	Agreement on issues relevant to Norfolk Vanguard project LVIA	High	Consultation of issues relevant to LVIA with council officers
Guidelines for Landscape and Visual Impact Assessment	2013	Accepted guidance for the production of LVIA	High	Guidelines setting out methodology and approach for LVIA

4.2.4.2 Methodology

1499. This section provides a summary of the methodology that would be used to carry out an LVIA to form a chapter in the ES. The full methodology will be agreed through more detailed consultation with Norfolk County Council, the Broads Authority and Natural England. This methodology reflects guidance presented in GLVIA3.

1500. The objective of the assessment of Norfolk Boreas is to predict the significant effects on the landscape and visual resource. In accordance with the EIA Regulations, the LVIA effects are assessed to be either significant or not significant.

1501. The significance of effects is assessed through a combination of two considerations – the sensitivity of the landscape or visual receptor and the magnitude of change that will result from Norfolk Boreas. In accordance with the Landscape Institute's GLVIA3, the LVIA author's methodology requires the application of professional judgement, but generally, the higher the sensitivity and the higher the magnitude of change the more likely a significant effect will be.

1502. The objective of the Cumulative Landscape and Visual Impact Assessment (CLVIA) is to describe, visually represent and assess the ways in which Norfolk Boreas would have additional effects when considered together with other existing, consented or application stage developments and to identify related significant cumulative effects arising from the Norfolk Boreas. The guiding principle in preparing the CLVIA is to 'focus on the likely significant effects' and in particular those which are likely to influence the outcome of the consenting process.

1503. The LVIA will determine whether the nature of the effect is beneficial, neutral or adverse in accordance with defined criteria. The effects of Norfolk Boreas would be of variable duration, and would be assessed as short-term or long-term, and permanent or temporary/reversible.

4.3 Socio-economics

4.3.1 Baseline

4.3.1.1 Data sources

1504. The following data sets have been used to inform the baseline for this scoping report and will also be used to inform the EIA:

Table 4.6 Socio-economics data sets

Source no.	Data	Source	Date
1	Socio-economic study	Miller Research Consulting	2016
2	The Plan 2015-2020.	Great Yarmouth Borough Council	2015
3	Breckland Local Plan	Breckland Council	2015
4	Broadland District Local Plan	Broadland District Council	2015
5	Economic Assessment for Norfolk	North Norfolk District Council	2012
6	Emerging Local Plan 2011 - 2036	Breckland Council	2011

4.3.1.2 Overview

1505. The onshore scoping area lies in the county of Norfolk which has an estimated population of 877,700 (Norfolk County Council, 2012). From 2004 to 2014, Norfolk's population is estimated to have increased by 7.6%, compared with an increase of 9.3% in the wider East of England region, and 8.2% in England (Norfolk County Council, 2012). Norfolk's population has an older age profile than the rest of England, with 23.4% of Norfolk's population aged 65 and over, compared with 17.6% in England (Norfolk County Council, 2012). The average age is higher around the coast, especially along the North Norfolk coast, and lower around areas of higher population, such as Norwich (Office for National Statistics, 2013).

1506. Average unemployment (aged 16+) in Norfolk is 4.1%, which is lower than the UK average (5.3%), however some areas (e.g. Great Yarmouth) have unemployment levels which are greater than the national average (Office for National Statistics, 2016) for both adults and young people. Almost half the total unemployed population in Norfolk are young people and, whilst youth unemployment has decreased slightly in recent years, the number of NEET (Not in Employment, Education or Training) people in Norfolk is still higher than the national average (Norfolk Community Foundation, 2016).

1507. The majority (87.9%) of businesses in Norfolk can be classified as 'Micro' with 0 to 9 employees (Office for National Statistics 2015a).

1508. Key industries have declined or have lower rates of growth in Norfolk compared to the UK between 2010 and 2015 (Office for National Statistics, 2015b). Local analyses suggest this may be a result of the reliance of the Norfolk economy on oil and gas, which has stalled in recent years (Shields, 2016).

1509. Norfolk County Council (2016a) states that manufacturing is the third most significant sector for employment despite having seen an overall decline since 2011. There are fewer construction and manufacturing businesses near the coast with higher numbers in the areas surrounding towns and cities such as Norwich.

1510. The energy sector currently employs 7,700 people directly in Norfolk and Suffolk (including Bacton and Sizewell), and thousands more indirectly as part of the supply chain and supporting services. The energy sector is worth approximately £994M per annum in Norfolk and Suffolk. This includes the historic North Sea oil and gas industry and the emerging offshore wind industry (New Anglia Local Enterprise Partnership (LEP), 2014). New Anglia LEP (2014) suggests that the offshore wind industry provides an important opportunity for economic growth in the region of Norfolk and Suffolk.

1511. The Great Yarmouth and Lowestoft area is one of six Centres of Offshore Renewable Engineering (CORE) in the UK, designated due to the presence of relevant engineering skills (Department for International Trade, 2015). As a CORE, the government and local partners aim to support businesses looking to invest in offshore wind in the area. Vattenfall will work with OrbisEnergy and East of England Energy Group (EEEGR), based in Lowerstoft and Great Yarmouth respectively throughout the project.

1512. The University of East Anglia is an internationally renowned university that offers undergraduate and postgraduate education to over 15,000 students. Education and training is offered in a range of areas relevant to the green economy, including environmental sciences, engineering and natural sciences. In addition to the University of East Anglia, there are 42 technical colleges or sixth form schools / colleges in the County that offer a diverse range of education and training to individuals.

1513. A review of socioeconomic baseline features will be undertaken and presented in the ES, including:

- Regional and local labour market (extracted from ONS or other available data) and trends;

- High level indication of temporary and rented accommodation supply (from letting agents and tourist information websites) and trends;
- Current workforce (resident location by postcode);
- Local and regional population and trends (extracted from ONS or other available);
- Local and regional employment and trends (extracted from ONS or Norfolk Insight, 2017);
- Norfolk Economic Intelligence and local economic strategies (Norfolk County Council, 2016a, Norfolk County Council, 2017b);
- Education (including special educational needs and school standards) (Norfolk County Council, 2016b).

1514. Social data relating to crime, health and leisure will also be considered where this is available.

4.3.1.3 Offshore project area

1515. The offshore project area is primarily used for commercial fisheries (see Section 2.10) and shipping (see Section 2.11). Significant natural gas infrastructure exists to the north of the site and much of it feeds into the Bacton Gas Terminal at the north end of the landfall search area. Aggregate dredging is also undertaken or in planning to the north and south of the development area (Section 2.14).

4.3.1.4 Landfall search area and cable relay station zones

1516. The main economic activities within the landfall and cable relay station zones are arable farming, tourism, and employment associated with the Bacton Gas Terminal.

1517. There are no large settlements within the landfall and onshore cable relay substation zones, however there are several villages including Happisburgh, Bacton and Walcott.

4.3.1.5 Onshore cable corridor

1518. The current onshore cable corridor lies predominantly on agricultural land, avoiding residential dwellings and minimising disruption to road and rail services. The current onshore cable corridor passes to the north of the settlements of Aylsham (population approximately 6,000), Reepham (population approximately 2,700), and Dereham; one of the larger towns in the centre of Norfolk, with a population of over 20,000.

4.3.1.6 Substation search area

1519. The substation search area is in the district of Breckland, in the vicinity of Necton, Little Dunham, Little Fransham, and Bradenham.

1520. The Breckland Economic Prosperity Strategy (Public & Corporate Economic Consultants (PACEC) & Breckland Council, 2015) recognises renewable energy supply chains as an economic opportunity for the area.

4.3.2 Potential Impacts

1521. Full details of the project description are provided in Section 1.5.

1522. Economic impacts will vary considerably at each stage, dependent on a range of factors, such as:

- The technologies and infrastructure to be deployed onshore and offshore;
- Construction, O&M and decommissioning methodologies;
- Procurement/contracting strategy;
- Availability and capacity of the supply chain;
- Number of workers;
- Where the workers come from; and
- The duration of employment.

4.3.2.1 Potential impacts during construction

1523. **Employment opportunities and supply chain:** As discussed in Section 1.2, the offshore wind industry presents an opportunity to utilise, and further develop the UK's maritime engineering skills as other industries decline (such as North Sea oil) in order to secure supply chain, operation and maintenance and other employment opportunities in the UK.

1524. The construction and operation of Norfolk Boreas would require very large-scale investment and would need to be supported by a substantial supply chain; a proportion of the capital and operational expenditure would add to local, regional and UK-wide economy during the lifetime of the project. There would be direct expenditure on key elements of the wind farm, such as components of wind turbines, foundations, cables, and onshore infrastructure as well as further expenditure throughout the supply chain. Clear opportunities exist which are directly and closely associated to the project providing equipment and technical services, maintenance and monitoring services for the project assets, providing port services, crew transfer services as well as the provision of goods including consumable goods required during the life of the project. These would include vessel fuel, lubricants, paints and other consumables.

1525. Whilst many of the personnel working on the maintenance and operation of the project would be locally based specialist services would be required. Visiting teams of specialists would require accommodation, transport and other general services

1526. The Norfolk Boreas project is expected to result in a range of direct and indirect economic impacts (e.g. training and education, day-to-day indirect spend from project employees). The Applicant will seek to work with UK suppliers and local East Anglian suppliers in particular to maximise the local benefit of the project where possible.

1527. In order to be eligible for CfD support from the UK Government, a detailed supply chain plan will be produced by the Applicant. The supply chain plan must demonstrate that the project would:

- Support the development of competition in supply chains;
- Support innovation in supply chains; and
- Support the development of skills in supply chains.

1528. The relevant Secretary of State will assess each of these three criteria against the following:

- The commitments or actions that the project has either already undertaken or will undertake in the future;
- The impact on the supply chain as a whole, using examples from the contracted supply chain; and
- The wider long term impacts across the relevant low carbon electricity generation industry.

1529. The supply chain and skills strategy for Norfolk Vanguard and Norfolk Boreas will consider the interests and needs of the existing local workforce and seek to prepare new workers adequately for the roles that would become available.

1530. The Vattenfall International Trainee Programme offers support and opportunities for graduates. In addition, Vattenfall offers internships, thesis project opportunities and school programmes to give young people and schools opportunities to get involved with local projects.

1531. Vattenfall's Local Liaison Officer and Skills and Education Champion for Norfolk Vanguard and Norfolk Boreas is liaising with numerous skills and education providers in the area, from UEA, to University Technical College, as well as numerous local schools, and has taken part in initiatives convened by EEEGR, the Mason Trust and others. Vattenfall is seeking to map opportunities within the area, support relevant initiatives and develop new initiatives where value can be added. School / college groups participated in the March/April 2017 drop-in exhibitions. Also in conjunction with the Spring 2017 drop-ins, an opportunity has been provided for a Masters Student at UEA to evaluate the engagement opportunities offered by the pre-application informal consultation, supported by Vattenfall's communications manager. Plans are emerging for pilot educational initiatives in the area. Vattenfall has a good track record in Kent of working in partnership with others, notably The Crown Estate to deliver educational programmes for younger pupils e.g. Coast Explorer[24].

1532. Career opportunities within offshore wind development, construction and operation are highly varied, including:

- Onshore Positions:
  - Project & Production Managers / Project Engineers;
  - Wind turbine generator Commissioning Engineers;
  - SCADA Engineers;
  - Marine & Logistics Coordinators;
  - Site & Yard Supervisors;
  - Risk Manager ;
  - Quality, Health, Safety and Environment (QHSE) Managers / Advisors;
  - Cost Engineers;
  - Commercial / Procurement / Sales Managers ;
  - Records Manager;
  - Document Controllers & Legal Specialists;
  - Logistic / Permit Coordinators;
  - Bid and Tender Managers & Logistics;
  - Media and Communications Managers; and
  - Commercial managers; lawyers etc.
- Offshore Positions:
  - Client Representatives (Cable, Foundation, Substation, OWF Topside, Survey, Geotechnical / Geophysical);
  - Offshore Superintendents / Managers;
  - Offshore Construction Managers;
  - Mechanical and Electrical Technicians;
  - Full cable Installation Crews;
  - FO & HV Cable Jointers / Testers;
  - Tower Team Riggers and Supervisors;
  - Cable Plough Technicians and Operators;
  - Trenching / Jetting and Burial Personnel;
  - Site & Service Technicians;
  - Offshore QHSE Managers;
  - Offshore Medics; and

[24] https://www.youtube.com/watch?v=JNonsa1lJXI

- Production Operatives.

1533. Supply chain businesses which would be required in the development, construction and operation of Norfolk Boreas include:

- Onshore civil engineers and contractors;
- Service vessel crews and skippers;
- Accommodation providers;
- Printing companies;
- Construction workers;
- Plant hire;
- Ecologists,
- Archaeologists;
- Land owner liaison officers; and
- Other goods and services.

1534. The likely project expenditure for Norfolk Boreas is not yet known in detail, but is expected to be in the order of £5Billion if the entire 1.8GW project is constructed. The expected capital expenditure costs of developing and constructing an offshore wind farm is approximately £2.8M per MW for projects that reach a final investment decision (FID) in 2018 and £2.4M per MW for projects that reach a FID in 2023 (PD Ports, 2014). This represents a 10% and 23% decrease respectively on the £3.1 million per MW cost at the beginning of 2014 (PD Ports, 2014). The Levy Exemption Certificate (LEC) for offshore wind has reduced by 11% during the period 2010-2014 from £136/MWh in 2010 and a target of £100/MWh by 2020 is achievable.

1535. Taken together the number and pace of development of offshore wind projects off the East coast of England represents a new and exciting sustainable marine industry. Working in concert with other project developers training providers, and the local supply chain Norfolk Boreas is committed to ensuring the long term opportunities and benefits can be realised locally as far as possible. A key element of this will be working with local technical colleges, schools and universities to assist and promote the development of training opportunities for the construction and operation phases of the offshore wind industry.

1536. RenewableUK (2013) states that more than 70,000 jobs will be created in the UK renewables industry within the next decade. Projects such as Norfolk Boreas will contribute to the growth of an economically important industry. The EIA will seek to identify potential opportunities and benefits for the local economy.

1537. In addition to the beneficial impacts of project expenditure there is also potential to impact upon other industries negatively as a result of displacement of workers currently employed in other industries. As discussed above VWPL's Local liaison officer is and will continue working with skills and training providers to ensure that this impact is minimised.

1538. **Impact on the demand for housing, accommodation and local services:** Direct and indirect employment generated during the construction phase could increase demand for housing, accommodation and local services during construction.

1539. **Impact on offshore industries:** Offshore, potential impacts, primarily on commercial fisheries (Section 2.10) as well as shipping and navigation (Section 2.11) will be considered in detail within the EIA. As discussed in Section 1.5, design work undertaken to locate the former zone, and to determine the offshore project area of Norfolk Boreas, has taken account of these activities.

1540. **Impact on offshore and coastal tourism and associated economic value**: Potential effects on tourism and recreation could be created by visual, noise and vibration impacts during the construction of coastal infrastructure and changes to local accommodation availability. Given the distance from shore of the Norfolk Boreas site there are unlikely to be significant direct impacts upon water sports or landscape impacts, however the Norfolk coastline provides a recognised tourism asset and there is potential for disturbance to occur during construction of the export cable. This is discussed further in Section 4.4.

1541. **Impacts on local tourism and recreation resources, including PRoWs**: There may be temporary disruption to local tourism and recreation resources, including PRoWs and cycling routes during construction of the onshore works. This is discussed further in Sections 3.5, 4.2 and 4.4.

4.3.2.2 Potential Impacts during operation

1542. **Employment opportunities and supply chain:** There would be opportunities for direct employment as well as supply chain expenditure during the operation and maintenance phases of Norfolk Boreas. It is envisaged that Norfolk Vanguard and Norfolk Boreas would provide up to 150 jobs in the area, including up to 75 skilled operations and maintenance team members and approximately five to ten site managers per project over their 25 plus years operating life.

1543. **Impact on the demand for housing, accommodation and local services:** Direct and indirect employment generated during the operation and maintenance phase could increase demand for housing, accommodation and local services.

1544. **Impacts on tourism and recreation activity and associated economic value**: Potential impacts to tourism and recreation facilities may occur during operation and maintenance activities through noise or visual disturbance. In addition, re-routing of or temporary stopping up of PRoWs (during maintenance activities) may have an impact on local activities. Closure of any PRoW for the lifetime of the project is considered very unlikely. This is further discussed in Section 4.4.1.3.

4.3.2.3 Potential impacts during decommissioning

1545. No decision has been made regarding the final decommissioning policy for the substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. It is likely that the substation and cable relay station equipment would be removed and reused or recycled. It is expected that the onshore cables would be removed from ducts and recycled, with the transition pits and ducts left in situ.

1546. The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan would be provided.

1547. It is anticipated that the decommissioning impacts would be similar in nature to those of construction. There is the potential for local job and supply chain opportunities during the decommissioning phase.

4.3.2.4 Potential cumulative impacts

1548. The approach to cumulative impacts is detailed in Section 4.5.

1549. There is potential for Norfolk Boreas to bring socio-economic benefits, for example by providing opportunities for business, jobs and training. The clustering of offshore wind farm development in the southern North Sea will, over time, provide longer term opportunities for the supply chain and skills sectors than a single development.

1550. Discussions with Local port facilities are ongoing to understand the extent to which they can support all phases of Norfolk Vanguard and Norfolk Boreas. This would provide job opportunities in that area. As discussed previously the operation and maintenance port is likely to be located on the East Anglian coast (Section 1.1.5)

1551. Conversely, there is also potential to cumulatively impact upon other industries negatively as a result of displacement of workers currently employed in other industries. This will be considered further in the EIA.

4.3.2.5 Summary of potential impacts

1552. Table 4.7 summarises the potential impacts relating to socio economics.

Table 4.7 Summary of impacts relating to socio-economics

Potential impacts	Construction	Operation	Decommissioning
Employment opportunities and supply chain	✓	✓	✓
Impact on the demand for housing, accommodation and local services	✓	✓	✓
Impact on offshore industries (will be considered in Section 2.10 and Section 2.11)	✓	✓	✓
Impact on offshore and coastal tourism and associated economic value	✓	✓	✓
Impacts on local tourism and recreation resources, including PRoWs	✓	✓	✓
Cumulative socio-economic impacts	✓	✓	✓

Scoped in (✓) and scoped out (X)

4.3.3 Mitigation

1553. As discussed in Section 1.5, design work undertaken to locate the former East Anglia Zone and to determine the offshore project area of Norfolk Boreas has considered and avoided potential constraints associated with other offshore industries where possible (Section 1.2.2 and 1.2.3).

1554. The final locations for the onshore infrastructure will be identified based on ongoing constraints analysis and feedback from the stakeholders and the public following submission of this Scoping Report and feedback from recent drop-in exhibitions.

1555. This presents an opportunity for Norfolk Boreas to minimise potential negative socio-economic impacts through the design of the project.

1556. Further mitigation measures specific to existing industries will be developed during the EIA in consultation with relevant stakeholders. These are discussed in:

- Section 2.11 Shipping and Navigation;
- Section 2.10 Commercial Fisheries;
- Section 3.5 Land use; and
- Section 4.4 Tourism and Recreation.

4.3.4 Approach to assessment and data gathering

1557. The approach to assessment and data gathering outlined below is informed by methodology discussed with regulators during the EPP for Norfolk Vanguard.

1558. The Overarching National Policy Statement for Energy (EN-1) (DECC, 2011d) states that where a project is likely to have an impact on socio-economics at a local or national scale the assessment should consider all relevant impacts. These may include:

- The creation of jobs and training opportunities;
- The provision of additional local services and improvements to local infrastructure;
- The impact on tourism (and associated economic value);
- The impact of a changing influx of workers on accommodation and other local facilities during the different construction, operation and decommissioning phases of the energy infrastructure; and
- Cumulative impacts.

1559. The assessment will also follow other relevant guidance documents such as the Productive Seas Evidence Group (2015) Social and Economic Assessment Requirements for Development Projects Affecting the Marine Environment.

1560. Establishing the baseline for the potential offshore and onshore impacts of Norfolk Boreas will draw upon national and regional economic data and nationally available sources such as the:

- Various data from ONS, including Census, Annual Population Survey, Labour Force Survey, Indices of Deprivation;
- Local Authority data and plans (e.g. economic strategies and development plans);
- Local Enterprise Partnerships policies and plans; and
- Available data relating to offshore wind farms e.g. from studies by Renewables UK, the Offshore Wind Industry Council, Offshore Renewable Energy Catapult.

1561. The approach to assessment and data gathering which may include local surveys will be discussed and agreed as part of the EPP (detailed in Section 1.6.2). Consultation will be undertaken at key stages throughout the EIA process.

4.4 Tourism and recreation

1562. For the basis of the EIA, tourism and recreation is defined as the perception and use of amenity / recreation assets and will be considered qualitatively. Information gathered for the tourism and recreation assessment will also inform the Socio-economic assessment (Section 4.3).

4.4.1 Baseline

1563. Tourism is very important to the economy of Norfolk, supporting more than 59,000 jobs directly attributed to tourism and contributing £2.96 billion to the local economy (Visit Norfolk, 2016). The attractiveness of the natural landscape of

Norfolk, which includes sandy beaches, lakes and rivers, is a key tourism asset, and the area offers a wide range of opportunities for recreational activities such as fishing, walking and sailing.

1564. This section describes the baseline, potential impacts and approach to the assessment for tourism and recreation. Socio-economics is considered in Section 4.3.

4.4.1.1 Data sources

1565. The baseline for this section was identified by undertaking an initial high level desk-based review using existing sources to characterise the area, including:

Table 4.8 data sets

Source no.	Data	Source	Date
1	Mapping	Ordnance Survey	2016
2	Aerial imagery	Google Earth	2016
3	Visit Norfolk	www.visitnorfolk.co.uk	2016
4	The Broads Authority	www.broads-authority.gov.uk	2017
5	Happisburgh Village Website	www.happisburgh.org	2017
6	Tour Norfolk	www.tournorfolk.co.uk;	
7	Sea Palling and Waxham Community Website	www.seapalling.com	2017

1566. The study area for the impact assessment is the Norfolk region for the onshore infrastructure as well as the waters in and around the offshore project area.

4.4.1.2 Coastal and marine

1567. This section provides a high level review of existing tourism and recreation along the north Norfolk coast and in nearshore waters in the vicinity of the landfall and offshore cable route scoping area, as well as recreational activity currently taking place within the vicinity of Norfolk Boreas.

1568. As the site of the Norfolk Boreas site is 72km offshore (to the nearest point), activities at the site are limited, with some sailing and sea angling taking place nearby. Therefore consideration of potential impacts on tourism and recreation will be focused on potential impacts as a result of installation at the landfall location.

Coastal tourism

1569. There are several coastal towns and villages providing accommodation and activities for tourists in the area, including Mundesley, Bacton, Wallcott, Happisburgh, and Eccles-on-Sea.

1570. Sandy beaches can be found from Bacton to Eccles-on-Sea, providing opportunities for dog walking and other beach activities, and the coastal villages provide for tourism with cafes, shops, historic buildings and pubs. There are two Blue Flag beaches, one north of the landfall zone at Mundesley and one south of the landfall zone at Sea Palling (Explore Norfolk, 2016). There are no golf courses in the landfall zones. A summary of coastal towns, villages and their tourism amenities is shown in Table 4.9 Summary of tourist amenities in the vicinity of the landfall zone Table 4.9

Table 4.9 Summary of tourist amenities in the vicinity of the landfall zone

Name of coastal resort	Assets
Mundesley	Accommodation, blue flag beach, clifftop walking, cinema, pubs
Bacton and Walcott	Accommodation, caravan park, sandy beaches, clifftop walking, St Andrews 15th century church, pubs, Bromholm Priory
Happisburgh	Accommodation, archaeological heritage, lighthouse, St Marys 14th century church, RNLI lifeboat station, sandy beaches, cafe
Eccles-on-Sea	Caravan park, accommodation, sandy beaches, Eccles Church Tower
Sea Palling	Accommodation, blue flag beach, pubs, cycle hire, seal sighting, amusements, Waxham 16th century barn

Sources: Mundesley Village (2016); Happisburgh Village (2016); Sea Palling & Waxham Community (2016); Information Britain (2016)

Recreation

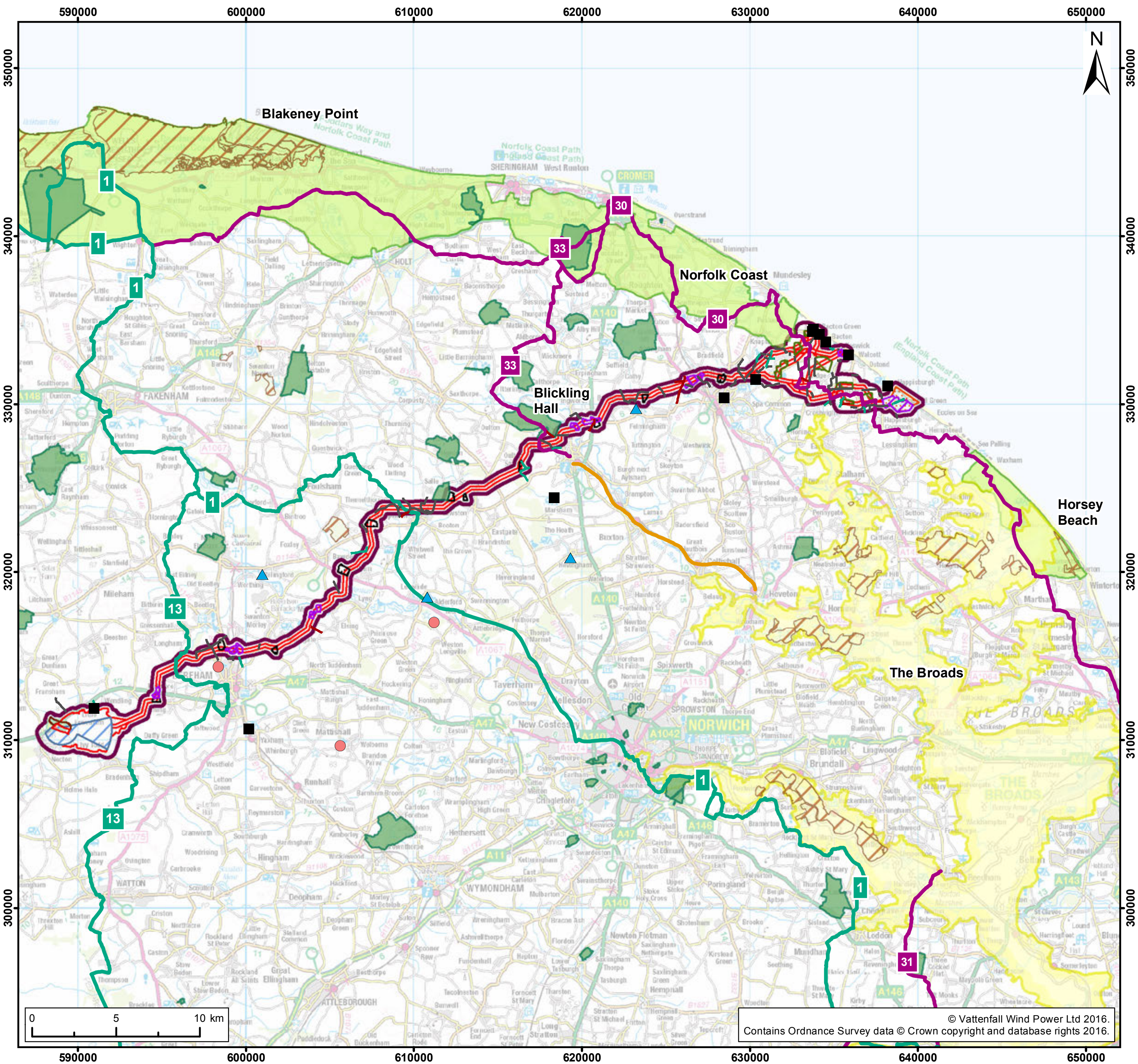
1571. Recreational activities in the coastal environment include coastal walks, cycling and sight-seeing. There are no boat trips or water sports facilities within the offshore scoping area. The Blue Flag beaches at Mundesley and Sea Palling provide good swimming opportunities. There are no known dive sites in the offshore scoping area, with diving in Norfolk focused on gullies and wreck sites off Blakeney, Sheringham and West Runton in North Norfolk. Anglian Divers launch from the beach at Sea Palling to visit the Norfolk chalk reef which runs from Cley-next-the-sea to Trimmingham, and wreck sites along the coast (British Sub Aqua Club, 2016).

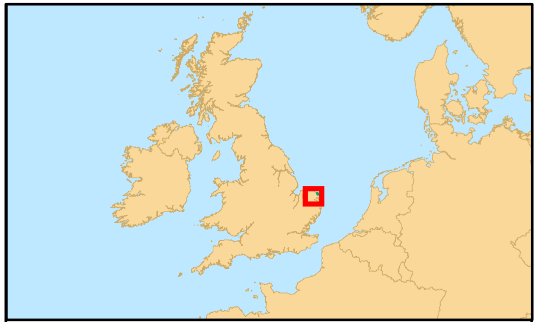
1572. Marine and inshore activities in the wider region include watersports such as sailing, kayaking/canoeing and jet skiing and activities such as fishing and wildlife watching, however there are no facilities to hire canoes/kayaks within the landfall zones.

1573. Recreational vessels for sailing and fishing are considered in Section 2.11.

1574. Within the landfall zones there are PRoWs including The Norfolk Coast and cycle routes include National Cycle Route 1 and 13 and Regional Cycle Route 30 and 33. PRoWs and cycle routes are considered further in Section 3.5.

1575. Camping and caravan sites at the landfall zones are shown on Figure 4.9.





Legend:

- Onshore Scoping Area

Norfolk Boreas Onshore Infrastructure

- National Grid Substation Extension Zone
- Overhead Line Modification Zone
- Onshore Project Substation Zone
- Onshore Cable Corridor
- Horizontal Directional Drilling (HDD) Zone
- Mobilisation Zone
- Cable Relay Station Zone
- Landfall Zone
- Area of Outstanding Natural Beauty (AONB)[1]
- National Park[1]
- National Nature Reserve (NNR)[1]
- Registered Park and Garden[2]
- Bure Valley Railway[3] [4]
- National Cycle Route [4]
- Regional Cycle Route

Norfolk Public Rights of Way[3]

- Footpath
- Bridleway
- Restricted Byway

Recreational Areas

- Camping and Caravan Site
- Fishing Lake
- Golf Club

[1] Natural England, 2016. [2] Historic England, 2016.
[3] Norfolk County Council, [4] Sustrans, 2016.

Project:	Report:
Norfolk Boreas	Environmental Impact Assessment Scoping Report

Title:

Recreational Features and Tourism Facilities

Figure: 4.9	Drawing No: PB5640-102-056				
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	13/03/17	JE	DT	A4	1:325,000

Co-ordinate System: British National Grid **EPSG:** 27700

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4.4.1.3 Onshore tourism and recreation

1576. Tourism and recreation within the onshore scoping area is relatively minimal compared to the North Norfolk coast (Blakeney, Wells and Cromer) and other tourist destinations such as Norwich. However there are a small number of B&Bs and guest houses, including some offering premium accommodation. The footprint of the onshore infrastructure would avoid the Norfolk Broads National Park and the North Norfolk AONB.

1577. Within the onshore scoping area, there are fishing lakes at Cobbleacre, Layfields, Billingford, Dunham and Bartles Lodge, and golf courses at Dereham and Weston Park.

1578. There are caravan parks and campsites at Fransham, Two Mills, North Walsham and Lyng, and guesthouses at Dereham, Aylesham, Necton, Weston Park as well as rural B&Bs and pubs.

1579. Norfolk Lakes Activity Centre, also at Lyng is popular for school visits and providing a range of water and land based activities. At Weston Park there is also a family adventure park with dinosaur trails, canoeing, fishing, horse riding and camping.

1580. National Cycle Route 1 crosses the onshore cable corridor, as well as footpaths and bridleways. The Norfolk Coast Path, the Paston Way and The Weavers Way long distance paths are all intersected by the current cable corridor. The Marriott's Way runs parallel to the onshore cable corridor near Reepham for several kilometres and is twice crossed by the onshore cable corridor in an area west of Reepham. The Bure Valley Way runs from Aylsham to Hoveton but is not intersected by the onshore cable corridor. PRoWs and cycle routes are considered further in Section 3.5.

1581. Seal watching along Norfolk's east coast (primarily at Horsey) is a major tourist attraction in winter months, generating over 100 visitors per hour on the coast during peak periods (Visitor Surveys at European Protected Sites in Norfolk during 2015- 2016; Norfolk County Council/ Norfolk Biodiversity Partnership/ Footprint Ecology; July 2016).

1582. Camping and caravan sites, golf courses, fishing lakes and other attractions in the onshore scoping area such as the Bure Valley Railway and the National Trust property Blickling Hall are shown in Figure 4.9. The Broads National Park, covering the area from Norwich to Great Yarmouth, and north from Wayford Bridge down to Beccles, draws approximately 8 million visitors per year (The Broads Authority, 2014), covering an area 303km^2 with more than 300km public footpaths and 2.7km of coastline. The Broads National Park contains Britain's third largest inland waterway covering 28 SSSI's, 13 scheduled ancient monuments and hosts many rare birds, insect and plant species. As a result, the Broads National Park attract a large number of visitors for sailing, fishing, walking and wildlife watching.

1583. Further consideration of designated sites such as SSSIs, rare species and scheduled ancient monuments is contained within Sections 3.6, 3.7 and 3.8. The Broads National Park is outside of the onshore scoping area, however due to its proximity will be considered further in the assessment to identify any potential impacts arising from Norfolk Boreas.

1584. Norfolk, and in particular the coast, provides many recreational activities for visitors, including fishing, walking, cycling, beaches, camping, birdwatching, heritage features and National Nature Reserves. Blakeney Point is popular for seal watching, whilst fishing takes place at the Broads, the Wash and the Fens, and from Wells round to Walcott, as well as at a multitude of inland lakes and rivers. There are popular birdwatching spots at Titchwell, Cley, Holkham, Blakeney, Snettisham and Welney.

4.4.2 Potential impacts

1585. Full details of the project description are provided in Section 1.5.

4.4.3 Potential impacts during construction

Coastal and marine

1586. **Visual impacts:** Associated with cable laying vessels and vessels moving to and from the offshore construction zone.

1587. **Disruption to marine and coastal recreational activities:** Offshore construction activities and associated Safety Zones could have a small potential to disrupt marine and coastal recreational activities. This would be temporary in nature. Marine users would be informed of Safety Zones, and these would be removed or reduced following completion of construction. The risk of collision due to the presence of structures and reduced navigable area as a result of the construction activity will be assessed in the EIA and is discussed in Section 2.11 Shipping and Navigation.

1588. **Restricted beach access:** There is the potential for beach access and the free passage of walkers along the beach to be affected during construction works at the landfall during the laying of the cable, however this would be temporary in nature, restricted to the landfall and immediate surroundings. Full and open access would be restored on completion of construction.

1589. **Deterioration to Bathing water / Blue flag beaches and resulting effect on tourism and recreation:** There may be some potential for landfall and associated nearshore cable construction works to result in some deterioration to the Bathing Water / Blue

Flag beach status. However, as discussed in Section 2.3, the impacts are very localised and temporary. In addition, locations of the bathing waters are 3.1km and 3.9km from the nearest landfall option and therefore unlikely to be impacted by temporary changes in water quality. It is therefore proposed that this impact should be scoped out from further consideration within the EIA.

Onshore (inland)

1590. **Disturbance including noise, dust and visual impact:** During the installation of the onshore infrastructure (including at the coast and along PRoWs), potential impacts could arise causing noise, dust and visual disturbance. Visual amenity may be made temporarily less picturesque during the period of construction. However these would be temporary in nature. Impacts from dust and noise are considered in Section 3.3 and 3.9 and visual impacts are considered in Section 4.2.

1591. **Disruption to local recreation and tourism provisions and businesses:** Local businesses and tourism facilities (potentially including those in neighbouring counties) may be temporarily disrupted through access route diversions as a result of construction work.

1592. **Reduction in available accommodation due to construction personnel:** The presence of a workforce during construction which is non-resident would result in a need for accommodation during some or the entire duration of the construction phase. Whilst there is a positive economic impact for accommodation providers in having high levels of occupancy there is also a potential negative impact on a reduction of available accommodation to serve the tourist industry. Reducing the available provision for tourist accommodation may result in temporary as well as potentially longer term impacts.

1593. **Alternate routes/closure of PRoWs:** Temporary closures or alternative routes for PRoWs and other long distance paths could discourage visitors. This is further discussed in Section 3.5.2.1. Any crossing of PRoWs would be discussed with the local PRoW officer and the appropriate mitigation would be put in place on a case by case basis.

4.4.3.1 Potential impacts during operation

1594. **Reduction in available accommodation due to O&M personnel**: The presence of the O&M workforce during annual maintenance season who are non-resident would result in a need for accommodation throughout the operational lifetime. Although numbers would be much smaller than those during the construction phase, accommodation providers may prioritise such accommodation provision over tourist visitors, thus reducing the available provision and resulting in a potential long term impact.

1595. **Obstruction or disturbance to other recreation / tourism Assets**: The operational and maintenance phase works at various onshore locations could result in localised temporary and occasional obstruction or disturbance (noise, air, visual) to recreation / tourism assets (sites). As with the above impact on Rights of Way this could result in potential reductions in visitor numbers. Depending on whether a cable relay station is required, and, if so, its location, there is potential for obstruction or disturbance to recreation / tourism assets.

1596. **Disruption to coastal and marine recreational activities:** The only main source of impact is associated with offshore Safety Zones during maintenance. It is therefore proposed that this impact should be scoped out from further consideration within the EIA.

1597. **Closure of PRoWs:** If any PRoWs require permanent closure, this could lead to reduced attractiveness of recreational activities such as walking. However, the project will seek to avoid placing permanent operational above ground infrastructure in the location of a PRoW and therefore it is considered unlikely that there would be any requirement to close a PRoW for the lifetime of the project. Any crossing of PRoWs would be discussed with the local PRoW officer and the appropriate mitigation would be put in place on a case by case basis.

1598. **Visual Impacts:** In line with the Scoping Opinion on Norfolk Vanguard, it is proposed that the operational impacts of the landfall and onshore cable route should be scoped out from further consideration within the EIA, but that consideration will be required of the impact of vegetation loss and the mitigation measures which would take place through replanting. The potential cable relay station, onshore project substation and Necton National Grid substation extension would have a greater potential impact during operation and maintenance phases, potentially including on PRoWs and other paths. Visual impacts are considered in Section 4.2.

4.4.3.2 Potential impacts during decommissioning

1599. No decision has been made regarding the final decommissioning policy for the onshore project substation and cable relay station, as it is recognised that industry best practice, rules and legislation change over time. However, the onshore project substation and cable relay station equipment would likely be removed and reused or recycled. It is expected that the onshore cables would be removed from ducts and recycled, with the transition pits and ducts left in situ.

1600. The detail and scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and agreed with the regulator. A decommissioning plan would be provided.

1601. It is anticipated that the decommissioning impacts would be similar in nature to those of construction. There is the potential for a positive impact as a result of reverting land to previous or improved condition, making the area more attractive to visitors.

4.4.3.3 Potential cumulative impacts

1602. The approach to assessing cumulative impacts is detailed in Section 4.5.

1603. Other developments with potential to impact upon tourism and recreation receptors will be considered. For a cumulative impact to arise during construction, for example, impacts on beach users, recreational sea users and on tourism and recreational facilities, a development would have to happen at the same time and be within a similar area or on a route.

1604. Further consideration will be given to these potential cumulative scenarios as part of the EIA in combination with other projects, particularly in respect to the combined Norfolk Vanguard and Norfolk Boreas scenarios, and the cable route for the proposed Hornsea Project 3.

4.4.3.4 Summary of potential impacts

Table 4.10 Summary of impacts relating to tourism and recreation

Potential impacts	Construction	Operation	Decommissioning
Coastal and marine			
Visual impacts	✓	✓	✓
Disruption to marine and coastal recreational activities	✓	x	✓
Restricted beach access	✓	x	✓
Deterioration to Bathing water / Blue flag beaches and resulting effect on tourism and recreation	x	x	x
Onshore (inland)			
Disturbance including noise, dust and visual impact	✓	x	✓
Disruption to local recreation and tourism provisions and businesses	✓	✓	✓
Reduction in Available Accommodation due to Construction Personnel	✓	✓	✓
Alternate routes / temporary/permanent	✓	✓	✓

Potential impacts	Construction	Operation	Decommissioning
closure of PRoWs			
Reverting land and amenity to an improved condition	x	x	✓
Cumulative impacts	✓	✓	✓

Scoped in (✓) and scoped out (x)

4.4.4 Mitigation

1605. Mitigation measures will be incorporated into the ES as appropriate. Embedded mitigation would ensure that major tourism and recreation facilities such as golf courses, caravan and camp sites, fishing lakes and other local attractions are avoided, wherever possible, during the siting of the onshore electrical infrastructure.

1606. In addition to the projects' embedded mitigation, the following measures may be incorporated in consultation with relevant parties and landowners:

- Adjusting the construction programme to minimise impacts where practicable;
- Avoiding permanent closure of PRoW through careful siting and design and agreeing mitigation (diversions or temporary alternative routes) with the relevant PRoW officers; and
- Siting discussions with landowners, occupiers and local communities during the site selection process.

4.4.5 Approach to assessment and data gathering

1607. The approach to assessment and data gathering outlined below is informed by methodology discussed with regulators during the EPP for Norfolk Vanguard.

1608. The tourism and recreation assessment will include the following:

- A desk-based study to identify tourism and recreation provisions which may be affected by Norfolk Boreas, using maps and local sources;
- Consultation with land owners, occupiers and the local community; their use of the area and the likely short and long term implications of disturbance on their decisions;
- Small sample questionnaire of local accommodation owners to ascertain how they may respond to construction / operational personnel and to understand any relevant seasonal aspects; and
- An assessment of the impacts of Norfolk Boreas on recreation and tourist facilities and identification of appropriate mitigation.

1609. The approach to assessment and data gathering will be discussed and agreed as part of the EPP (detailed in Section 1.6.2) prior to commencement. Consultation will be undertaken at key stages throughout the EIA process.

4.5 Cumulative impacts summary

1610. Wider scheme cumulative impacts will be considered as part of the EIA process. Any other project with the potential to result in impacts that may act cumulatively with Norfolk Boreas will be identified during consultation as part of the Scoping process and following a review of available information and as set out in the Planning Inspectorate's Advice Note 11 (Planning Inspectorate, 2012e). These projects will then be included in the CIA and therefore are scoped into the assessment. The list of cumulative developments to be considered will be consulted upon and agreed with statutory consultees.

1611. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Boreas in the context of other developments that are existing, consented or at application stage, or as part of the development plan.

1612. As discussed in Section 1.2, Vattenfall are seeking to minimise cumulative impacts between Norfolk Boreas and Norfolk Vanguard through the alignment of onshore cable route and the preference for Norfolk Vanguard to pre-install ducts and undertake other enabling works for Norfolk Boreas (Scenario 1 described in Section 1.5.4). Any cumulative impacts between the two sister projects will be assessed within the Norfolk Boreas EIA.

1613. Potential projects may include offshore wind farms, coastal defence projects (such as the Bacton sandscaping scheme) road or large infrastructure projects (including the dualling of the A47, Sizewell Nuclear Power Station and the Norwich Northern Distributor Road) which have a potential to act together with the construction, operation or decommissioning phases of Norfolk Boreas in a cumulative way. In particular, Vattenfall are committed to working with DONG Energy on identifying the potential interactions between the Norfolk Boreas and Norfolk Vanguard onshore cable corridor with the Hornsea Project 3 Offshore Wind Farm onshore cable route, and assessing and mitigating and cumulative effects.

1614. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Boreas in the context of other developments that are existing, consented or at application stage.

1615. Cumulative impacts as a result of the works required for Norfolk Boreas and Norfolk

Vanguard at the Necton National Grid Substation will be included as part of this assessment.

1616. Table 4.11 collates the scoping of onshore cumulative impacts discussed in Sections 4.2 to 4.4.

Table 4.11 Summary of onshore cumulative impacts

Potential impacts	Construction	Operation	Decommissioning
Landscape and Visual	✓	✓	✓
Socio-economics	✓	✓	✓
Tourism and recreation	✓	✓	✓

Scoped in (✓) and scoped out (X)

5 PART 5: CONSULTATION

5.1 Overview

1617. Under the Planning Act 2008 (as amended) consultation relating to an NSIP must be undertaken with statutory or prescribed bodies (under Section 42 of the Act), with local communities (under Section 47) and more widely through the general notification of a proposed application (under Section 48). An applicant must have regard to any relevant response received as a result of this statutory consultation when deciding on the application it will make to the Planning Inspectorate (Section 49).

1618. Section 37 of the Act requires all applications for a DCO to be accompanied by a consultation report which gives details of compliance with the statutory requirements, any relevant responses received and the account taken of those responses. A Consultation Report will be provided along with the DCO application.

1619. Under Section 47 of the Act, a Statement of Community Consultation (SoCC) must be produced to describe how the applicant proposes to consult with the local community. The Applicant will publish the SoCC in early 2018 in advance of consultation on the PEIR (Section 1.1.8). In advance of publishing the SoCC, informal consultation will be on going, as described below.

1620. Under Section 48 of the Act, the applicant is required to advertise formal consultation of the PEIR and proposal to submit a DCO application in relevant newspapers, including a national newspaper, a local newspaper for at least two successive weeks, once in the London Gazette, once in Lloyds List and in a fishing trade journal. Formal consultation commences on the date of the last advert and continues for at least 28 days. During this period, all interested parties have the opportunity to provide feedback to the Applicant to inform the proposed application to be submitted.

5.2 Consultation with Statutory and prescribed bodies

1621. As discussed in Section 1.6.2, the Applicant will undertake key technical stakeholder consultation under the EPP. The EPP provides a mechanism to help agree the information the Applicant needs to supply to the Planning Inspectorate as part of a DCO application for Norfolk Boreas to ensure compliance with the EIA Regulations and Habitat Regulations.

1622. The EPP aims to assist all parties in the process during the development of the proposed DCO application, by:

- Giving greater certainty to all parties on the amount and range of evidence to be presented within the application;
- Providing structure and efficiency to discussion and sequential identification of key environmental and consenting issues;
- Enabling time and resource requirements to be planned and optimised for all parties;
- Helping address and agree issues earlier on in the pre-application stage where possible so robust, streamlined decisions can be taken, and additional data can be collected as required; and
- Providing a platform to debate advice on one topic between multiple agencies.

1623. Although the EPP is not part of the formal consultation, it will provide the audit trail of discussion and where appropriate, agreement for the PEIR produced by the Applicant, which will then be formally consulted upon. It is hoped that the minutes from meetings, and other technical reports produced as part of the EPP will help to form the basis for Statements of Common Ground (SoCG), and relevant sections of the Consultation Report, which will be submitted as part of the DCO application. SoCG provide details of the areas of agreement and disagreement between the Norfolk Boreas development and technical stakeholders with regards to the application, to aid the examination process.

1624. The EPP will include expert topic group meetings. The process will be monitored by an EPP steering group chaired by the Planning Inspectorate, and will be formulated to meet the requirements of Planning Act 2008 and DCO application process.

1625. It is proposed that there are two parallel streams of the EPP, namely:

- Offshore – covering offshore topics of relevance to nature conservation which form part of the HRA and EIA:
    - Physical Processes (nearshore and offshore);
    - Offshore Ornithology;
    - Water and Sediment Quality
    - Benthic Ecology;
    - Marine Mammal Ecology; and
    - Fish and Shellfish Ecology.
- Onshore – covering topics of particular concern to onshore regulators and stakeholders:
    - Onshore ecology (including onshore ornithology);
    - Water Quality, WFD and Flood Risk;
    - Land Quality and Geology;
    - Traffic and Transport;

  - Air Quality and Noise;
  - Health and Socio-Economics;
  - Archaeology (offshore and onshore); and
  - Landscape and Land Use.

- EIA topic areas for which there are established consultation processes will stand outside the EPP, namely:
  - Commercial Fisheries;
  - Shipping and Navigation; and
  - Aviation and Radar.

1626. Following refinement of the onshore project areas based on feedback from this Scoping Report, public consultation and ongoing constraints mapping, relevant landowners will be identified to allow further consultation.

5.3 Community consultation

1627. The Applicant is committed to liaising with communities local to the project and will use a range of methods to disseminate information and seek feedback. Further information will be provided in the SoCC (Section 5.1).

1628. The Applicant is developing a communication strategy to support and drive engagement and evidence gathering compliant with the requirements of the Planning Inspectorate's NSIP process. The strategy will take into account the challenges of differentiation and/or confusion of the Norfolk Boreas project with other offshore wind farms in the area (including Norfolk Vanguard), and local consultation fatigue, and will seek to engage with a broad range of interested parties and demographics during the community consultation process. Where appropriate the Applicant will seek to provide information on both the Norfolk Vanguard and Norfolk Boreas projects at once; this will allow the Applicant to highlight similarities and synergies linking the projects, as well as point out differences. The Applicant will be careful to develop information gathering and involvement methodologies that focus on the individual projects, particularly during statutory consultation on the PEIR.

1629. Key stakeholders will be the first point of contact locally, and will have early notice ahead of any planned engagement, and will be consulted on the Applicant's approach to engagement:

- Parish Councils;
- District and County Council;
- Elected Representatives;
- Key network organisations (if relevant);
- Key community groups e.g. Resident's Associations, development trusts / community

development organisations; and

- Local Authority Neighbourhood Officer(s)/consultation officers (or equivalent function).

1630. In addition, within the agreed core consultation area, the following will be invited and encouraged to participate in the process:

- Local residents;
- Local groups (i.e. those with environmental, social or economic interests,); and
- Business groups.

1631. The Applicant will also engage with the 'hard to reach' audience and interested parties in the wider area, raising awareness of the project, and creating relevant opportunities to encourage participation in consultation events and activities.

1632. Drop-in exhibitions will continue to be held at specific intervals during the EIA process to allow ongoing engagement with local communities. The first phase of these events was held in October 2016 to introduce the projects and the second was held in March and April 2017 to provide further information on the development of the projects. Both phases included multiple locations throughout the onshore scoping area, enabling members of the public to learn about Norfolk Boreas and to share their knowledge of the area to help inform the project design. Further community consultation events will take place during 2018 and following the publication of PEIR.

1633. The display boards presented at the March 2017 drop-in exhibitions are available from the Norfolk Boreas project website[25].

1634. Further to the drop-in exhibitions, members of the public will be given the opportunity to join a mailing list to receive updates on the project. In addition, information will be circulated through media advertising, posters, social media and regular updates to the project website:

http://norfolkboreas.vattenfall.co.uk

1635. Consultation will also be ongoing with Norfolk County Council and relevant District Councils and Parish Councils throughout the EIA process.

1636. The information, views and opinions provided as part of the community consultation both informally and formally will be recorded and along with the views and advice from other stakeholders will be considered in the development of the EIA and in the refinement of the project prior to the DCO application being made. Wherever possible the PEIR and EIA will highlight where and how input and opinion received has been taken into account in the development of the project.

[25] http://norfolkboreas.vattenfall.co.uk/article/documents.

6 PART 6: SUMMARY AND CONCLUSIONS

1637. Summaries of all the potential impacts considered within this scoping report are provided below in Table 6.1, Table 6.2 and Table 6.3. A ✓ indicates that the Applicant proposes to scope the impact into the EIA whereas an x indicates that the Applicant is proposing to scope the impact out of the assessment.

Table 6.1 Summary of potential offshore environment impacts

	Construction	Operation	Decommissioning
Marine Geology, Oceanography and Physical Processes			
Effects to hydrodynamic regime (waves and tidal currents)	x	✓	x
Effects on sediments and sedimentary structures	✓	✓	✓
Effects on suspended sediment concentrations and transport	✓	✓	✓
Cumulative impacts	✓	✓	✓
Transboundary impacts	x	x	x
Marine Water and Sediment Quality			
Deterioration in water quality due to re-suspension of sediments	✓	✓	✓
Release of contaminated sediments	✓	✓	✓
Accidental release of contaminants	x	x	x
Cumulative impacts	✓	✓	✓
Transboundary impacts	x	x	x
Air Quality			
Impacts on offshore air quality	x	x	x
Airborne noise			
Impacts of airborne noise from the offshore project area	x	x	x
Benthic and Intertidal Ecology			
Physical disturbance	✓	✓	✓
Increased suspended sediments	✓	✓	✓
Smothering	✓	✓	✓
Re-mobilisation of contaminated sediments	✓	x	✓
Underwater noise and vibration	✓	x	✓
Loss of habitat	✓	✓	x
Colonisation of foundations	x	✓	x

	Construction	Operation	Decommissioning
Sites of Marine Conservation Interest	✓	✓	✓
Electromagnetic fields (EMF)	x	x	x
Cumulative impacts	✓	✓	✓
Transboundary impacts	x	x	x
Fish Ecology			
Physical Disturbance	✓	✓	✓
Suspended sediments	✓	✓	✓
Re-suspension of contaminants	✓	x	✓
Loss of habitat	x	✓	x
Noise and vibration disturbance	✓	✓	✓
Fish aggregation	x	✓	x
EMF	x	✓	x
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓
Marine Mammal Ecology			
Underwater noise	✓	✓	✓
Barrier effects	✓	✓	✓
Entanglement	x	✓	x
Impacts upon prey species	✓	✓	✓
Vessel interactions	✓	✓	✓
EMF	x	x	x
Disturbance at haul out sites	✓	x	✓
Changes to water quality	✓	✓	✓
Potential impacts on sites of Marine Conservation Interest	✓	✓	✓
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓
Offshore Ornithology			
Disturbance and displacement	✓	✓*	✓
Indirect impacts through effects on habitats and prey species.	✓	x	✓
Collision risk	x	✓*	x
Barrier effect	x	✓*	x
Cumulative impacts	✓	✓	✓

	Construction	Operation	Decommissioning
Transboundary impacts	✓	✓	✓
Commercial Fisheries			
Impacts on commercially exploited species	✓	✓	✓
Loss of or restricted access to traditional fishing grounds	✓	✓	✓
Displacement of fishing activity	✓	✓	✓
Loss of or damage to fishing gear	x	✓	✓
Increased collision risk (to be covered by NRA)	✓	✓	✓
Increased steaming times	✓	✓	✓
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓
Shipping and Navigation			
Vessel routeing	✓	✓	✓
Displacement of Third Party marine activities:	✓	✓	✓
Increased collision risk	✓	✓	✓
Allision risk	✓	✓	✓
Interference with marine navigational equipment	x	✓	x
Interaction with subsea cables	✓	✓	✓
Impacts on Emergency Response Resources	✓	✓	✓
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓
Offshore Archaeology and Cultural Heritage			
Direct physical disturbance	✓	✓	✓
Indirect physical disturbance	✓	✓	✓
Indirect disturbance of setting (offshore)	✓	✓	✓
Indirect disturbance of setting (landfall)	✓	x	x
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓
Aviation and Radar			
Impact on Radar Systems	x	✓	x
Impact HMRs and Offshore Platforms	✓	✓	✓
Impact on Military Training Area	x	x	x
Increased collision risk	✓	✓	✓

	Construction	Operation	Decommissioning
Cumulative impacts	✓	✓	✓
Transboundary impacts	x	x	x
Infrastructure and Other Users			
Potential interference with other wind farms development	x	x	x
Potential interference with oil and gas operations	✓	x	x
Physical impacts on subsea cables and pipelines	✓	x	✓
Impacts on aggregate dredging activities	✓	x	✓
Impacts on disposal sites	x	x	x
Initiation of UXO	x	x	x
Impacts on MOD activities	x	x	x
Cumulative impacts	x	x	x
Transboundary impacts	x	x	x

*Only assessed in relation to the Norfolk Boreas site and not the export cable. Scoped in (✓), scoped out (x)

Table 6.2 Summary of potential onshore environment impacts

	Construction	Operation	Decommissioning
Ground Condition and Contamination			
Contaminant mobilisation from earthworks during construction	✓	x	✓
Alteration to coast line, including coastal geological designated sites	✓	x	✓
Sterilisation of mineral resources and waste generation	✓	x	✓
Cumulative impacts	✓	x	✓
Air Quality			
Increase in traffic based air quality pollutant concentrations – human receptor locations	✓	x	✓
Increase in traffic based air quality pollutant concentrations – ecological habitats	✓	x	✓
Construction dust impacts – human receptors	✓	x	✓
Construction dust impacts – ecological habitats	✓	x	✓
Cumulative impacts	✓	x	✓
Water Resource and Flood Risk			
Impacts on water resources	✓	✓	✓

	Construction	Operation	Decommissioning
Flood risk	✓	✓	✓
Cumulative impacts	✓	✓	✓
Land Use			
Agricultural productivity	✓	✓	✓
Drainage	✓	✓	✓
Disruption to farming practices	✓	✓	✓
Temporary closure/redirection of PRoWs/cycle paths	✓	✓	✓
Existing utilities	✓	x	✓
Public health and safety	✓	✓	✓
Loss of land	x	✓	x
Diversion of PRoWs	x	✓	x
Soil heating/ desiccation	x	✓	x
Cumulative impacts	✓	✓	✓
Onshore Ecology			
Impacts to statutory and non-statutory designated sites	✓	✓	✓
Permanent and temporary loss of habitats	✓	x	✓
Temporary habitat fragmentation and species isolation	✓	x	✓
Impacts to legally protected and notable species	✓	✓	✓
Spread of non-native invasive species	✓	x	✓
Impacts from lighting	✓	✓	✓
Cumulative impacts	✓	✓	✓
Onshore Ornithology			
Impacts to legally protected and notable species	✓	x	✓
Temporary and permanent loss of habitat suitable for nesting, roosting and foraging birds	✓	✓	x
Noise, vibration and visual disturbance to birds	✓	✓	✓
Cumulative impacts	✓	✓	✓
Archaeology and Cultural Heritage			
Direct impact on (permanent change to) buried archaeological remains	✓	x	✓
Direct impact on (permanent change to) above ground archaeological remains – e.g. historic earthworks (including the historic landscape character)	✓	x	✓

	Construction	Operation	Decommissioning
Indirect impact on the setting of heritage assets (designated and non-designated, including historic landscape character)	✓	✓	✓
Impact on potential geoarchaeological / palaeoenvironmental remains, potentially indicative of former land surfaces	✓	x	✓
Cumulative impacts	✓	✓	✓
Noise and Vibration			
Noise affecting human and ecological receptors	✓	✓	✓
Vibration affecting human and ecological receptors	✓	x	✓
Cumulative impacts	✓	✓	✓
Traffic and Transport			
Driver delay	✓	x	✓
Severance	✓	x	✓
Pedestrian/cycle amenity	✓	x	✓
Road safety	✓	✓	✓
Abnormal loads	✓	x	✓
Cumulative impacts	✓	x	✓
Health			
Accidental / Incidental Chemical Spills / Leaks to Surface / Ground / Coastal waters or Soils	✓	x	✓
Emissions to air (including dust)	✓	x	✓
Waste disposal and transport	✓	x	✓
Transport related accidents	✓	✓	✓
Obstruction to or loss of open space and health benefits	✓	✓	✓
Community stress and anxiety as a result of increased pollution (water) risk, flood risk, noise, visual, heavy traffic, or crime due to in-migrant workers	✓	✓	✓
EMF	x	✓	x
Cumulative	✓	✓	✓

Scoped in (✓) and scoped out (x)

Table 6.3 Summary of potential impacts on wider scheme aspects

	Construction	Operation	Decommissioning
Landscape, Seascape and Visual amenity			
Landscape, visual and cumulative impacts of offshore components	x	x	x
Landscape and visual impacts of landfall	✓	x	x
Landscape and visual impacts of cable relay station	✓	✓	✓
Landscape and visual impacts of onshore cable route	✓	x	x
Landscape and visual impacts of substation	✓	✓	✓
Cumulative impacts of landfall	x	x	x
Cumulative impacts of cable relay station	✓	✓	✓
Cumulative impacts of onshore cable route	✓	x	x
Cumulative impacts of substation	✓	✓	✓
Socio-economics			
Employment opportunities and supply chain	✓	✓	✓
Impact on the demand for housing, accommodation and local services	✓	✓	✓
Impact on offshore industries (will be considered in Section 2.10 and Section 2.11)	✓	✓	✓
Impact on offshore and coastal tourism and associated economic value	✓	✓	✓
Impacts on local tourism and recreation resources, including PRoWs	✓	✓	✓
Cumulative socio-economic impacts	✓	✓	✓
Tourism and Recreation			
Coastal and marine			
Visual impacts	✓	✓	✓
Disruption to marine and coastal recreational activities	✓	x	✓
Restricted beach access	✓	x	✓
Deterioration to Bathing water / Blue flag beaches and resulting effect on tourism and recreation	x	x	x
Onshore (inland)			
Disturbance including noise, dust and visual impact	✓	x	✓
Disruption to local recreation and tourism provisions and businesses	✓	✓	✓
Reduction in Available Accommodation due to Construction Personnel	✓	✓	✓

	Construction	Operation	Decommissioning
Alternate routes / temporary/permanent closure of PRoWs	✓	✓	✓
Reverting land and amenity to an improved condition	x	x	✓
Cumulative impacts	✓	✓	✓

Scoped in (✓) and scoped out (X)

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