Norfolk Vanguard Offshore Wind Farm

Environmental Impact Assessment Scoping Report

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Photo: Kentish Flats Offshore Wind Farm

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October 2016

For and on behalf of Vattenfall Wind Power Limited

Approved by: Andrew Pain

Signed: [redacted]

Date: 23/09/2016

For and on behalf of Royal HaskoningDHV

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Date: 23/09/2016

EXECUTIVE SUMMARY

This document supports a request for an Environmental Impact Assessment (EIA) Scoping Opinion from the Planning Inspectorate for the Norfolk Vanguard offshore wind farm. Norfolk Vanguard 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 Vanguard project are reducing greenhouse gas emissions, providing energy security, and maximising economic opportunities from investment for the UK.

Norfolk Vanguard is located 47km offshore (at the closest point). It will have a generation capacity of 1.8GW (1800MW) and will produce enough energy to power 1.3million UK households[1]. The wind farm comprises two distinct areas, Norfolk Vanguard East (NV East) and Norfolk Vanguard West (NV West) and will be connected to the shore by offshore export cables installed within the provisional offshore cable corridor.

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

- Landfall (within the landfall search area);
- Cable relay station if required (within the cable relay search area);
- Underground cables (within the cable corridor search area); and
- Onshore substation (within the substation search area).

A grid connection offer was provided by National Grid in July 2016 based on an onshore connection point at the existing 400kV Necton National Grid Substation. The Applicant has taken up this offer and is committed to an underground cable solution which has the benefit of avoiding landscape and visual impacts associated with overhead lines.

The exact locations of the landfall and onshore infrastructure are yet to be determined. Site selection for the onshore infrastructure locations is ongoing and responses to the Scoping Request and public consultation will help to inform the development of Norfolk Vanguard.

Norfolk Vanguard is being developed by VWPL (or an affiliate company). 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 2017. Vattenfall plans to invest £5bn in renewables, mainly offshore wind, in Northern Europe by 2020 and Norfolk Vanguard represents the next step in the UK. VWPL has world leading experience in offshore wind, as owners of the Kentish Flats, Kentish Flats Extension, Ormonde, and Thanet offshore wind farms, which are currently operational in the UK.

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

The EIA will be completed by technical specialists using best practice and following appropriate guidance. Key aspects of the EIA are likely to be traffic and transport, noise, landscape and visual, tourism and recreation, commercial fisheries, ornithology and marine mammals. This Scoping Report outlines all of the receptors that will be considered during the EIA and the planned approach to characterising the existing environment, assessing potential impacts associated with Norfolk Vanguard and developing mitigation measures. Consultation will be ongoing with stakeholders 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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Glossary of acronyms

$\mu g\ l^{-1}$	Microgram per litre
AAC	Army Air Corp
ADR	Air Defence Radar
AfL	Agreements for Lease
AGLV	Areas Of Great Landscape Value
AIS	Automatic Identification System
ALC	Agricultural Land Classification
AONB	Area of Outstanding Natural Beauty
BODC	British Oceanographic Data Centre
CAA	Civil Aviation Authority
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
CPUE	Catch Per Unit Effort
CTMP	Construction Traffic Management Plan
CTV	Crew Transit Vessel
CWS	County Wildlife Sites
DCO	Development Consent Order
DP	Dynamic Positioning
dSPA	Draft Special Protection Area
DWR	Deep Water Routes
DWT	Deadweight Tonnes
EAOW	The Consortium Company, East Anglia Offshore Wind Ltd
EcIA	Ecological Impact Assessment
EEA	European Economic Area
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
ER	Environmental Report
ERA	Environmental Risk Assessment
ES	Environmental Statement
EU	European Union
FRA	Flood Risk Assessment
FSA	Formal Safety Assessment
GBS	Gravity Base Systems
GDP	Gross Domestic Product
GES	Good Environmental Status

GMSL	Global Marine Systems
GT	Gross Tonnes
GW	Gigawatt
HDD	Horizontal Directional Drilling
HIR	Health Impact Review
HRA	Habitat Regulations Assessment
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
IBTS	Internaltional Bottom Trawl Survey
ICES	International Council for the Exploration of the Sea
IMO	International Maritime Organisation
JNCC	Joint Nature Conservation Committee
LEC	Levelised Energy Cost
LVNL	Luchtverkeersleiding Nederland
m	Metres
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
MMO	Marine Management Organisation
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
MSL	Mean Sea Level
MW	Megawatt
NATS	National Air Traffic Services
NDC	Nationally Determined Contribution
NERL	National Air Traffic Services En Route Ltd
$ng\ l^{-1}$	Nanogram per Litre
nm	Nautical Miles
NMMP	National Marine Monitoring Programme
NNR	National Nature Reserve
NPPF	National Planning Policy Framework
NPS	National Policy Statement
NRA	Navigation Risk Assessment
NSIP	Nationally Significant Infrastructure Project
NTS	Non-Technical Summary
NUC	Not Under Command
NV East	Norfolk Vanguard East
NV West	Norfolk Vanguard West
O&G	Oil and Gas
O&M	Operation and Maintenance
OAV	Offshore Accommodation Vessel
OEM	Original Equipment Manufacturer

OESEA	Offshore Energy Strategic Environmental Assessment
OFTO	Offshore Transmission Owner
OREI	Offshore Renewable Energy Installation
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
PEI	Preliminary Environmental Information
PEIR	Preliminary Environmental Information Report
PrOW	Public Right of Way
pSAC	Proposed Special Area Of Conservation
PSR	Primary Surveillance Radar
RAF	Royal Air Force
RYA	Royal Yachting Association
SAC	Special Area of Conservation
SAR	Search and Rescue
SCI	Site of Community Importance
SCOS	Special Committee on Seals
SPA	Special Protection Area
SPR	Scottishpower Renewables (UK) Limited
S-P-R	Source-Pathway-Receptor
SPZ	Source Protection Zone
TEU	Treaty on European Union
TSS	Traffic Separation Scheme
UK	United Kingdom
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
VMS	Vessel Monitoring Systems
VWPL	Vattenfall Wind Power Ltd
WFD	Water Framework Directive
WTG	Wind Turbine Generators
ZAP	Zone Appraisal and Planning
ZDA	Zone Development Agreement
ZEA	Zone Environmental Appraisal
ZTA	Zone Technical Appraisal

Glossary of Terminology

Array cables	Cables which link the wind turbine generators and the offshore substation platform.
Onshore Cable corridor	The area which contains the buried cables as well as the temporary running track, topsoil storage and excavated material during construction.
Onshore Cable corridor search area	The area being considered within which the cable corridor will be located
Cable relay search area	The area being considered within which the cable relay station will be located
Cable relay station	Primarily comprised of an outdoor compound containing reactors (also called inductors, or coils) and switchgear.The function of the reactors is to increase the power transfer capability of the cables, and reduce electrical losses in the system.
Evidence Plan Process	A voluntary consultation process with specialist stakeholders to agree the

	approach to the EIA and information to support HRA.
Existing Necton 400kV National Grid Substation	The grid connection location for Norfolk Vanguard
Interface cables	Buried high-voltage cables linking the onshore substation to the Existing Necton 400kV National Grid substation
Jointing pit	Underground structures constructed at regular intervals along the 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 search area	The area being considered within which the landfall will be located
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 bring electricity from the offshore substation platform to the landfall.
Offshore project area	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 marshall the power from the wind turbine generators and convert it into a more suitable form for export to shore. In an HVAC solution the substation steps up the power from 66kV (array cable voltage) to 220kV (export cable voltage). In an HVDC solution the substation steps up the voltage and also converts the power from AC to DC.
Onshore cables	The cables which take the electricity from landfall to the onshore substation
Onshore scoping area	The overall area of the landfall search area, cable relay station search area, cable corridor search area and substation search areas. This will be refined following further site selection and consultation
Provisional offshore cable corridor	The area where the offshore export cables will be located. This will 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.
Onshore substation	A 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 will 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.
Substation search area	The area being considered within which the onshore substation will be located
The OWF sites	The two distinct offshore wind farm areas, Norfolk Vanguard East and Norfolk Vanguard West
The Applicant	Vattenfall Wind Power Ltd or an affiliate company
The Project	Norfolk Vanguard Offshore Wind Farm, including the 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 document supports a request for a formal Environmental Impact Assessment (EIA) Scoping Opinion from the Planning Inspectorate for the Norfolk Vanguard offshore wind farm (OWF). This Scoping Report 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 1.3.2.5, respectively).

2. The project will have a capacity of 1800MW which is enough to power 1.3 million UK households[2]. The offshore wind farm comprises two distinct areas, Norfolk Vanguard East (NV East) and Norfolk Vanguard West (NV West) (the 'OWF sites') and will be connected to the shore by offshore export cables installed within the provisional offshore cable corridor (Figure 1.1). The OWF sites 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 and areas.

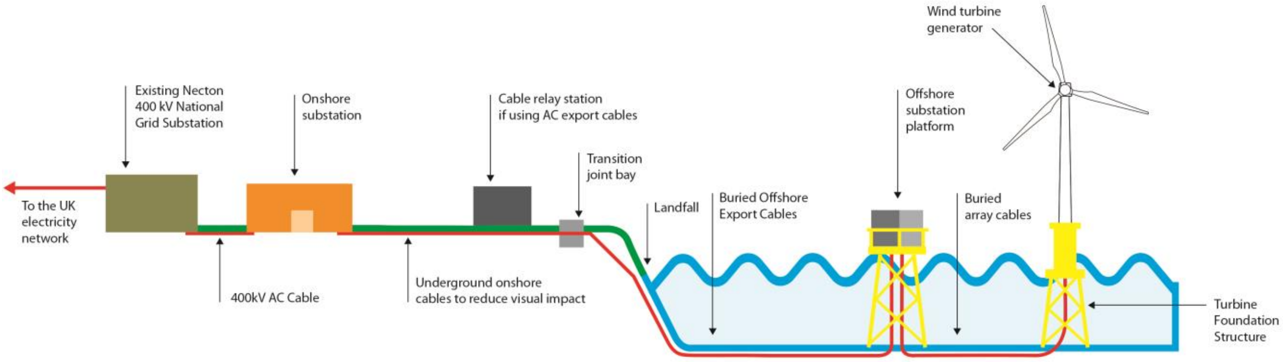


Plate 1.1 Schematic diagram of Norfolk Vanguard

3. The project will also require onshore infrastructure in order to connect the offshore wind farm to the National Grid. This is explained in Sections 1.4.3 and 1.4.4 and in summary will comprise:

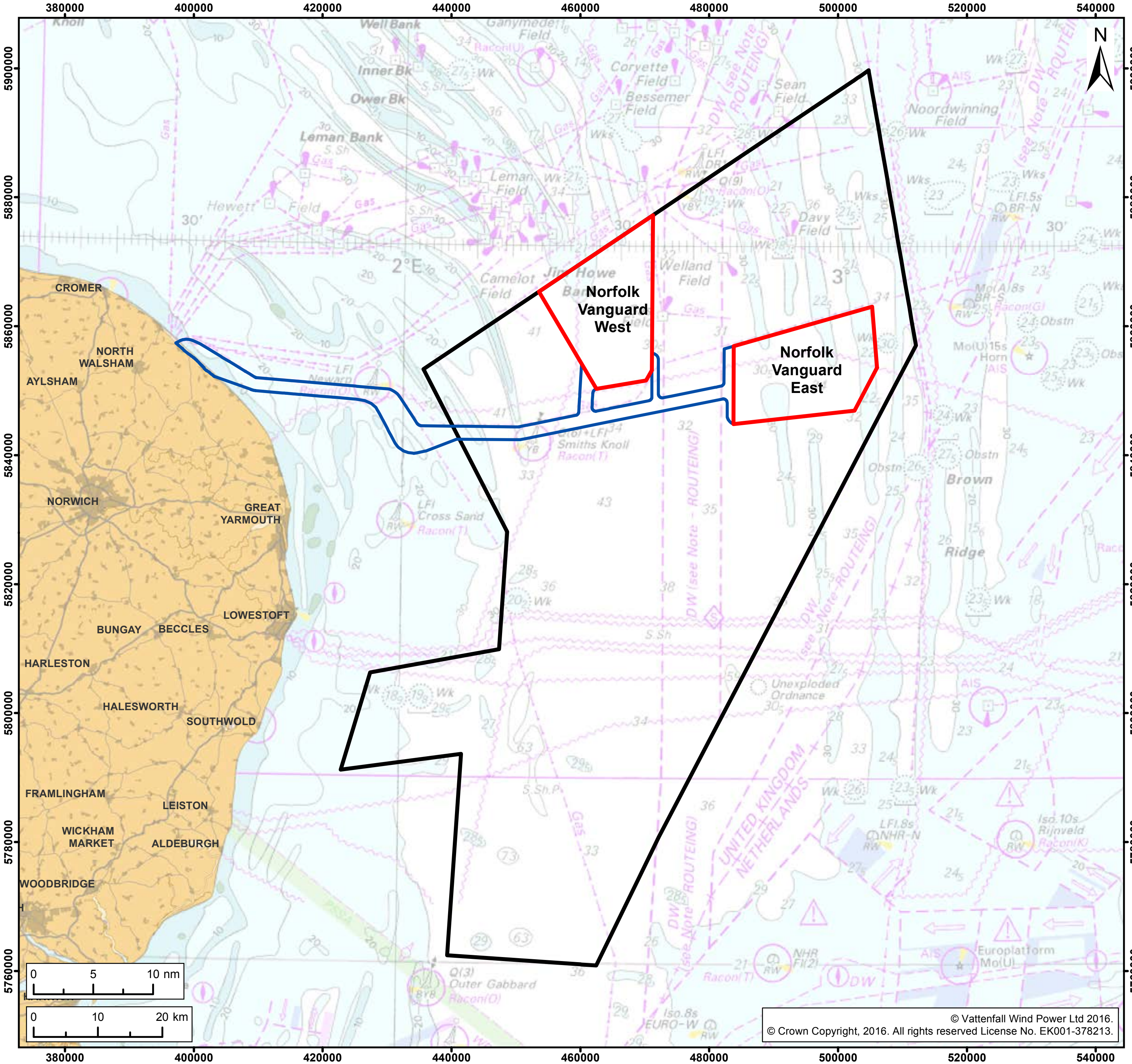
- Landfall (within the landfall search area, Figure 1.3);
- Cable relay station if required (within the cable relay search area, Figure 1.6);
- Underground cables (within the cable corridor search area, Figure 1.5);
- Substation (within the substation search area, Figure 1.4); and
- Connection to the existing Necton 400kV National Grid Substation (Figure 1.2).

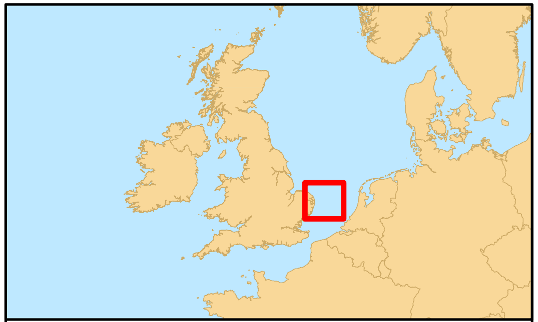
[2] http://www.renewableuk.com/page/UKWEDExplained assuming a load factor of 34.88

4. The search areas combined comprise the ‘onshore scoping area’ (Figure 1.2).

5. The offshore and onshore electrical infrastructure will be sold to an Offshore Transmission Owner (OFTO). This is expected to be after the project has been built and commissioned.

6. Site selection is ongoing to refine the locations of the onshore infrastructure (see Section 1.4). Responses to the Scoping Request will inform the development of Norfolk Vanguard. A full description of the project can be found in Section 1.4.





Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- former East Anglia Zone

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Norfolk Vanguard Offshore Project Area

Figure: 1.1 Drawing No: PB4476-002-2-001

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
03	05/09/16	JE	GK	A4	1:850,000
02	10/06/16	JE	GK	A4	1:850,000

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

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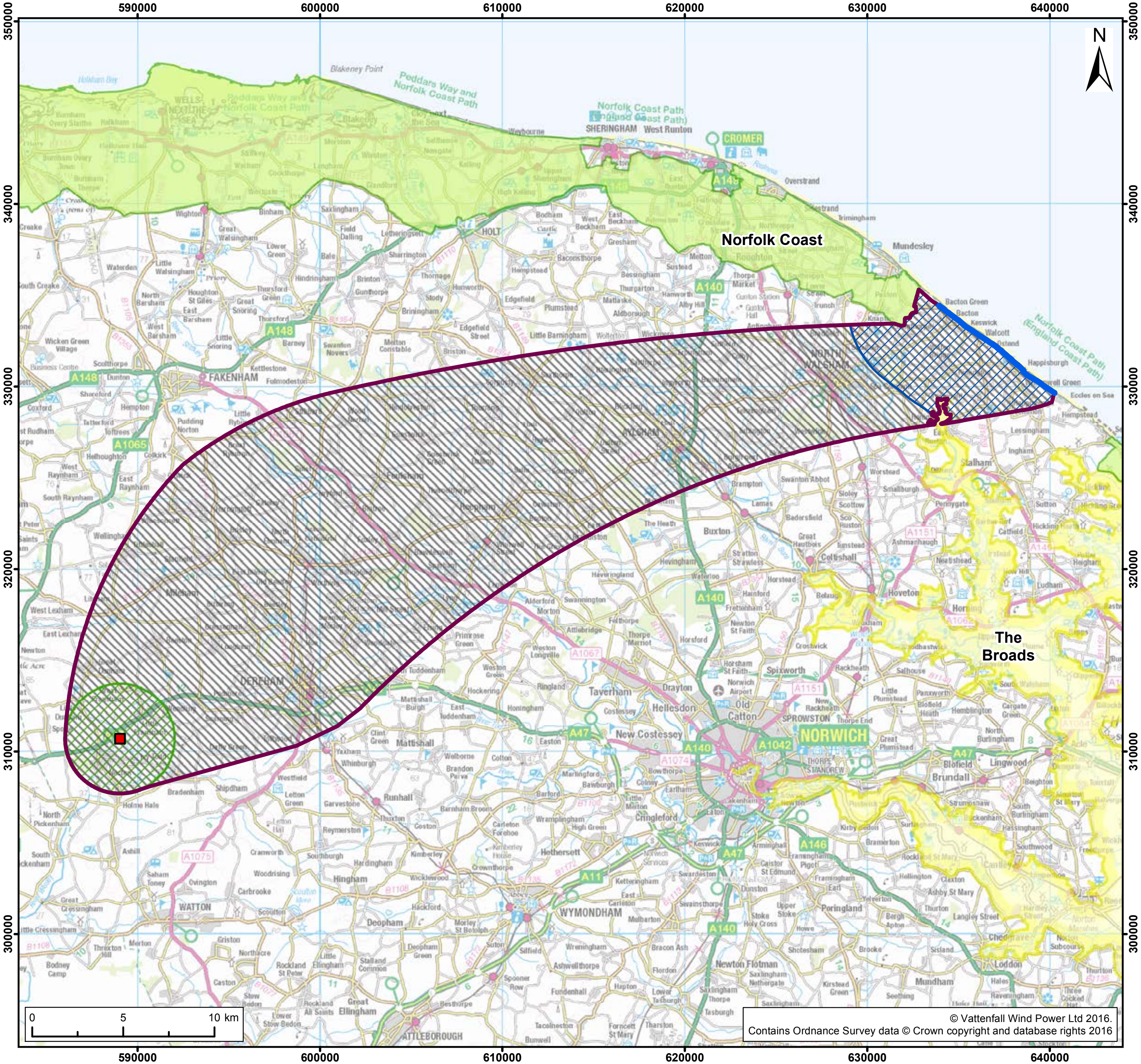

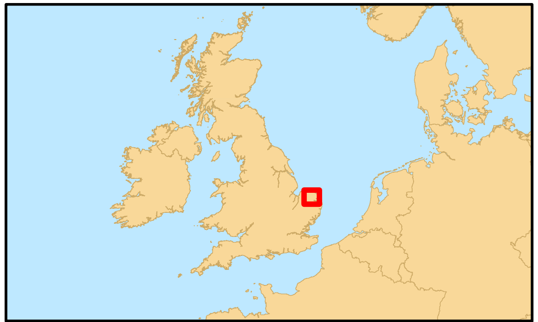

Legend:

- Onshore Scoping Area
- Existing Necton 400kV National Grid Substation
- Landfall Search Area
- Cable Relay Station Search Area
- Substation Search Area
- Cable Corridor Search Area
- Area of Outstanding Natural Beauty (AONB)
- National Park

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Norfolk Vanguard Onshore Scoping Area

Figure: 1.2 Drawing No: PB4476-002-2-043

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	JE	RH	A4	1:300,000

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

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1.1.1 Description of the offshore project area

7. Norfolk Vanguard comprises two distinct areas, NV East and NV West, which are located approximately, 70km and 47km from the coast of Norfolk, respectively (at the nearest points). These two areas are included in the EIA and DCO application process as a single project.

8. The offshore site includes areas of sand ridges with associated peaks and troughs. Water depths range from 25m to 47m relative to Chart Datum (CD) in NV West and from 21m to 45m (CD) in NV East (Figure 1.1). The site has a maximum tidal range of approximately 1.96m (from -0.99m mean seal level (MSL) to 0.97m (MSL). The physical characteristics of the offshore environment are discussed further in Section 2.2.

9. Offshore infrastructure will include wind turbines and foundations, array cables which join together the turbines in strings, up to three offshore substations, and offshore export cables connecting the offshore substations to landfall (discussed further in Section 1.4.2.3).

1.1.2 Description of the onshore scoping area

10. The onshore scoping area is currently based on wide search areas (see Figure 1.2) which have been identified by initial constraints and feasibility studies. Within these search areas are sensitive features that will be avoided where possible (see Section 1.5.6).

11. The landfall search area is dominated by arable farming, tourism, and the Bacton Gas Terminal in the north. There are no large settlements within the landfall and cable relay station search areas, however, there are several small villages including Happisburgh, Bacton and Walcott. The cable corridor search area is currently relatively broad and lies within the county of Norfolk. The substation search area is in the parish of Necton.

12. Onshore infrastructure requirements are discussed in Section 1.4.4. These include landfall, a cable relay station, onshore cables, and the onshore substation in proximity to the grid connection point at the existing Necton 400kV National Grid Substation. The exact location of each of these will be determined by ongoing constraints analysis as well as public and stakeholder consultation during the EIA and DCO application process.

1.1.3 Port locations

13. 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 (OEMs) (to minimise transportation requirements) and availability of suitable dockside space.

14. The primary base for the operations and maintenance (O&M) facility for Norfolk Vanguard is likely to be at a suitable port facility on the Norfolk coast. Options currently include ports at Lowestoft, Great Yarmouth and Wells-next-the-Sea.

15. 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.

1.1.4 Project background

16. 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 Vattenfall Wind Power Ltd (VWPL) and ScottishPower Renewables (UK) Limited (SPR). Under the ZDA, the joint venture consented East Anglia ONE and commenced the EIAs for East Anglia THREE (prior to the project being taken forward to submission by SPR) and East Anglia FOUR (up to submission of a request for Scoping Opinion in 2012).

17. In December 2014, a decision was taken to split the zone, with VWPL having development rights within the north of the former East Anglia Zone and SPR continuing to develop the southern part. In agreement with The Crown Estate, the ZDA was effectively dissolved in 2016. New Agreement for Lease (AfL) areas have been awarded by The Crown Estate within the former Zone, separately to VWPL/its affiliate companies and SPR/its affiliates.

18. VWPL or an affiliate company (hereafter referred to as 'the Applicant') is now undertaking the EIA for Norfolk Vanguard ("the project"). NV East (Figure 1.1) includes the former East Anglia FOUR area with a slightly revised boundary. A Scoping Report for East Anglia FOUR was submitted in 2012 under the former ZDA (EAOW, 2012b).

19. VWPL also has an AfL for a second development, Norfolk Boreas (shown in Figure 2.33), which will be the subject of a separate DCO application. Norfolk Boreas will be considered further within the EIA as part of the Cumulative Impact Assessment (CIA) (see Section 2.17). Norfolk Vanguard and Norfolk Boreas each have a capacity of 1800MW, providing a total offshore wind farm generation capacity of 3600MW (3.6GW).

1.1.5 The Applicant

20. Vattenfall is the Swedish state-owned utility and one of Europe's largest generators of electricity and heat. Vattenfall is also the second largest player in the global offshore sector. It is Vattenfall's ambition to be at the forefront of the low carbon transition and the company is strongly committed to significant growth in wind energy, onshore and offshore. Vattenfall 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 2017. Vattenfall plans to invest £5bn in renewables, mainly offshore wind, in Northern Europe by 2020 and has the ambition that the UK will continue to be a growth market for Vattenfall, with Norfolk Vanguard and Norfolk Boreas providing the next steps.

21. Vattenfall has world leading experience in offshore wind, as owners of the Kent cluster – Kentish Flats, Kentish Flats Extension and Thanet offshore wind farms, and Ormonde offshore wind farm, which are currently operational in the UK. Vattenfall is also developing a number of European offshore wind farms and 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.

1.1.6 The Scoping Report

22. This Scoping Report supports a request for a formal EIA Scoping Opinion from the Planning Inspectorate. The 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, operation and maintenance (O&M) and eventual decommissioning of Norfolk Vanguard.

23. The 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 Scoping Opinion from the Planning Inspectorate on the information to be included in an Environmental Statement (ES).

24. 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 1.3). 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 be significant,

reducing the emphasis on those issues which are increasingly shown (from repeated assessment in offshore wind and professional judgement) to be non-significant. The EIA for Norfolk Vanguard will take into account the lessons learnt on those offshore wind farm projects that have gone through the consenting, construction, O&M and decommissioning processes already. In line with this approach, the Scoping Report will make robust recommendations, supported by evidence, regarding the issues that the Applicant proposes to exclude (scoped 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 this will be considered further as part of the EIA (scoped in).

25. 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.

1.1.7 The Scoping Report structure

26. The Scoping Report has the following structure:

- Part 1 – Introductory Section (this section)
    - Introduction – this section introduces the Scoping Report;
    - 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 Vanguard 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;
    - 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;
    - EIA Methodology – a description of how the EIA will be undertaken, the philosophy 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

27. The following key milestones are planned for the Norfolk Vanguard EIA:

- Submission of Scoping Report to the Planning Inspectorate - October 2016;
- Scoping consultation phase - 42 days from submission;
- First drop-in exhibitions - October 2016 (discussed further in Section 5);
- Further drop-in exhibitions - dates expected in 2017 and 2018;
- PEIR submission - Q4 2017;
- PEIR formal consultation - Q4 2017 (a minimum of 28 days); and
- DCO application submission - Q2 2018.

1.2 Need for the Project

28. The key drivers underpinning the need for renewable energy are:

- The need to reduce greenhouse gas emissions, including increasing energy generation from low carbon sources to replace high carbon energy sources such as burning coal and oil;
- The need for energy security, including:

    - The need to secure safe, affordable, reliable and preferably local energy generation for the UK market;
    - The need to replace existing old energy generation infrastructure;
    - The need to support expected electricity demand whilst meeting climate change commitments; and

- The need to maximise economic opportunities from energy infrastructure investment for the UK.

29. In a post-Brexit speech at the Utility Week Energy Summit in July 2016, the UK Secretary of State for Environment, Food and Rural Affairs confirmed the importance of these key drivers to the UK and that offshore wind has strategic importance in achieving these. The UK government has committed to support up to 10GW of new projects in the 2020s (HM Government, 2016).

1.2.1 The need to reduce greenhouse gas emissions

30. 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.

31. Commitment was made during the 21st Conference of the Parties (COP) in Paris in 2015 (Section 1.3.1.1) 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.

32. Between 2009 and 2014 power sector emissions declined by an average of 4% per annum, with a record 18% fall during 2014 as a result of moving to low carbon sources. In order to achieve necessary ongoing reductions in emissions, the Committee on Climate Change recommended that the UK government should support 1-2GW of offshore wind per year until subsidies can be removed in the 2020s (Committee on Climate Change (undated)).

33. The European Union (EU) and UK legislation that has been put in place to secure a reduction in emissions is outlined in Section 1.3.1.

1.2.2 The need for energy security

34. 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, 2016). Electricity generated in the UK during this period fell by 3.4%, however the share of electricity generated from renewable sources increased by 2.3%. Key issues associated with energy security in the UK are the decline in fossil fuel reserves (in particular North Sea oil and gas) as well as the ongoing decommissioning of existing fossil fuel and nuclear electricity generating infrastructure and the need for replacement sources. These plants have either reached the end of their operational life span, are no longer economical to run, and/or do not meet legal emissions levels. Around a fifth of the energy capacity available in 2011 will close within this decade (DECC, 2012).

35. As heating, transport and industry become increasingly electrified, the electricity demand is very likely to increase (HM Government, 2011). The National Policy Statement for Energy (see Section 1.3.2.4) estimates that additional electricity generating infrastructure to ensure adequate supplies will require net new capacity of approximately 59GW by 2025, of which, 33GW will need to be from renewable sources (DECC, 2011a).

36. The former Secretary of State for Energy and Climate Change outlined that energy security is the number one priority for the government, whilst also seeking to achieve a supply that is affordable and clean. It was confirmed that offshore wind is expected to be a significant component of the UK's energy security (HM Government, 2015).

37. Reliance on global markets for imported energy leaves the UK vulnerable to spikes in world energy market prices and potentially, to physical supply disruptions. The DECC (2012) Energy Security Strategy outlines the approach to ensuring that consumers have access to energy to meet the demand (physical security) at prices which are resilient to volatile prices such as those experienced for fossil fuels (price security).

38. The UK Offshore Energy Strategic Environmental Assessment (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.

1.2.3 The need to maximise economic opportunities

39. 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). The energy sector in the UK plays a central role in the economy and renewable energy can play a major part in boosting the economy and providing new jobs and skills.

40. 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.

41. The offshore wind industry presents an opportunity to utilise, and further develop the UK's maritime engineering skills as other industries decline (such as shipbuilding and North Sea oil) in order to secure supply chain and other employment opportunities in the UK. The importance of maximising opportunities for the involvement of local businesses and communities in offshore wind has been highlighted as a key success factor for the sector in the UK (Crown Estate 2014).

42. The replacement of existing infrastructure with new technologies also represents significant investment in the UK economy.

1.3 Policy and Legislative Context

43. This section presents a summary of the key legislative and policy drivers that underpin and support development of Norfolk Vanguard.

44. 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 2016 referendum on UK withdrawal from the EU, the UK will continue to be committed to all EU treaties until finalisation of the withdrawal agreement and/or until two years after initiation of article 50 of the Treaty on European Union (TEU). At the time of writing, article 50 has not yet been initiated. Following withdrawal, the exact nature of amendments to UK legislation which had an origin in EU law will depend on the agreements made with the EU and the extent to which EU measures continue to apply (e.g. in order to achieve trading agreements) as well as the ongoing political agendas of the UK government. The key drivers regarding the need for offshore wind (discussed in Section 1.2) will continue to be important in the UK following withdrawal from the EU.

1.3.1 Climate change and renewable energy policy and legislation

1.3.1.1 United Nations Framework Convention on Climate Change

45. The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC), which commits its parties to setting internationally binding emission reduction targets as well as monitoring and reporting emissions. The protocol was agreed in 1997 and was ratified by the United Kingdom (UK) in 2002.

46. During the latest annual United Nations Climate Change Conference in Paris in 2015 (known as ‘COP21’) the following key areas of agreement were achieved (UNFCCC, 2016):

- Limit global temperature increase to below 2^{o}C, while pursuing efforts to limit the increase to 1.5^{o}C above the pre-industrial average temperature;
- Parties aim to reach global peaking of greenhouse gas emissions as soon as possible in order to achieve the temperature goal;
- Commitments by all Parties to prepare, communicate and maintain a Nationally Determined Contribution (NDC);
- Contribute to the mitigation of greenhouse gas emissions and support sustainable development;
- Enhance adaptive capacity, strengthen resilience and reduce vulnerability to climate change;
- Help vulnerable countries cope with the adverse effects of climate change, including extreme weather events and slow-onset events such as sea-level rise;
- Support the efforts of developing countries to build clean, climate-resilient futures;
- Transparent reporting of information on mitigation, adaptation and support which undergoes international review; and
- In 2023 and every 5 years thereafter, a global stocktake will assess collective progress toward meeting the purpose of the Agreement.

1.3.1.2 European Union Renewables Directive/Renewable Energy Directive

47. In September 2001, the EU adopted its first renewable energy Directive (2001/77/EC) on the 'Promotion of Electricity Produced from Renewable Energy Sources in the Internal Electricity Market'. In April 2009, this was replaced with the Renewables Directive (2009/28/EC). The two key targets this Directive proposed to achieve were:

- 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.

48. In order to achieve the required reduction in emissions there is a target for the UK to produce 15% of its energy consumption from renewables (DECC, 2011b). Around 6.5% of the UK electricity requirement in October to December 2015 was provided by offshore wind (DECC, 2016).

1.3.1.3 The UK Climate Change Act (2008)

49. The Climate Change Act sets the framework for the UK to transition to a low-carbon economy and exceeds the targets set out in the EU Renewables Directives with the following:

- A reduction of 34% in greenhouse gases by 2020 (below 1990 levels); and
- A reduction of 80% in greenhouse gases by 2050

50. The Department for Energy and Climate Change (DECC) UK Renewable Energy Roadmap (DECC, 2013) sets out in detail how the UK plans to reach its renewable energy targets, with strong emphasis on offshore wind.

51. The UK's fifth carbon budget was approved by the UK Government in July 2016. This provides a commitment to reducing emissions by 57% by 2030 to work towards achieving the 80% target by 2050. Offshore wind represents an important contribution to these targets by providing low-carbon energy generation (Committee on Climate Change, 2015).

1.3.1.4 The UK Energy Act (2013)

52. The Electricity Market Reform policy and Energy Act 2013 introduced Contracts for Difference (CFD) to provide incentives in the form of revenue stabilisation for new low carbon initiatives, replacing the previous Renewable Obligation system. CFD is driven to ensure Levelised Energy Cost (LEC) to the consumer. However, in 2015 the UK Government announced cuts to the CFD subsidies for renewable energy with the focus being to deliver UK energy security through a sustainable electricity market with minimal government intervention, whilst maintaining relatively consistent costs for consumers. If Government conditions on cost reductions are met by developers, budget may be made available for further CFD auctions. VWPL is focusing on lowest cost of energy during the development of Norfolk Vanguard in order to increase the viability of the project and the chance of success in line with current government policies.

1.3.2 Planning legislation

1.3.2.1 The Planning Act 2008

53. 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).

54. NSIPs are usually large scale, nationally significant developments such as new ports, airports, major road and rail schemes or power generating stations. As NSIPs they, require permission to construct and operate known as a DCO, under procedures governed by the Planning Act 2008. The 2008 Act sets out thresholds above which certain types of infrastructure development are considered to be nationally significant and require a DCO. For offshore energy developments the threshold is a generating capacity of over 100MW. Norfolk Vanguard will have a generating capacity of 1800MW and is therefore an NSIP and a DCO application, supported by an ES, will be the project consenting route followed by the Applicant.

55. As part of its application for a DCO, the Applicant will seek other relevant permissions, consents and licences. Powers to compulsorily acquire land or rights, either permanently or temporarily may also be sought as part of the DCO. Where considered appropriate, other consents or powers necessary to construct or operate the proposed project may be sought. These may include (but are not limited to) the following:

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

56. Secondary legislation and guidance relevant to DCO applications have also been taken into account in planning the approach to the Norfolk Vanguard EIA. A full list of these can be found on the Planning Inspectorate website[3].

1.3.2.2 Localism Act 2011

57. Under the Localism Act 2011, the Planning Inspectorate became the agency responsible for operating the planning process for NSIPs. As discussed above, any developer wishing to construct a NSIP must obtain a DCO. For such projects, the Planning Inspectorate examines the application and will make a recommendation to the relevant Secretary of State, who will make the decision on whether to grant or to refuse development consent.

1.3.2.3 Marine and Coastal Access Act 2009

58. The Marine and Coastal Access Act (MCAA) 2009 sets out improved management and protection of the marine and coastal environment. The MCAA established the

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

Marine Management Organisation (MMO), the authority tasked with ensuring the delivery of sustainable development in the marine area.

59. The MCAA also adds a new section to the Planning Act 2008, enabling a DCO applicant to apply for a deemed marine licence as part of the DCO process.

60. Through the MCAA, the UK Government introduced a marine planning system. The Marine Policy Statement (MPS) adopted by all UK administrations in March 2011 provides the policy framework for the preparation of marine plans, establishing how decisions affecting the marine area should be made in order to enable sustainable development. The East Inshore and Offshore Marine Plans encompass the Norfolk Vanguard offshore project area and states "*Proposals for Offshore Wind Farms inside Round 3 zones, including relevant supporting projects and infrastructure, should be supported*" (HM Government, 2014).

61. The MCAA enables the designation of Marine Conservation Zones (MCZs) in England and Wales as well as UK offshore areas (see Section 1.3.3.5).

1.3.2.4 National Policy Statements

62. 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. Planning decisions will be taken within the clear policy framework set out in the NPSs, making these decisions as transparent as possible. The Planning Inspectorate will have regard to NPSs in its examination of applications for development consent, and Ministers will have regard to them when making decisions. NPSs include the Government's objectives for the development of nationally significant infrastructure in a particular sector and state:

- How these objectives will contribute to sustainable development;
- How these objectives have been integrated with other Government policies;
- How actual and projected capacity and demand have been taken into account;
- Relevant issues in relation to safety or technology;
- Circumstances where it would be particularly important to address the adverse impacts of development; and
- A clear framework for investment and planning decisions.

63. There are twelve NPS in total, of which six are relevant to energy and were produced by the former DECC. The energy NPS received designation by the former Secretary of State for Energy and Climate Change on 19 July 2011. The three NPS of relevance to Norfolk Vanguard 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.

1.3.2.5 Requirement for EIA and the EIA process

64. EIA is a tool for systematically examining and assessing the impacts of a development on the physical, biological and human environment. This process allows management and mitigation measures to be identified to ensure the development is sustainable. The ES, which documents the EIA process, will contain the following information:

- A description of the development comprising information on the site, design and size of the development;
- A description of the mitigation measures envisaged in order to avoid, reduce and, if possible, offset significant adverse effects;
- The data required to identify and assess the main effects which the development is likely to have on the environment;
- An outline of the main alternatives studied by the applicant and an indication of the main reasons for the applicant's choice, taking into account the environmental effects; and
- A non-technical summary (NTS).

65. EIA was introduced under the 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).

66. The amendments made by EIA Directive 2014/52/EU are due to be transposed into UK legislation in May 2017. 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 processes 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 development;
- 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.

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

68. The EIA process will take account of guidance provided by the Planning Inspectorate in the form of the non-statutory National Infrastructure Advice Notes. These are published to provide advice and information on a range of issues arising throughout the whole life of the application process. Although in many cases they include recommendations from the Planning Inspectorate about the approach to particular matters of process, which developers and others are encouraged to consider carefully, it is not a requirement for developers or others to have regard to the content of Advice Notes. 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, 2012);
- Advice Note Ten: Habitat Regulations Assessment (the Planning Inspectorate, 2016); and
- Advice Note Twelve: Transboundary Impacts (the Planning Inspectorate, 2015c).

1.3.2.6 The project design envelope principle

69. The Norfolk Vanguard EIA will be based on a ‘Rochdale Envelope’ approach. The Planning Inspectorate Advice Note Nine (the Planning Inspectorate, 2012) 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 development. This is due to a number of factors such as the evolution of technology, the need for flexibility in key commercial project decisions and the need for further detailed surveys (especially geotechnical surveys) which are required before a final design and layout can be determined. It is therefore important that a design envelope is used to provide flexibility. 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. This principle is referred to as the 'Rochdale Envelope' and it allows confidence that the EIA process is robustly considering the likely impact of the project while allowing the project to be optimised and refined by the time of construction, which may be several years after the DCO application is made. 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.

70. The general principle of the assessment is that for each receptor and potential impact, the impact assessment will be based on assessing a range of project design parameters, whilst ensuring that all project scenarios from which the parameters are derived are realistic and buildable. If a combination of design parameters leads to a scenario that cannot realistically occur then the worst case scenario will be reconsidered and a realistic set of worst case parameters will be assessed. The end result will be an EIA based on clearly defined environmental parameters that will govern or define the full range of development possibilities and hence the likely environmental impacts that could result from the grant of development consent.

1.3.2.7 Transboundary considerations

71. 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 Espoo Convention has been implemented by the EC Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment (known as the EIA Directive) as amended by Directives 97/11/EC, 2003/35/EC and 2009/31/EC. It is transposed into UK law for NSIPs by way of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 (the EIA Regulations)., specifically under regulation 24. This requires that, where the application is for EIA development, and where the Planning Inspectorate is of a view that it will have significant effects on the environment of another member state or receives a request for involvement from another European Economic Area (EEA)[4] member state, it must undertake a prescribed process of consultation and notification.

72. The Planning Inspectorate published Advice Note Twelve: Development with significant transboundary impacts consultation (Planning Inspectorate, 2015c)

[4] The EEA comprises the countries of the European Union (EU) plus Iceland, Liechtenstein and Norway

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 Advice Note sets out the roles of the Planning Inspectorate, UK Government departments and developers. Developers are advised to identify the possible significant transboundary effects or why they consider that there would not be any significant effects on another EEA State, *inter alia*.

1.3.3 Environmental legislation

1.3.3.1 The OSPAR Convention

73. International cooperation to protect the marine environment (including biodiversity) of the north east Atlantic is achieved through the OSPAR Convention.

74. A key part of OSPAR's biodiversity strategy is to establish a network of Marine Protected Areas (MPAs). The UK has currently identified 244 OSPAR MPAs, many of which are Natura 2000 sites (see Section 1.3.3.4) that also meet the relevant OSPAR selection criteria (OSPAR, 2003).

1.3.3.2 The Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention)

75. Ramsar Sites are designated under the Convention on Wetlands of International Importance, agreed in Ramsar, Iran in 1971 and ratified by the UK in 1976. The criteria for assessing a site for designation as a Ramsar site include whether or not the wetland supports 20,000 water birds and/or supports 1% of the individuals in a population of one species or subspecies of water bird. UK Government policy affords the same protection to Ramsar sites as European designations such as SPAs and SACs. The UK has generally chosen to underpin the designation of its Ramsar sites through prior notification of these areas as Sites of Special Scientific Interest (SSSI).

1.3.3.3 The Convention on Biological Diversity

76. The Convention on Biological Diversity is a legally binding treaty, which came into force in December 1993 with 168 signatories, of which the UK is one. It has three main objectives:

- The conservation of biological diversity;
- The sustainable use of the components of biological diversity; and
- The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources.

77. The Convention on Biological Diversity recognised for the first time in international law that the conservation of biological diversity is "*a common concern of*

humankind" and is an integral part of the development process. The Convention covers all ecosystems, species, and genetic resources.

1.3.3.4 European Union Directives

Water Framework Directive (WFD)

78. The WFD (2000/60/EEC) addresses the quality of inland, estuarine and groundwater bodies including coastal surface waters up to an offshore limit of one nautical mile. Monitoring of the aquatic environment in relation to physical, chemical and biological parameters started in 2006 with a view to ensuring a ‘good ecological status’ of all surface water bodies. Chemical and biological Environmental Quality Indicators (EQI) are used and a programme of measures is implemented in order to improve surface waters that do not meet the required status.

Marine Strategy Framework Directive (MSFD)

79. The MSFD (European Council Directive 2008/56/EC) aims to establish a framework within which Member States will take measures to maintain or achieve ‘good environmental status’ (GES) in the marine environment by 2020.

80. The MSFD aims to be complementary to, and provide the overarching framework for a number of other key Directives and legislation at the European and UK level, such as the Habitats Directive, the Birds Directive, the WFD, the Common Fisheries Policy and the UK Marine and Coastal Access Act.

Habitats Directive and Birds Directive

81. EC Directive 92/43/EEC implements the Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention) and The Convention on the Conservation of Migratory Species of Wild Animals (the Bonn Convention) and is known as the Habitats Directive. The directive 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.

82. The Habitats Directive provides for robust protection for those habitats and species of European importance. A key element of this protection is the establishment under Article 3 of the Directive of a European wide network of protected sites, known as Special Areas of Conservation (SACs).

83. EC Directive 2009/147/EC on the conservation of wild birds (known as the Birds Directive) provides a framework for the conservation and management of wild birds

in Europe. It sets broad objectives for a wide range of activities. The directive also resulted in the establishment under Article 4 of the Directive of a network of Special Protection Areas (SPAs) for rare or vulnerable species listed in Annex I of the Directive and for all regularly occurring migratory species. It also establishes a general scheme of protection for all wild birds (required by Article 5). The Directive requires national Governments to establish SPAs and to have in place mechanisms to protect and manage them. The SPA protection procedures originally set out in Article 4 of the Birds Directive have been replaced by the Article 6 provisions of the Habitats Directive.

84. Natura 2000 is an EC term that incorporates both SPA and SAC designated sites. SACs and SPAs form the Natura 2000 network of important high-quality conservation sites that are intended to significantly contribute to the conservation of habitats and species listed in the EU Birds and Habitats Directives.

85. European Protected Species (EPS) are those listed in Annexes II and IV of the Habitats Directive. These species include both animals and plants in marine and terrestrial environments.

1.3.3.5 UK Legislation

Marine Coastal and Access Act 2009

86. As discussed in Section 1.3.2.3, the MCAA enables the designation of MCZs in England, Wales and UK offshore waters. MCZs are intended to conserve a functioning marine ecosystem without a specific bias towards any particular species or habitat. The primary aim of MCZs is to deliver the government's vision for an 'ecologically coherent network of MPAs' across the UK and to ensure the health of the wider UK marine environment. These sites are intended to protect habitats and species not necessarily covered by existing mechanisms and complement the existing MPA network of SACs and SPAs.

87. The Act includes provisions for the coastal environment including improving access to the coast and undertaking Integrated Coastal Zone Management (ICZM), which brings policy makers, decision makers and stakeholders together to manage coastal and estuarine areas.

Wildlife and Countryside Act, Habitats Regulations and Offshore Marine Regulations

88. 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. Improved provisions for the protection and management of SSSIs were also introduced by the Countryside and Rights of Way Act 2000. SSSIs are often designated for very specific areas, and the presence of several SSSIs in one

region has, in many cases, formed the basis of SPA and SAC boundary classification. Natural England has overall responsibility for the management of the SSSI network in England.

89. The Wildlife and Countryside Act 1981 also enables Statutory Nature Conservation Bodies to declare sites which are considered to be of national importance as National Nature Reserves (NNRs). NNRs also provide additional statutory protection to the finest SSSIs in England and Wales. Natural England is the body responsible for the designation of NNRs under the legislation previously mentioned for SSSIs as all NNRs must be within a designated SSSI. Natural England manages the majority of English NNRs, with the remaining sites managed by other approved organisations such as the National Trust, the Forestry Commission, the RSPB, local Wildlife Trusts, and Local Authorities.

90. The Wildlife and Countryside Act makes it an offence (with exception to species listed in Schedule 2 and with additional penalties for species listed in Schedule 1) to intentionally: kill, injure, or take any wild bird; take, damage or destroy the nest of any wild bird while that nest is in use or being built; and take or destroy an egg of any wild bird. The Act 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 shelter or protection. The Act also makes it an offence (subject to exceptions) to intentionally pick, uproot or destroy any wild plant listed in Schedule 8 and it is a criminal offence to plant or otherwise cause to grow any non-native, invasive species listed under Schedule 9 of the Act.

91. In England and Wales the Habitats Directive is implemented under the Conservation of Habitats and Species Regulations 2010 (the 'Habitats Regulations'). For UK offshore waters (i.e. 12nm from the coast out to 200nm or to the limit of the UK Continental Shelf Designated Area), the Habitats Directive is transposed into UK law by the Offshore Marine Conservation (Natural Habitats & c.) Regulations 2007 (as amended) (the 'Offshore Marine Regulations').

92. The Habitat Regulations and the Offshore Marine Conservation (Natural Habitats, & c.) Regulations 2007 (as amended), make it an offence to kill, injure, capture or disturb EPS. Where appropriate, licences can be obtained to allow persons to carry out activities that would otherwise be prohibited, without committing an offence. Licences for actions which may affect marine EPS are issued by the MMO beyond 12nm and for action up to 12nm can be obtained from Natural England. Licences required for terrestrial species would be obtained from Natural England. The Habitats Regulations make it an offence (subject to exceptions) to deliberately capture, kill, disturb, or trade in the animals listed in Schedule 2, or pick, collect, cut, uproot, destroy, or trade in the plants listed in Schedule 4. The Regulations require

competent authorities to consider or review planning permission, applied for or granted, affecting a European site, and, subject to certain exceptions, restrict or revoke permission where the integrity of the site would be adversely affected.

93. The provisions of the Birds Directive are implemented through the Wildlife and Countryside Act 1981 (as amended), the Habitats Regulations (2010) as well as other legislation related to the use of land and sea.

94. Natural England is responsible for identifying sites suitable for SPA or SAC designation and for conducting public consultation on those sites in English inshore waters (0-12 nm). The Joint Nature Conservation Committee (JNCC) leads on the selection of SPAs and SACs within the UK offshore area (i.e. those beyond 12nm). Sites that span inshore and offshore waters are progressed jointly by Natural England and JNCC.

95. Once a site has been identified, it becomes a draft SPA or SAC and then undergoes consultation within the UK to become a possible SPA/SAC. Following consultation and assignment of conservation objectives, it is submitted for approval to the EC (becoming a candidate SPA/SAC) and must receive protection that is equivalent to a fully designated SPA/SAC. Once approved by the EC, it becomes a Site of Community Importance (SCI) and then the UK government designates the site as an SPA (under the Birds Directive) or SAC (under the Habitats Directive).

Habitat Regulations Assessment

96. 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.

97. HRA generally follows a four stage process (Defra, 2010):

- Stage 1: Screening is the process which initially identifies the likely impacts upon a Natura 2000 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 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, 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 (IROPI) and, if so, of the compensatory measures needed to maintain the overall coherence of the Natura 2000 network.

98. It is important to note that where priority habitats or species are present, the imperative reasons need to be "…*reasons relating to human health, public safety or beneficial consequences of primary importance to the environment, or other reasons which in the opinion of the European Commission are imperative reasons of overriding public interest*", whereas for non-priority habitats and species, imperative reasons of a social or economic nature may be acceptable, as long as they are "*considered to be sufficient to override the harm to the site*."

99. 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.

Countryside and Rights of Way Act 2000

100. Under the Countryside and Rights of Way Act 2000, Natural England has the power to designate Areas of Outstanding Natural Beauty (AONBs) in England that are outside national parks and that are considered to have significant landscape value. The Act amends the law relating to public rights of way including making provision for public access on foot to certain types of land. Amendments are made in relation to SSSIs to improve their management and protection, as well as to the Wildlife and Countryside Act 1981, to strengthen the legal protection for threatened species. Provision is also made for AONBs to improve their management.

The Protection of Badgers Act 1992

101. The Act 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. The Act also 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)

102. Section 41 of the Act requires the relevant Secretary of State to compile a list of habitats and species of principal importance for the conservation of biodiversity in England (herein 'S41 species'). Decision makers of public bodies, in the execution of their duties, must have regard to the conservation of biodiversity in England, and the list is intended to guide them.

The Hedgerow Regulations 1997

103. The Regulations 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

104. The Act aims to protect areas of common land, in a sustainable manner delivering benefits for farming, public access and biodiversity.

1.4 Project Description

105. This section provides an overview of the likely key parameters and description of the project design (Sections 1.4.1 to 1.4.4), indicative construction sequencing (Section 1.4.5), the possible construction methodologies (Section 1.4.6) and the decommissioning options (Section 1.4.8). The parameters provided are indicative in order to inform the scoping process and will be detailed in the ES to provide the design envelope (see Section 1.3.2.6) for the DCO application. The key offshore components of the wind farm are likely to comprise the following:

- Wind turbine generators (WTGs) and their associated foundations;
- Offshore Substation Platforms (OSPs);
- Offshore Accommodation Platforms (if required) or Offshore Accommodation Vessels (OAV);
- Array cables between the WTG and the OSPs;
- Subsea export cables between the OSPs and the shore; and
- Scour protection around foundations and on array and export cables as required.

106. 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; and
- Onshore substation in proximity to the grid connection location at the existing Necton 400kV National Grid Substation.

107. Meteorological and oceanographic monitoring equipment (e.g. Light Detection and Ranging (LIDAR)) may be required during pre-construction, construction and operation.

108. Table 1.1 provides an overview of the indicative project parameters.

Table 1.1 Indicative project characteristics

Feature	Indicative Parameters
Offshore	
Maximum capacity	1800MW
Lease period	50 years
Number of turbines	120 - 257
NV East area	297km^2
NV West area	295km^2
Distance from Norfolk Vanguard to shore (closest distance)	47km
Approximate provisional offshore cable corridor length from NV East to shore	89km
Approximate provisional offshore cable corridor length from NV West to shore	73km
Maximum number of offshore export cables	6
Maximum number of offshore fibre optic cables	6
Offshore export cable burial depth	1-3m
WTG capacity	7 – 15MW
Maximum WTG rotor diameter	250m
Hub height	150m
Tip height	275m
Minimum rotor clearance above Mean High Water Springs (MHWS)	22m
Indicative minimum separation between turbines	1km
Water depth over wind farm site	21 – 47m
Offshore substation platforms and accommodation platform (if required)	2 – 6 platforms
Inter array cable length and format	Approximately 500km (66kV)
Landfall	
Number of cables	Up to 6 cables in 6 separate ducts
Number of transition pits	Up to 6

Feature	Indicative Parameters
Transition pit footprint	10m x 15m (5m deep)
Number of HDD exit pit	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)
Number of interface cables	Up to 12
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 1000m), up to 6 at each location
Substation footprint	300m x 250m
Substation buildings height	20m

1.4.1 Electrical connection options

109. Two different electrical connection options will be included within the consent for the Norfolk Vanguard (high voltage alternating current (HVAC) and high voltage direct current (HVDC)). The decision as to which option will be used for the project will be agreed post consent and will depend on availability, technical considerations 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, up to 18. Both options avoid the need for new overhead lines.

1.4.2 Offshore

1.4.2.1 Wind Turbine Generators

110. Currently available WTGs include, for example Siemens SWT-154-7.0 and Vestas V164, which have ratings of 7MW and 8MW, respectively. WTG development between the time of scoping and construction (see Section 1.1.8) is unknown, however it is anticipated, based on industry research, that ratings of 15MW may become available prior to construction of Norfolk Vanguard. The EIA will therefore be undertaken on a range of rated capacities (e.g. 7MW to 15MW) in order to future proof the EIA and DCO.

111. Based on this WTG capacity range and the total site capacity of 1800MW, Norfolk Vanguard is likely to consist of up to 257 WTGs. It is possible that more than one turbine model will be used across the site.

112. It is estimated that the maximum turbine hub height used would be 150m with

maximum rotor diameter likely to be 250m. The wind turbines will incorporate tapered tubular towers and three blades attached to a nacelle housing mechanical and electrical generating equipment.

113. The division of WTGs across NV East and NV West and the layout will be informed by site investigation works post consent. Each site could have up to 1200MW with an overall combined maximum capacity of 1800MW.

114. It is anticipated that the layout of WTGs will be regular in plan (i.e. turbines will be set out in rows).

1.4.2.2 Foundations

115. The design of foundations for the WTGs and OSPs will be informed by site investigation and procurement, post consent. A number of factors will influence the choice of foundation and the parameters of each foundation option (e.g. the type and size of WTG 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); and
- Gravity base structures (GBS).

116. 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 1.2 below.

Table 1.2 Foundation descriptions

Foundation type	Description
Monopile	Cylindrical steel pile with conical transitions - up to 10m diameter Penetration could be 30 to 60m depth below seabed level
Jackets on pin piles (3 or 4 legs)	Steel pin piles - diameter approximately 3m Seabed penetration of up to 60m Spacing 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)	Numerous design variants will be considered: • Reinforced or pre-stressed concrete shell with sand ballast fill • Typically conical shape

Foundation type	Description
	• Up to 60m diameter footprint at base • Minimal penetration

117. 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 10 x diameter (i.e. 10m monopile may require 100m diameter scour protection). Alternative foundation options are likely to require smaller areas of scour protection.

1.4.2.3 Offshore electrical infrastructure

118. Offshore electrical infrastructure will include the following components:

- Array cabling;
- OSP; and
- Export cabling to bring the electricity from the wind farm sites to landfall.

119. 66kV array cables will be used to connect the WTGs to the OSP. Array cables will be 3-core HVAC cables with a diameter of approximately 160mm. The maximum length of array cabling for Norfolk Vanguard will be 650km, with a more likely total length estimated to be 500km. The location of the array cabling will be determined post consent, subject to the final layout of the WTGs.

120. If HVAC is selected, up to three 600MW OSP will be required. Alternatively, for the HVDC option, two 900MW will be required. This would provide a combined capacity of 1800MW for either option.

121. The export cables will 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.

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

1.4.3 Landfall

123. Cable landfall, where the export cables are brought onshore, will be achieved by techniques such as Horizontal Directional Drilling (HDD) from the land above the

seacliffs to the intertidal zone (known as short HDD) or into the subtidal zone (long HDD) (see Section 1.4.6.4).

124. On the landward side of the HDD, up to six ducts will be required to transfer the offshore export cables to the transition pits where they will be joined to the onshore cables.

125. Transition pits are below-ground structures that house the joints between the offshore export cables and the onshore cables. There will be up to six transition pits located within the landfall search area. Typical dimensions for each pit would be approximately 10m wide, 15m long and 5m deep. Each transition pit will comprise a buried concrete structure with access by a manhole cover. These transition pits may also house the required SCADA equipment or alternatively a second set of smaller jointing pits would be provided.

1.4.4 Onshore

1.4.4.1 Cable relay station

126. If HVAC export cabling is selected, a cable relay station will be required in order to condition the electricity for onward transmission to the grid.

127. The cable relay station is primarily comprised of an outdoor compound of approximately 150m x 75m encompassing reactors (also called inductors, or coils). In AC power systems, reactors are used to absorb unwanted charging currents that are produced in capacitive components such as cables. This technique, which is referred to as 'reactive compensation', increases the power transfer capability of cables, and reduces electrical losses in the system.

128. The reactors are a passive electrical component which resists changes in electric current passing through it. The device comprises one or more sets of conducting coils; when current flows in these coils, energy is stored in a magnetic field that passes through each of the coils.

129. The indicative height of equipment within the cable relay station will be 8m.

1.4.4.2 Onshore cable corridor and onshore cabling

130. To facilitate the installation of onshore cables, buried ducts for all onshore cables will be installed in advance (approximate duct diameter 260mm). Onshore cables will be pulled through at later stages (see Section 1.4.6.5).

131. The HVAC option will require up to 18 onshore cables, each in separate ducts. Cables will be laid in up to six trenches (each trench is approximately 1.5m deep and 1m

wide) and there will be three export cables per trench (Plate 1.2). Up to six fibre optic cables will be required, each in separate ducts with one laid in each trench.

132. The HVDC option will require up to 4 onshore cables, each in separate ducts. Cables will be laid in up to two trenches, each with two cables (Plate 1.2). Up to two fibre optic cables will be required, each in separate ducts with one laid in each trench. Onshore SCADA infrastructure will be considered as part of the EIA.

133. The following onshore cable options are anticipated:

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

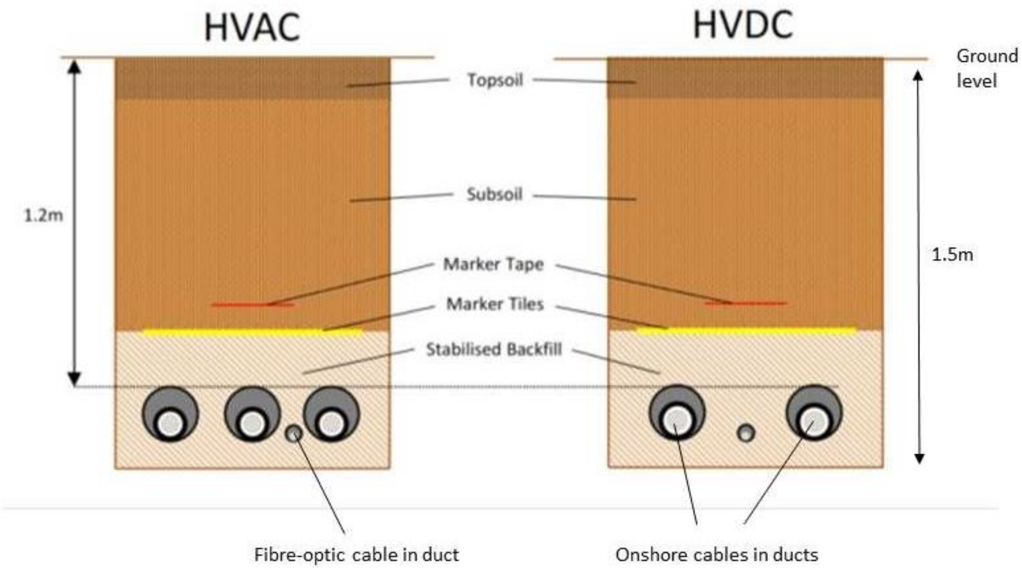

Plate 1.2 Indicative cable trench sections for HVAC and HVDC options

134. A temporary onshore cable corridor will be required during the construction phase (see Section 1.4.6.5) which would provide an area for storage of excavated substrate and a track alongside the trench. Plate 1.3 and Plate 1.4 provide an indication of the areas required for the HVDC and HVAC options, showing the maximum corridor width will be 50m, except for short sections at major crossings and engineering constraints where it may be wider.

135. The cable will be transported to the site on a drum 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.

136. The jointing pits will be underground concrete structures of approximately 15m (length) x 6m (width) x 2m (depth). The jointing pits will be constructed at regular intervals along the cable route (500 - 1000m) to facilitate installation of the cables

into the buried ducts (see Section 1.4.6.5), with up to six bays 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 will be located at the edge of field boundaries or roads to facilitate future access and minimise any potential impacts.

137. Link boxes will be required at a number of locations 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 will be small markers at each link box.

138. Temporary mobilisation areas will be required for welfare, parking and storage. Additional working areas will be required at crossing sites. The location and size of all areas required for construction will be defined in the EIA, based on the final cable route selection.

139. Following construction, the cable trench will be infilled and the cable corridor reinstated. The jointing pits will be covered with topsoil once the cables have been installed and the joints have been completed and tested. Access points to the link boxes will be maintained.

140. The Applicant is currently awaiting a grid connection offer from National Grid in relation to Norfolk Boreas. Once that offer has been received, consideration will be given to an appropriate cable connection route and substation location for Norfolk Boreas. In the event that a common cable corridor for Norfolk Vanguard and Norfolk Boreas is considered to be appropriate, consideration will also be given to potential efficiencies and synergies between the projects, with the aim of minimising adverse impacts. The Applicant will discuss its proposed approach with relevant consultees, where appropriate once the grid connection location for Norfolk Boreas is known.

Plate 1.3 Indicative HVDC onshore cable corridor

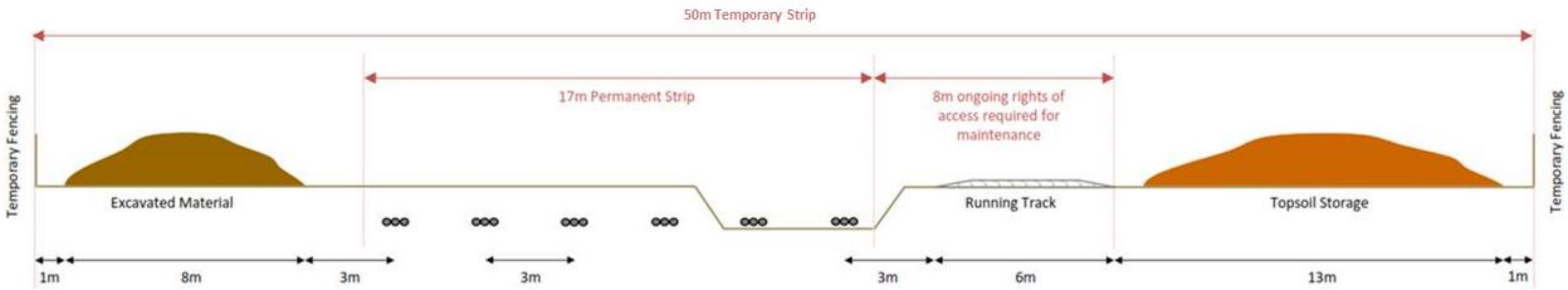

Plate 1.4 Indicative HVAC onshore cable corridor

1.4.4.3 Substation

141. A substation is required to be sited near the to the existing Necton 400kV National Grid Substation to enable connection to the National Grid (see Section 1.5.6). In an HVAC system the substation will convert the exported power from 220kV (export cable voltage) to 400kV (grid voltage). For an HVDC system this will 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.

142. The substation will be a fenced compound encompassing buildings and outdoor equipment. The area of the compound will be approximately 300m x 250m, based on the maximum parameters of an HVDC substation. The maximum height of the buildings will be approximately 20m.

143. The appearance of the substation will depend on whether the HVAC or HVDC technology is utilised. In the case of HVAC, most of the substation compound will consist of outdoor electrical plant such as transformers, reactors and capacitor banks. The majority of this equipment will be 6m or less in height, but some items will be up to 10m. There will be a central control building (indicative height 15m) containing high-voltage gas-insulted switchgear, control rooms and other facilities; there will also be a number of smaller buildings (indicative height 4m). In the case of HVDC option, the substation will comprise two identical HVDC converter stations; each converter station will contain a high-voltage AC switchyard area and a large warehouse-style building (indicative height 20m). The AC switchyard will contain transformers, reactors, capacitor banks and other outdoor equipment; height of this equipment will generally be 10m or less, but some items could be up to 15m. The large building will house the DC converter equipment.

144. The connection between the Norfolk Vanguard onshore substation and the existing Necton 400kV National Grid Substation will require interface cables, comprising up to twelve 400kV underground cables. The interface cables will 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.

145. It is envisaged that any works required at the existing Necton 400kV National Grid Substation would be consented and constructed by National Grid. Consultation has been undertaken with National Grid and is ongoing to understand the extent and level of works to the existing Necton 400kV National Grid Substation, however additional switchgear and electrical equipment for connection of the onshore export cable system to the transmission networks will be required. These will be considered in the CIA for Norfolk Vanguard.

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

1.4.5 Construction sequencing

1.4.5.1 Offshore

147. It is envisaged that Norfolk Vanguard will be built out in either two phases of 900MW (HVDC option) or three phases of 600MW (HVAC option). The location of each phase across NV East and NV West will be determined based on constraints identification throughout the EIA process as well as post consent site investigations. The EIA will therefore assess a capacity range in each of NV East and NV West up to a combined capacity of 1800MW.

148. Construction is likely to be staggered with temporal overlap. 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 2023 to 2025, commissioning 2025;
- Phase 2 - Construction 2024 to 2026, commissioning 2026; and
- Phase 3 - Construction 2025 to 2027, commissioning 2027.

1.4.5.2 Landfall

149. Installation of the landfall ducts is expected to be from 2022 to 2024.

1.4.5.3 Onshore

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

- Onshore enabling works - 2020 onwards;
- Main works for substation infrastructure and cable ducting - 2022 to 2023;
- Installation of cables and substation plant for phase 1 - 2024;
- Installation of cables and substation plant for phase 2 - 2025; and
- Installation of cables and substation plant for phase 3 - 2026.

1.4.6 Construction methods

1.4.6.1 WTG and offshore platform installation

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

152. Different methods will 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 1.3 .

Table 1.3 Foundation and WTG 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/caissons transported to site • Installation template set down on seabed • Piles stabbed and driven/suction caissons sunk • Tripods lifted and set down on piles/caissons • 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 piles/caissons transported to site • Installation template set down on seabed • Piles stabbed and driven/suction caissons sunk • Tripods lifted and set down on piles/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.

Foundation type	Description
GBS	• Seabed preparation (dredging) as necessary • GBS transported to site by vessel (or floated) • 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.

1.4.6.2 Offshore cable installation

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

154. Burial depths for the offshore export cables will 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) will 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).

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

1.4.6.3 Offshore safety zones

156. During offshore construction activities, the Applicant will apply for safety zones[5] around WTG, platforms and installation vessels as appropriate. These safety zones will be based on an appropriate navigation risk assessment and applied for to the relevant authorities and in consultation with relevant consultees.

1.4.6.4 Landfall

157. The short HDD option would place 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 see the exit points taken up to 1000m offshore.

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[5] 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)

158. The factors influencing the choice of exit point 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 will determine the maximum length of the long option HDD.

159. 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 will most likely fall between the two extremes quoted above, being a factor of all the issues.

160. At the point at which the HDD punches out, be that a short or long option, a pit is excavated on the seabed. The pit is designed to protect the installed duct from natural erosion and third party interference from other seabed users. This depth of the exit pit below seabed level will 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 will be a function of the stability of 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.

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

1.4.6.5 Onshore construction

Pre-construction Work

162. Pre-construction activities for cabling 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).

163. At the cable relay station and substation, pre-construction activities may include, but are not limited to, topographic surveys, ecological pre-construction work, archaeological pre-construction work, drainage surveys, geotechnical and ground stability surveys.

Installation of the Onshore Cables

164. Temporary fencing will be installed around the cable corridor. The working width will then be cleared of vegetation, and the topsoil stripped and stored locally (on mats to the side of the cable trench).

165. Temporary haul roads would then be installed to provide access points onto local roads, where necessary and a running track will be installed along the cable corridor.

166. Each cable trench will be excavated and the material stored locally before installing the ducts and infilling the trench.

167. HDD may also be required at certain crossing locations. The HDD method comprises three key stages:

- A pilot hole is drilled along the designed route;
- The hole is enlarged by passing through a larger cutting tool known as the back reamer; and
- The product or casing pipe is placed in the enlarged hole.

168. HDD is undertaken with the help of a viscous fluid known as drilling fluid. It is usually a mixture of water and bentonite or a suitable polymer. During drilling the fluid is continuously pumped to the cutting head or drill bit to facilitate the removal of cuttings, stabilise the borehole, cool the cutting head, and lubricate the passage of the product pipe. The drilling fluid is collected, cleaned and reused in the drilling process.

169. During refinement of the engineering design, other installation methods (e.g. auger boring) will be considered.

170. Following installation of the ducts, the cable corridor will 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.

171. 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.

172. As discussed in Section 1.4.4.2, the cables will be delivered on drums. Cables will be installed into the ducts by aligning the cable drums with pulling wires at each joint

bay, then mechanically pulling the cables into the ducts and making the cable joints. The jointing pits will then be closed up and covered over.

Construction of the Cable Relay Station

173. Construction of any access roads to the cable relay station would be undertaken initially, followed by grading, earthworks and drainage of the site.

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

175. The main part of the cable relay station construction is then the installation of the reactors. Due to their size and weight they would be delivered to the site using multi-axle vehicles.

176. Working hours will normally be 7am to 7pm, however there may be certain exceptions which will be discussed with the local authority (for example, larger components may be best delivered outside these hours to avoid traffic impacts).

Construction of the Substation

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

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

179. Once the foundation works are complete, the electrical plant will be delivered and installed, and buildings will be erected. Heavy items such as transformers will 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 will be erected with the use of small mobile plant and lifting apparatus.

180. The proposed building structures are typically 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.

181. For the HVAC option, most of the electrical plant will be located outdoors though some items will be delivered to site in containerised 'modules'. There will be a single steel-frame building housing high-voltage switchgear and control equipment.

182. For the HVDC option, the converter valves will be housed in large steel-frame buildings built up from a concrete foundation plinth. The converter station will also

include an outdoor AC switchyard with transformers and overhead gantries.

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

1.4.7 Operations and maintenance strategy

1.4.7.1 Offshore

184. All offshore infrastructure, including WTGs, foundations, cables and offshore substations will be monitored and maintained during the operational life.

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

186. 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 OAV or a fixed offshore platform (possibly shared with other infrastructure such as an OSP 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.

187. A number of vessel and/or helicopter visits to each turbine will be required each year to allow for scheduled and unscheduled maintenance. If the onshore maintenance strategy is chosen, this will mean small crew vessels sailing to and from the wind farm on a daily basis from shore, possibly supported by helicopters. If the offshore maintenance option is preferred, the majority of small crew vessels will 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 OAVs and up to eight crew transit vessels (CTVs). The OAVs will be deployed offshore on a year-round basis, returning to port approximately every 2 weeks for crew changes.

188. Although it is not anticipated that large components (e.g. turbine blades or substation transformers) will 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.

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

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

1.4.7.2 Landfall

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

1.4.7.3 Onshore

192. The substation and cable relay station will not be permanently manned. O&M staff will 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 will be teams working 24/7 in order to complete the tasks quickly and return any affected equipment to service. Most annual maintenance campaigns will be short (approximately 1 week), but if required some campaigns may be longer (e.g. 1-2 months).

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

194. Occasional access will be required at those joint bays with link boxes; access will be via the link box access hatch.

1.4.8 Decommissioning

195. 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 Vanguard 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.

196. 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 turbine offshore wind farm was decommissioned in 2015/2016. The rotor blades and nacelles have been removed, the towers dismantled and the foundations cut at the level of the seabed. Underwater cables were removed in summer 2016.

197. Offshore decommissioning may include the removal of all of the turbine components, part of the foundations (those above seabed level), the inter-array cables, and the export cables subject to agreement with the regulator.

198. The substation and cable relay station equipment will 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 pit 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 will be removed from ducts and recycled, with the transition pits and ducts left *in situ*.

199. 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.

200. 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.

1.5 Site Selection and Outline Assessment of Alternatives

201. This section provides an overview of the main site selection activities undertaken to determine the scoping area for Norfolk Vanguard and an assessment of alternatives considered.

1.5.1 Site selection process

202. Norfolk Vanguard 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.

203. The site selection process (shown in Plate 1.5) begins 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.

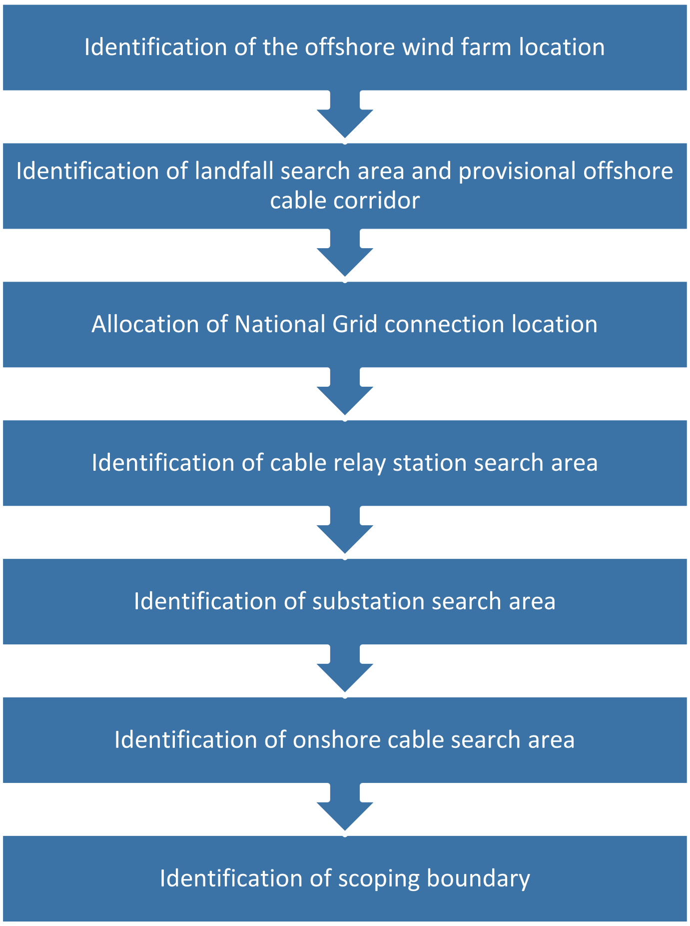


Plate 1.5 Site selection process for Norfolk Vanguard scoping area

1.5.2 Zone 5

204. The former Zone 5 (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.

205. The proposed Round 3 zones were the subject of the Offshore Energy Strategic Environmental Assessment (OESEA) which assessed the 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 required capacity of offshore wind within acceptable environmental limits. The zones were subject to an offshore tender round in 2009.

1.5.3 Wind farm

206. Following the offshore tender round in 2009, The Crown Estate awarded EAOW the rights to develop Zone 5 (the former East Anglia Zone). The former Zone is located off the coast of East Anglia and has a target capacity of 7,200MW.

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

208. 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.

209. As discussed in Section 1.1.4, following the decision to split the former Zone, VWPL took control of all development activities for projects in the northern half and SPR in the southern half. Commercial agreements to finalise this arrangement were completed in February 2016.

210. During 2015, VWPL revisited the ZDP for the northern half of the former Zone. The location of Norfolk Vanguard was identified using a three-step process:

- Step 1: Potential development areas which had been identified in the ZDP were reviewed through spatial constraints mapping using up-to-date data. 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 1.3.1.4). This exercise was based on the following indicative parameters (see Section 1.4 for an outline of the likely parameters of Norfolk Vanguard that will be considered in the EIA):
    - One 75 x 8MW (600MW) phase of a wind farm;
    - An HVAC connection;
    - Monopile foundations;
    - 75kV inter-array cables;
    - 220-245kV export cables;
    - Two export cables;
    - One offshore substation; and
    - A connection to the national grid close to the coast.

211. 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 NV East and NV West would provide the lowest cost of energy to consumers (in line with Government targets) whilst minimising environmental impacts.

212. The main considerations when identifying the location of Norfolk Vanguard are:

- 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 existing oil and gas infrastructure;
- Outside any dredging and aggregate extraction areas;
- Outside any know Ministry of Defence (MoD) danger and exercise areas;
- Outside any existing Natura 2000 sites and MCZs. Proposals for a possible Special Area of Conservation (pSAC) for harbour porpoise (see Section 2.15) are currently in consultation, however as plans currently cover the entire former Zone, the area, if designated, cannot be avoided;
- Outside any areas of known significant ornithological activity; its distance from the nearest existing SPAs for breeding birds (>210km from Flamborough Head and Bempton Cliffs and >100km from the Alde-Ore Estuary) reduces the potential for interaction with breeding and foraging bird species;
- Outside any sandeel, herring or cod spawning areas;

- Located such that it reduces the number of cable and pipeline crossings likely to be required. Crossing agreements will be required for the two cables that cross the OWF sites; proximity agreement may also be required if infrastructure is placed within a set distance from existing cables or pipelines.

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

1.5.4 Landfall and provisional offshore cable corridor

214. Possible landfall locations were initially identified through constraints mapping and a site walkover by a landscape architect.

215. The majority of the coast is covered by high level designations (Section 2.15):

- North Norfolk Coast 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.

216. In order to avoid these designations, potential landfall areas were identified as follows:

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

217. In parallel with the landfall assessment, VWPL's in-house mapping team identified options for provisional offshore cable corridors from Norfolk Vanguard to each of the three landfall areas. 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.

218. The route lengths and cable crossings for the provisional offshore cable corridor options identified are shown in Table 1.4.

Table 1.4 Route lengths and cable crossings for the provisional offshore cable corridor options

Potential landfall location	Measured route lengths to potential offshore substation locations (km)	No. active cable/pipeline crossings required
Bacton area	79 – 96	5 cables/3 pipelines
Gorleston– on–Sea	67 – 84	3 cable/2 pipelines
Lowestoft area	102-116	9 cables/2 pipelines

219. Due to the complex nature of the area, 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 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.

220. The route to a landfall in the Lowestoft area is considerably longer than the other routes as well as being more complex, requiring a high number of cable/pipeline crossing agreements (see Table 1.4). For this reason, this landfall option was removed from further consideration at an early stage.

221. The conclusion of the GMSL study was that the corridor to Gorleston-on-Sea was less favourable than the corridor to the Bacton area for the following reasons

- The approaches to the Gorleston-on-Sea landfall option are within an area of highly mobile sandwaves; and
- Proximity of the cable corridor for the Gorleston-on-Sea landfall option to both existing and potential aggregate dredging areas and therefore the potential for interaction.

222. Although the landfall itself is outside the Broads National Park, all onshore routes from this location would also have to be routed through the Broads National Park. The cable corridor to Gorleston-on-Sea was therefore discounted.

223. The provisional offshore cable corridor to the Bacton area is seen as favourable for the following reasons:

- It is a relatively short route from Norfolk Vanguard;
- There are minimal cable/pipeline crossings required (up to 5 active cable crossings and 2 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 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 routeing options outside the Broads National Park.

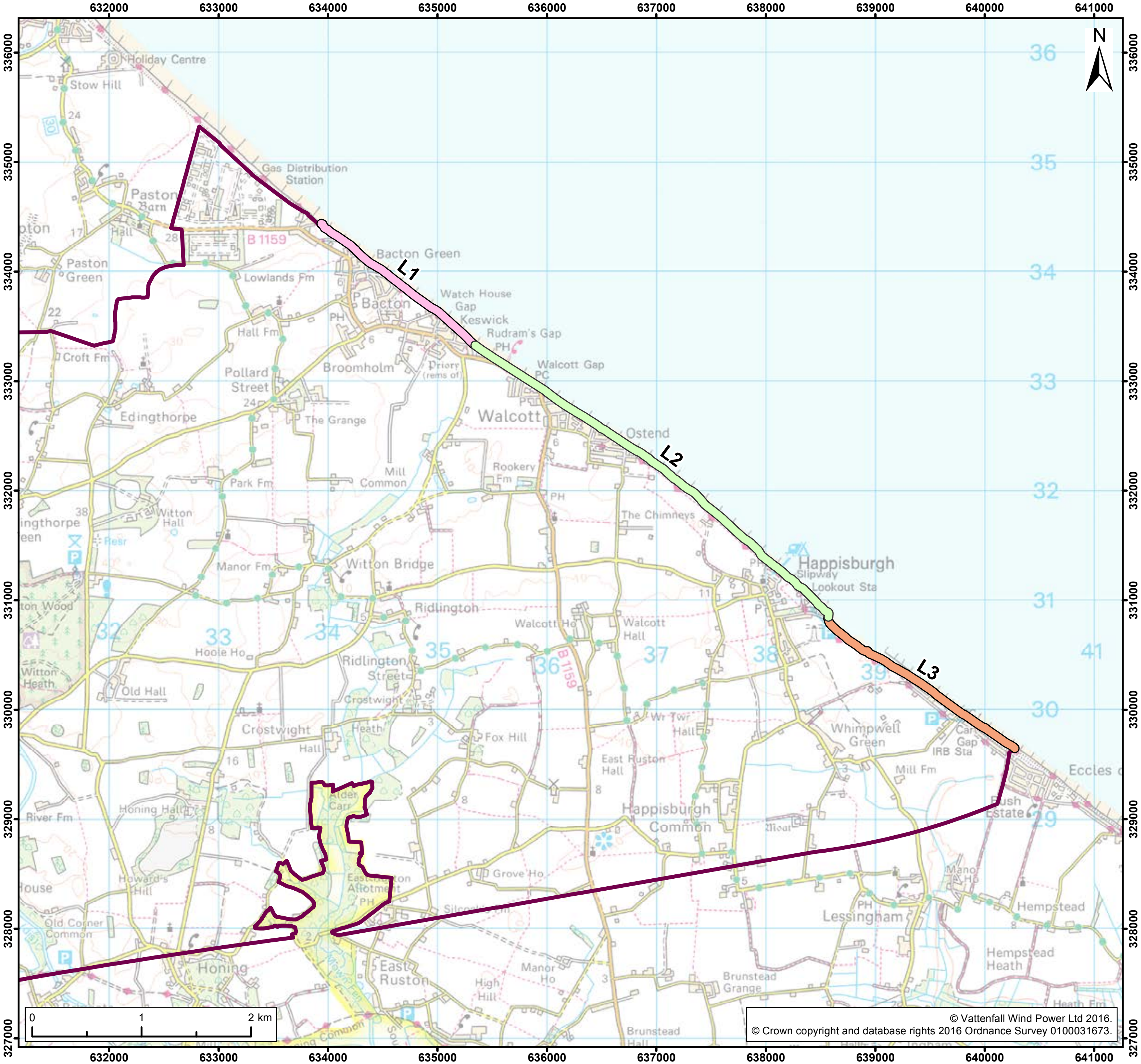
224. The provisional offshore cable corridor (shown in Figure 1.1) will be further refined during the EIA, particularly in the inshore area to align with the final landfall location once this has been selected from the options within the existing landfall search area.

225. The final choice of landfall will be decided following the results of the offshore geophysical survey and further work on the onshore routeing options. The landfall search area includes an area from Bacton Green to Eccles-on-Sea (Figure 1.3).

226. In order to understand the constraints and opportunities associated with landfall, and allow more targeted feedback from consultation, the landfall search area has been divided into three sectors using the following criteria:

- L1 - Bacton Green to Rudram's Gap;
- L2 – Rudram's Gap to Beach Road; and
- L3 – Beach Road to Bush Estate.

Q1. Please tell us about any information you can share regarding any or each of the sectors which will help VWPL understand constraints and opportunities associated with identifying the most suitable landfall location within this search area?



Legend:

- Onshore Scoping Area
- Landfall Search Area Sectors
  - L1
  - L2
  - L3

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Landfall Search Area

Figure: 1.3 | Drawing No: PB4476-002-2-040

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	JE	RH	A4	1:50,000

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

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1.5.5 Grid connection

227. In May 2010, following the award of rights to develop the former East Anglia Zone, EAOW submitted an application for 7200MW 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.

228. The change in operating structure of EAOW, resulted in VWPL and SPR each retaining connection agreements for up to 3600MW, i.e. each now has half of the total capacity of the zone.

229. In July 2016, following a site selection exercise, a modification application for Norfolk Vanguard 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 OSPs 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 economical point to connect to the National Grid network. A grid connection offer was provided by National Grid in July 2016 based on an onshore connection point at the existing Necton 400kV National Grid Substation. The Applicant has taken up this offer and is committed to an underground cable solution which has the benefit of avoiding landscape and visual impacts associated with overhead lines.

230. Confirmation of the connection location at the existing Necton 400kV National Grid Substation has allowed search areas for the onshore infrastructure, i.e. the substation, cable relay station and onshore cable corridor, to be identified as well as the landfall search area.

231. All search areas identified would allow for infrastructure for Norfolk Boreas as well as Norfolk Vanguard if appropriate, however the requirement for this is dependent on the outcome of National Grid's connection offer for Norfolk Boreas.

1.5.6 Onshore substation

232. In order to identify the most appropriate location to site the substation, National Grid's Guidelines on Substation Siting and Design (The Horlock Rules) have been taken into consideration. These guidelines document National Grid's best practice for the consideration of relevant constraints associated with the siting of electricity network infrastructure.

233. 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."

234. Consideration is given to placing the electrical infrastructure as close as possible to the existing National Grid connection point (if feasible) in order to minimise the landscape and visual effects associated with introducing new electricity infrastructure to the environment. The final siting and location of the substation will 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.

235. Depending upon the site specifics, the following development considerations will also influence the location of the 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; and
    - Number of landowners.
- Planning.
    - Other planning applications that may influence future development.

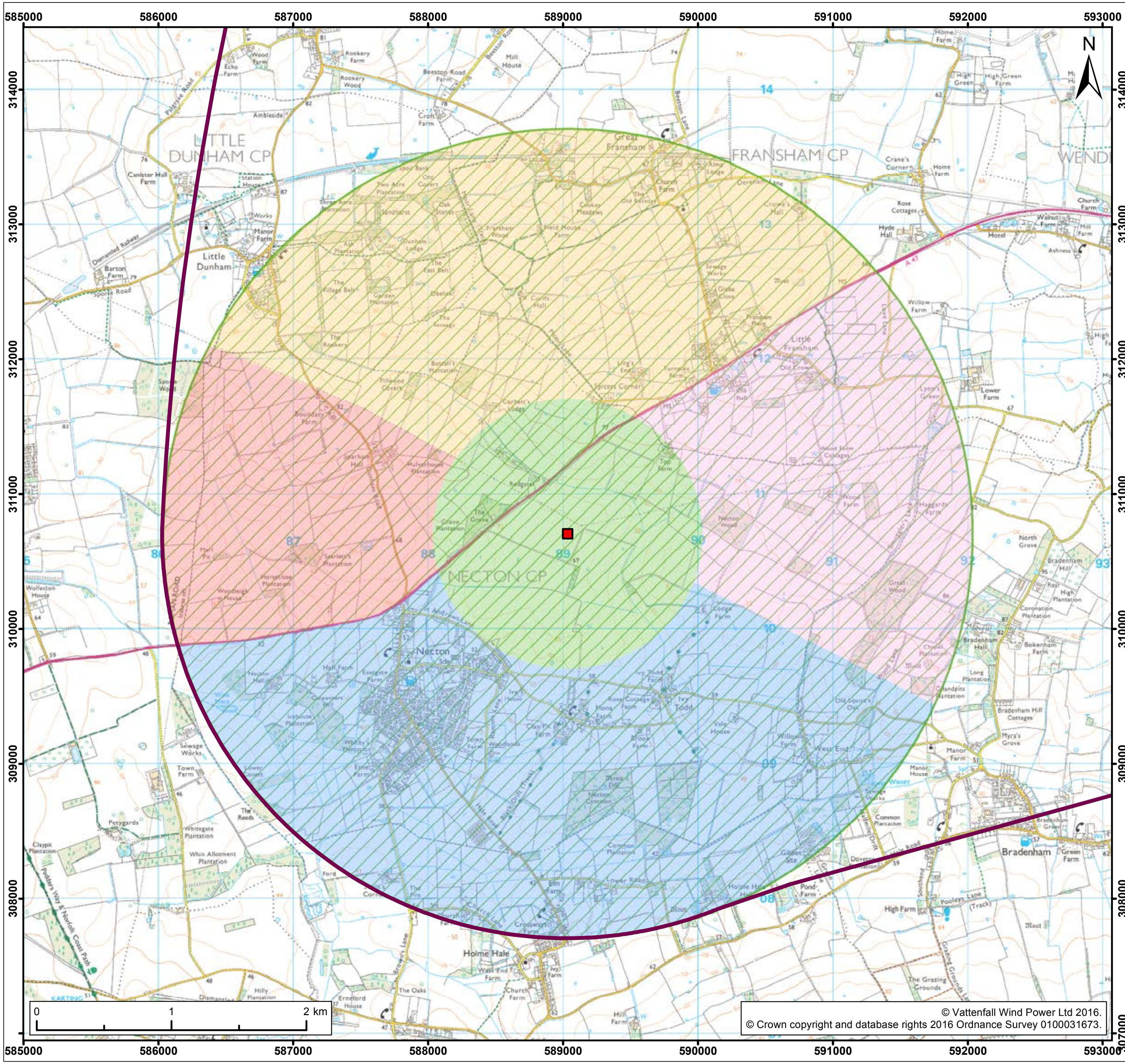
236. Figure 1.4 shows the location of the onshore substation search area, which has been divided into sectors. The substation and associated infrastructure will be located within this search area.

237. In accordance with the Horlock Rules, the substation search area has been defined as a 3km radius from the existing Necton 400kV National Grid Substation.

238. In order to understand the constraints and opportunities associated with the substation, and allow more targeted feedback from consultation, the substation search area has been divided into five sectors using the following criteria:

- 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 existing Necton 400kV National Grid Substation.

Q2. Please tell us about any information regarding each of the sectors which will help the applicant understand constraints and opportunities associated with identifying the most suitable substation location within this search area?



Legend:

- Onshore Scoping Area
- Existing Necton 400kV National Grid Substation
- Substation Search Area

Substation Site Sectors

- S1
- S2
- S3
- S4
- S5

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Substation Search Area and Sectors

Figure: 1.4 Drawing No: PB4476-002-2-042

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	05/09/16	JE	RH	A4	1:40,000
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Co-ordinate System: British National Grid **EPSG:** 27700

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1.5.7 Onshore cable route

239. The onshore cable route is largely driven by the location of the landfall search area and the connection location to National Grid. In order to minimise permanent visual impact during the operational life of the wind farm the onshore cables between the landfall and the electrical connection point will involve a new underground (buried) cable system rather than any new overhead lines, in order to minimise permanent landscape and visual impact during the operational life of the wind farm.

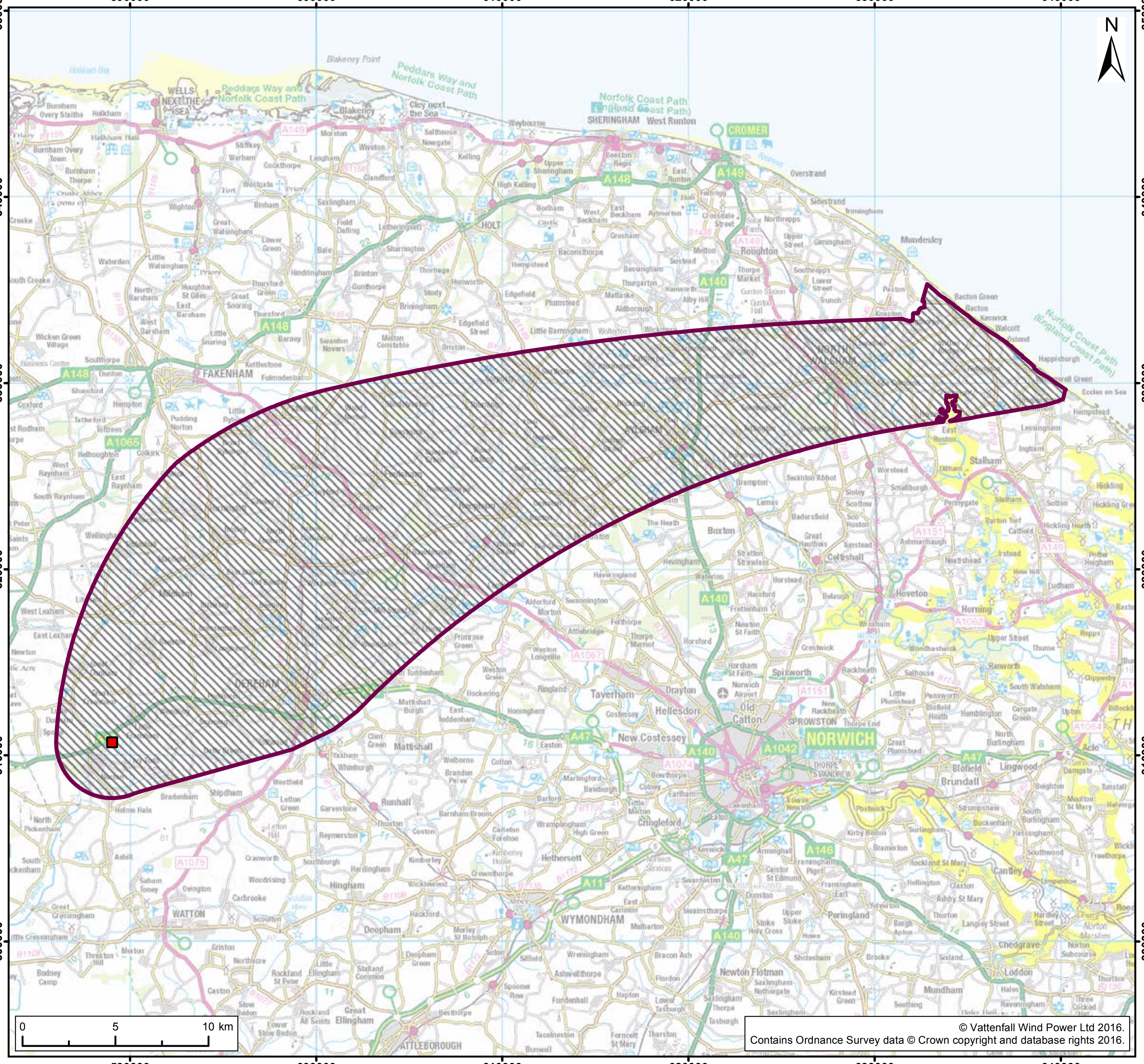
240. Detailed feasibility and route selection studies are ongoing in order to identify the route for the buried cable system with least environmental impact and opportunities for environmental enhancement. Figure 1.5 shows the search area, where the onshore cable route and associated infrastructure may be sited.

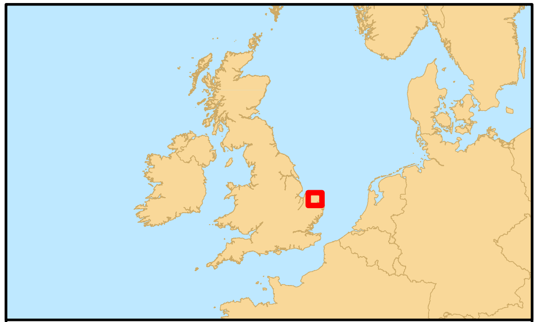
241. At this scoping stage, the current onshore search area is being retained to ensure stakeholders have an opportunity to input into the final option taken forward for the consent application.

242. The following key principles will be incorporated where practical in the final site selection of the onshore cable route and associated onshore infrastructure:

- 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 cables route 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 and installing cables along field boundaries preferentially.

Q3. Please tell us about any information which will help the Applicant understand constraints and opportunities associated with identifying the most suitable cable route within this search area?





Legend:

- Onshore Scoping Area
- Existing Necton 400kV National Grid Substation
- Cable Corridor Search Area

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Onshore Cable Route Search Area

Figure: 1.5 Drawing No: PB4476-002-2-041

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

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1.5.8 Cable relay station

243. If HVAC export cabling is selected, a cable relay station will be required in order to condition the electricity for onward transmission to the grid (see Section 1.4.4.1). The final siting and location of the cable relay station will take into account the following elements, in order to identify the most appropriate location to site the cable relay station:

- 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.

244. Depending upon the site specifics, the following development considerations will also influence the location of the cable relay station site:

- Community;
    - Proximity to residential properties;
    - Proximity to public rights of way; and
    - Sensitive land uses, e.g. schools, hospitals.
- Archaeology;
    - Presence/proximity to Scheduled Monuments and listed buildings;
    - Ecology;
    - Proximity to designated sites; and
    - Presence of protected species.
- Landscape;
    - Proximity to AGLV;
    - Proximity to other areas of local landscape importance; and
    - Landscapes sensitivity to development.
- Hydrogeology, land quality and flood risk;
    - Proximity to SPZ;
    - Presence of potentially contaminated land; and
    - Flood risk.
- Engineering Requirements;
    - Highway access (construction and operation); and
    - Complexity of design required.
- Property; and
    - Number of landowners.

- Planning.
    - Other planning applications that may influence future development.

245. Figure 1.6 shows the location of the cable relay station search area, which has been divided into sectors. The cable relay station and associated infrastructure will be located within this search area.

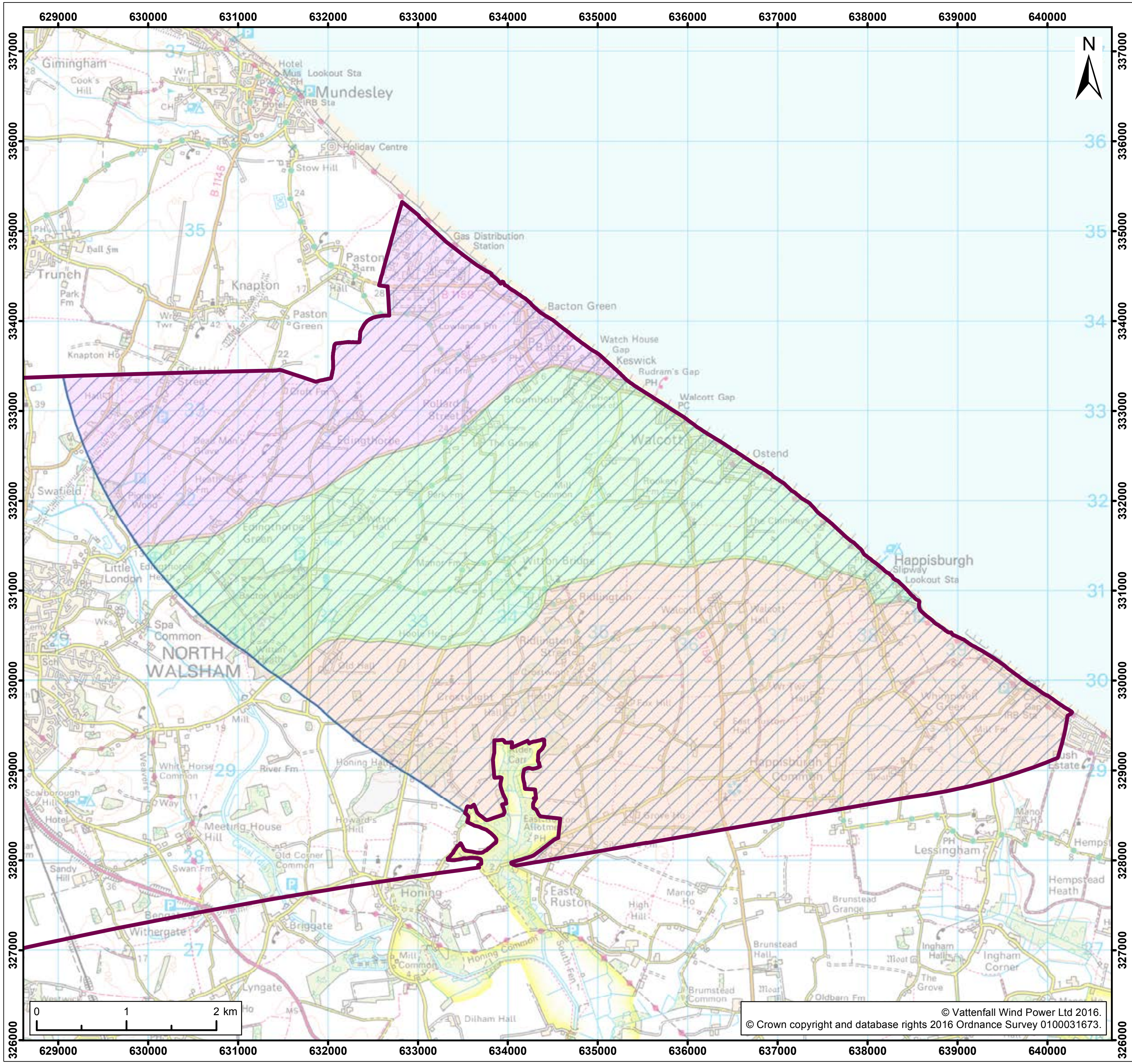
246. To minimise electrical losses, the cable relay station would need to be located approximately half way along the total export cable length (offshore and onshore), and therefore will be located as close as possible to the landfall location. As a result, the cable relay station search area has been defined as a 5km radius from the landfall search area.

247. There are two key national designations which have been specifically avoided by the cable relay station search area; the Norfolk Coast Area of Outstanding Natural Beauty (AONB) in the north, and the Broads National Park in the south. The cable relay station search area avoids the AONB and National Park, and no electrical infrastructure would be sited within those designations.

248. In order to understand the constraints and opportunities associated within the search area, and allow more targeted feedback from consultation, the cable relay station search area has then been divided into three sectors using the existing road infrastructure in the area:

- North Walsham Road – Bloodslat Lane (divides sectors R1 and R2 from west to east); and
- North Walsham Road – Happisburgh Road (divides sectors R2 and R3 from west to east).

Q4. Please tell us about any information regarding each of the sectors which will help the Applicant understand constraints and opportunities associated with identifying the most suitable substation location within this search area?



Legend:

- Onshore Scoping Area
- Cable Relay Station Search Area

Cable Relay Station Sectors

- R1
- R2
- R3

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Cable Relay Station Search Area and Sectors

Figure: 1.6 Drawing No: PB4476-002-2-044

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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1.6 EIA Methodology

1.6.1 Introduction

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

250. The EIA will be carried out in accordance with the Planning Act 2008 (see Section 1.3.2.1) and the EIA regulations (see Section 1.3.2.5). 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, 2012; 2015a; 2015b; 2015c; 2016)
- Overarching National Policy Statements for Energy EN-1, Renewable Energy Infrastructure EN-3, and Electricity Networks Infrastructure EN-5 (DECC, 2011);
- Relevant guidance issued by other government and non-governmental organisations; and
- Receptor specific guidance documents.

251. 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

252. An Evidence Plan Process (EPP) will be undertaken during the EIA to structure technical stakeholder consultation.

253. 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.

254. 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.

255. 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.

1.6.3 Characterisation of the existing environment

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

- Study areas defined for each receptor based on the relevant characteristics of the receptor (e.g. mobility/range);
- Review available information;
- Review 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 data gathered are targeted and directed at answering the key question and filling key data gaps; and
- Review information gathered to ensure the environment can be sufficiently characterised in sufficient detail.

257. 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 Norfolk Vanguard.

258. 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

259. 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 Vanguard.

1.6.4.1 Determining receptor sensitivity and value

260. The characterisation of the existing environment will help to determine the receptor sensitivity in order to assess the potential impacts upon it.

261. 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.

262. 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 time required for recovery will be key considerations in determining receptor sensitivity.

263. 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.

264. Note that 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

265. 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

266. 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 1.5 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.

267. Table 1.6 provides an indication of the significance definitions that the Applicant proposes to use in the assessment process for the majority of parameters.

268. 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 1.5 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 1.6 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

269. 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

270. 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.

271. 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

272. 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

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

274. Offshore, onshore and wider-scheme inter-relationships are discussed in Sections 2.16, 3.12 and 4.5.

1.6.4.8 Cumulative impacts

275. 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 incorporate continuing work from industry-wide initiatives with regard to cumulative impact. Sections 2.17, 3.13, and 4.6 of this Scoping Report provide a high-level discussion of potential cumulative considerations that are believed to require inclusion within the EIA.

276. The Planning Inspectorate Advice Note Nine provides 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 Inspectorates 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.

277. 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.

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

279. It is anticipated that VWPL will have submitted the request for a Scoping Opinion for Norfolk Boreas before finalisation of the Norfolk Vanguard EIA. Therefore, this project will be a material consideration in the CIA for Norfolk Vanguard.

280. 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.

281. 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.

282. 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

283. 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.

284. 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.

285. 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

286. 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
        - Introduction
        - Need for the Project
        - Policy and Legislative Context
        - Site Selection and Assessment of Alternatives
        - Project Description
        - EIA Methodology
    - Part 2: Offshore environment
        - Marine Geology, Oceanography and Physical Processes
        - Marine Water and Sediment Quality
        - Benthic and Intertidal Ecology
        - Fish and Shellfish Ecology
        - Marine Mammal Ecology
        - Offshore Ornithology
        - Commercial Fisheries
        - Shipping and Navigation
        - Offshore Archaeology and Cultural Heritage
        - Aviation and Radar
        - Infrastructure and Other Users
    - Part 3: Onshore environment
        - Ground Condition and Contamination
        - Air Quality
        - Water Resources and Flood Risk
        - Land Use
        - Onshore Ecology
        - Onshore Ornithology
        - Onshore Archaeology and Cultural Heritage
        - Noise and Vibration

- Traffic and Transport
- Health

- Part 4: Wider Scheme Aspects
  - Landscape and Visual
  - Socio-economics
  - Tourism and Recreation

- Part 5: Cumulative and Transboundary Impacts
  - CIA within the former East Anglia Zone
  - Wider Offshore CIA
  - Transboundary Impacts
  - Onshore CIA

- Summary of Impacts

- Volume 3: Technical appendices

2 PART 2: OFFSHORE

2.1 Introduction

287. This section presents the main baseline characteristics of the offshore environment within the offshore project area (NV East, NV West and the provisional offshore cable corridor) and the surrounding area, where relevant. The potential impacts of Norfolk Vanguard during construction, O&M and decommissioning are considered. Where there is no pathway for a potential impact, each section outlines impacts that are proposed 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.

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

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

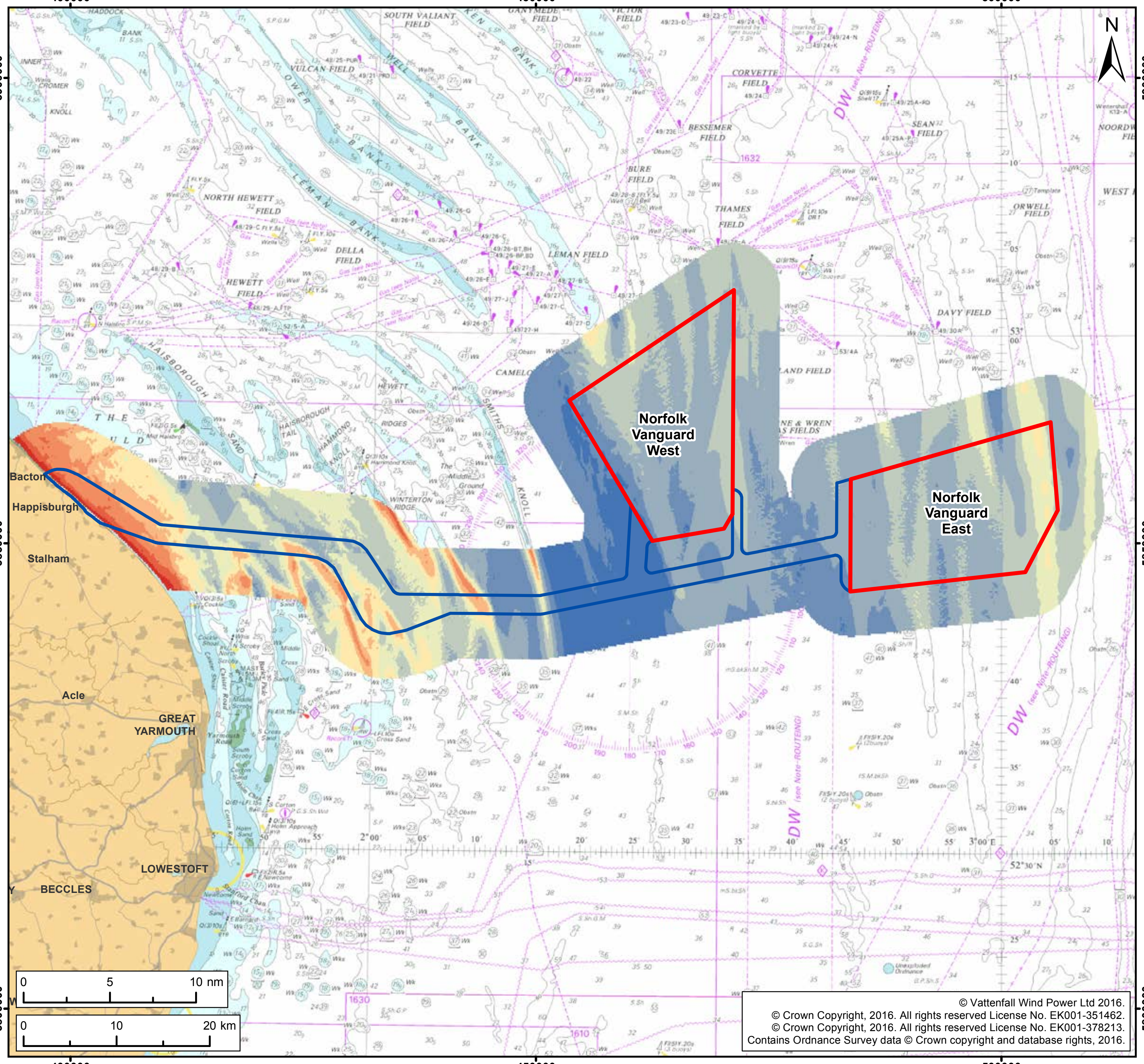
289. Information to support the Scoping Report for Norfolk Vanguard has come from a series of previous surveys and studies, including numerical modelling studies, which were undertaken to inform the ZEA for the former East Anglia Zone (EAOW, 2012a) as well as the ES for the East Anglia ONE project (EAOW, 2012b) and the East Anglia THREE project (EATL, 2015).

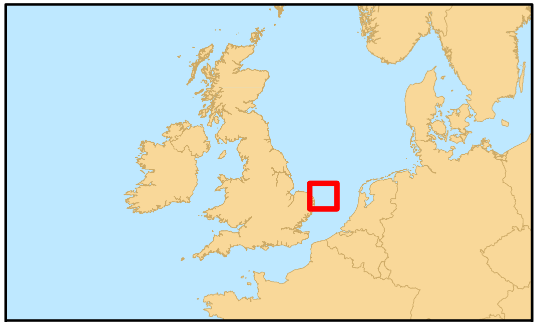
290. In addition, a range of information sources is available, many of which were collated for the ZEA, including:

- Marine Renewable Atlas (BERR, 2008);
- Wavenet (Cefas, undated);
- National Tide and Sea Level Forecasting Service;
- 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

291. Water depths across both NV East and NV West are between 21-47m (Figure 2.1). The Haisborough sand bank system lies between NV West and the coast, comprising a series of north west to south east oriented en-echelon (approximately parallel) sand ridges. The provisional offshore cable corridor for Norfolk Vanguard passes through the southern end of this sand bank system.





Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor

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:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Bathymetry

Figure: 2.1 Drawing No: PB4476-002-2-006

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/05/16	JE	GK	A4	1:600,000

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

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2.2.1.3 Water levels

292. Norfolk Vanguard 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 just outside the central, eastern boundary of the former Zone. 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. The southern boundary of NV East is located about 30km north of the amphidromic point and subject to a tidal range of approximately 1m. The southern boundary of NV West is 40km from the amphidromic point, but is still only subject to tidal ranges less than 1.5m. With progression west along the provisional offshore cable corridor, the tidal range increases. At the landfall study area (Bacton Green to Eccles-on-Sea), the tidal range is 2.6m on mean spring tides. The suite of astronomical tidal levels reported by the UK Hydrographic Office's Admiralty Tide Tables for Winterton, approximately 10km south of the provisional offshore cable corridor, is presented in Table 2.1.

Table 2.1 Astronomical tidal levels at Winterton (Admiralty Tide Tables, 2016)

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

293. The North Sea is particularly susceptible to storm surges and water levels can become elevated between 1.5 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

294. Tidal current data and modelling at locations across Norfolk Vanguard show that currents generally flow north to south on the flooding tide and south to north on the ebbing tide. The fastest recorded flows are typically associated with the ebb tide,

with speeds reaching in excess of 1.2m/s, which flow across and close to NV West. The weakest currents are observed in deeper water where maximum speeds do not exceed 0.9m/s. These currents flow across and close to NV East.

295. Tidal currents increase in the shallower waters nearer to shore, especially across the offshore location of the provisional offshore cable corridor and as it approaches the coast of Norfolk to the west of Norfolk Vanguard. Currents here can exceed 1.5m/s.

296. Storm surges 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

297. The wave regime across Norfolk Vanguard, 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 within and close to Norfolk Vanguard show that the predominant waves arrive from south of south west with subordinate waves from the north (ABPmer, 2012a).

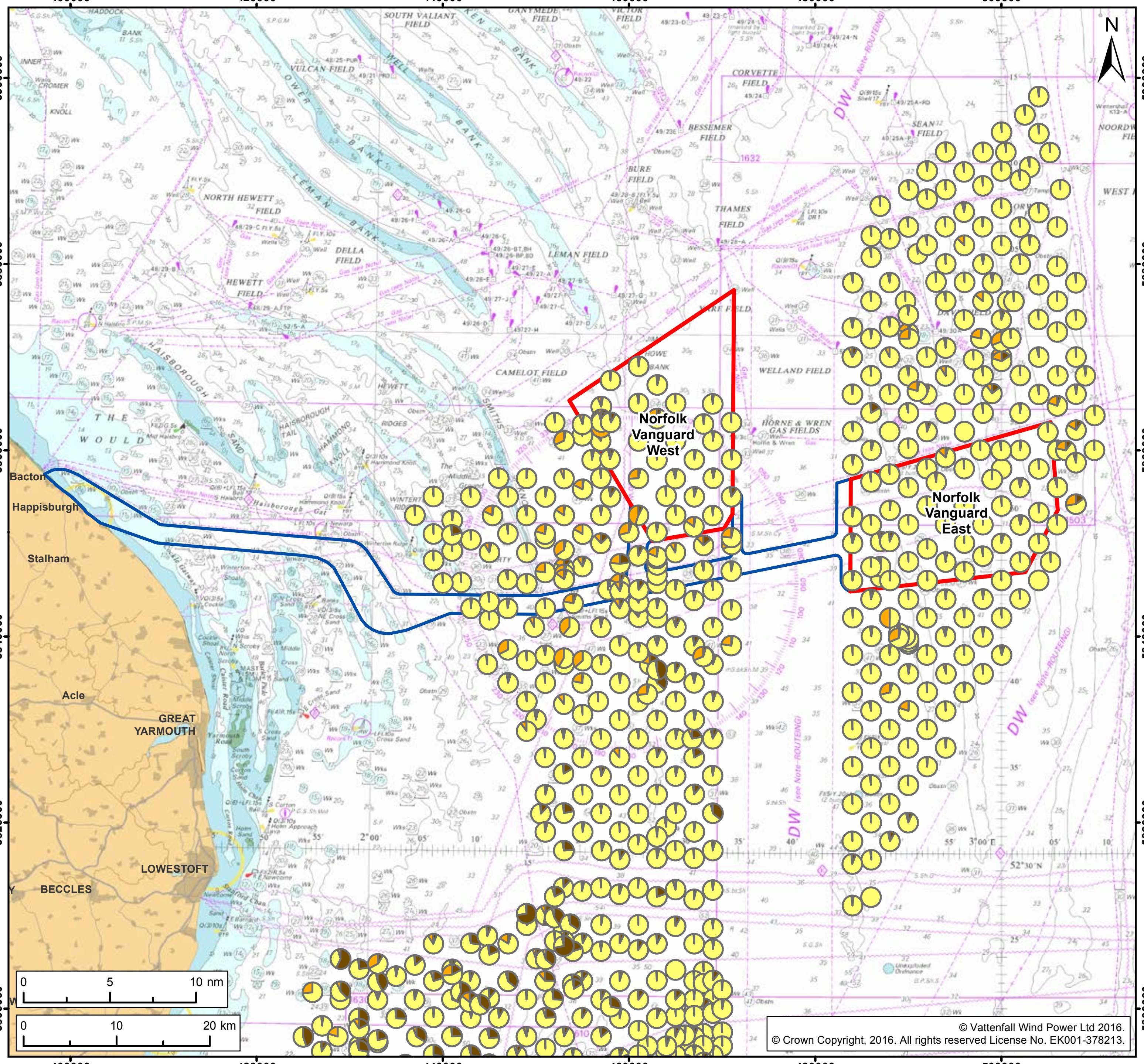
298. Across the wider former Zone, there is a general north south reduction in maximum observed wave heights. On the northern boundary, a 1 in 50 year return period event has a significant wave height in excess of 8m whereas on the southern boundary a corresponding event has a significant wave height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

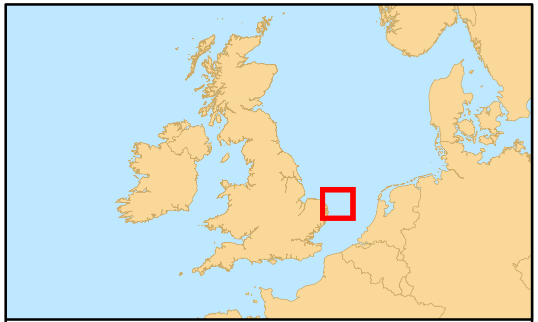
299. Across the majority of Norfolk Vanguard, water depths are likely to be sufficient to limit the effect of wave action on seabed sediments, apart from during exceptionally stormy seas or over shallower areas. Closer to shore, water depths reduce and wave effects become more important. At shallow water locations off the 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

300. The geology of Norfolk Vanguard 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.

301. Grab sample data collected across the former Zone (shown in Figure 2.2) correspond well with existing British Geological Survey seabed sediment data (shown in Figure 2.3) and reveal that Norfolk Vanguard is dominated by slightly gravelly sand. Remaining areas within Norfolk Vanguard are primarily characterised by sand and gravelly sand.





Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor

Sediment Distribution [1]

- Gravel
- Sand
- Silt

[1] MESL, 2016.

Project:	Report:
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Title:

Seabed Sediment Distribution

Figure: 2.2 Drawing No: PB4476-002-2-010

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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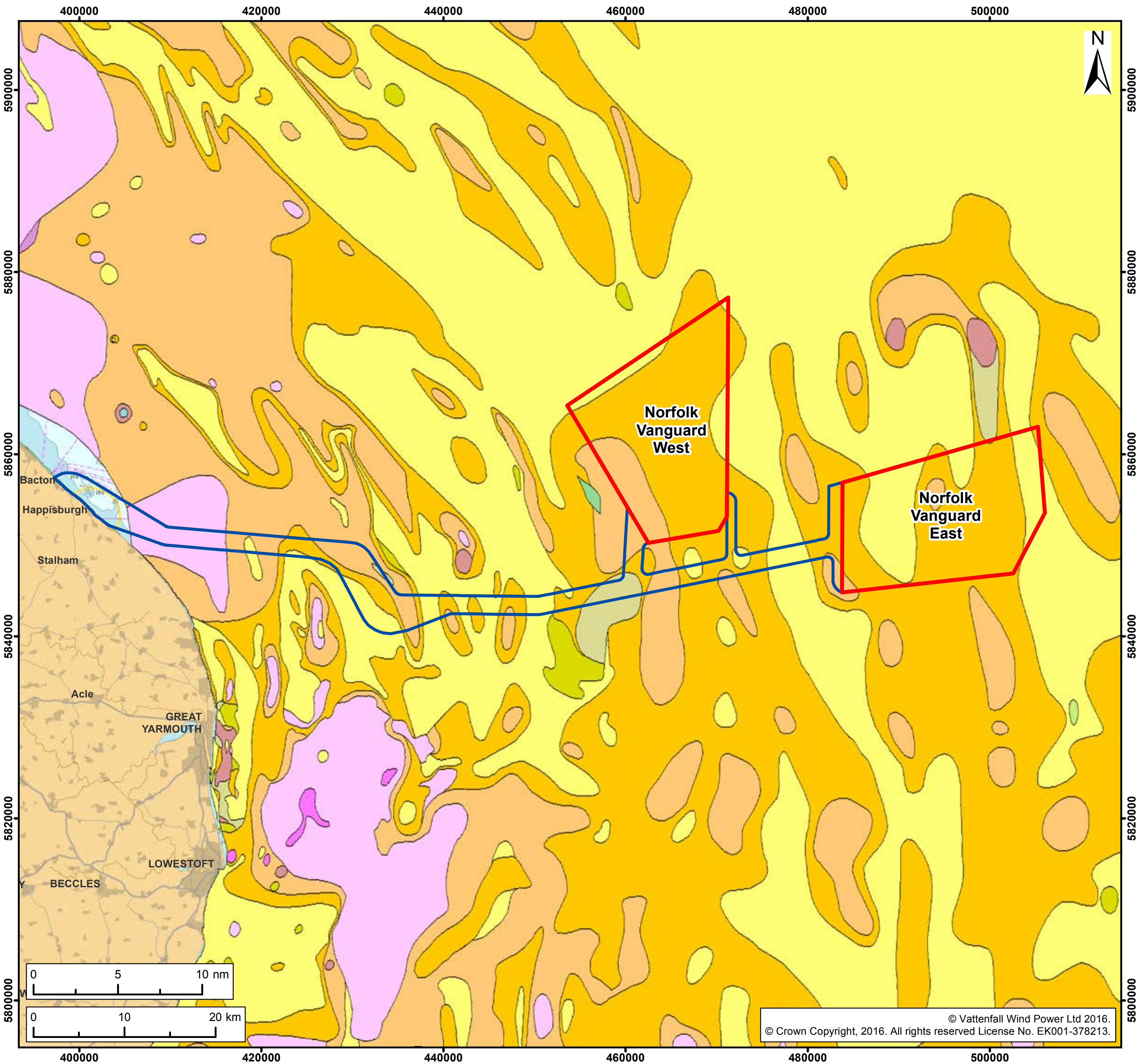

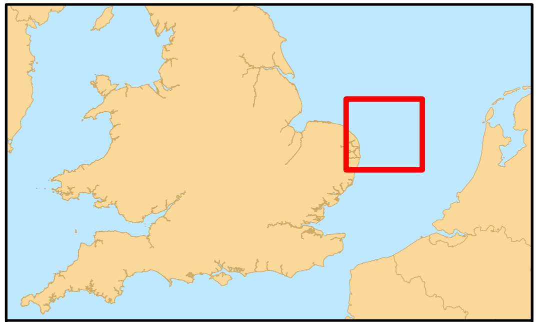

Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor

Sea Bed Sediments[1]

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

[1] British Geological Society, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

British Geology Survey Seabed Sediment

Figure: 2.3 | Drawing No: PB4476-002-2-018

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	17/06/16	JE	GK	A4	1:600,000

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

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302. Sediment transport pathways within the former Zone have been analysed using the orientation of bedforms. Sand waves are present across parts of Norfolk Vanguard, and 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.

303. 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 NV West. 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.

304. The coast of north east Norfolk is an almost continuous line of glacial tills cliffs. The coast is exposed and therefore very dynamic. Rapid cliff erosion is 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.

2.2.1.7 Suspended sediment

305. Suspended sediment concentrations across Norfolk Vanguard could range from 1mg/l to 35mg/l. During the Land Ocean Interaction Study, measurements within the former Zone recorded a maximum turbidity value of 83mg/l, but a mean value of only 15mg/l during an 18 month deployment.

2.2.2 Potential impacts

2.2.2.1 Potential impacts during construction

306. **Effects to 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.

307. **Effects on sediments and sedimentary structures**: Construction of the wind farm will not change the geology of the site other than in the case of 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, and neither would there be any changes in coastal morphology. However, further consideration (using conceptual methods) will be given to the potential effects on the form and function of the bedload sedimentary processes, including across the Haisborough, Hammond and Winterton SCI due to cable installation.

308. **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.

2.2.2.2 Potential impacts during operation

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

310. Evidence gained from monitoring work at operational offshore wind farms demonstrates that impacts on the hydrodynamic regime are restricted to near-field changes only (i.e. close to the structures); far field effects outside other offshore developments (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 of far-field effects.

311. 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.

312. As NV East and NV West are located approximately 70km and 47km from the coast, respectively, no impact is expected on the coastline. During the operational phase the export cables will be buried beneath the seabed and will have no effect on waves and tidal currents at the coast. Hence, any ongoing processes of coastal erosion or accretion will continue to be controlled by natural processes unaffected by the presence of the wind farm.

313. **Effects on sediments and sedimentary structures**: Impacts 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 impacts 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 will vary depending on the details of the foundations and wind farm layout). Impacts 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.

314. **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 conceptual methods) to likely changes in suspended sediment concentrations due to scour during both construction and operational phases.

2.2.2.3 Potential impacts during decommissioning

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

2.2.2.4 Potential cumulative impacts

316. **Interactions with other wind farms**: Consideration will be given to the potential for interaction with other wind farms within the former Zone and wider region. This includes interactions of Norfolk Vanguard with Norfolk Boreas, East Anglia ONE, East Anglia THREE, East Anglia ONE North and East Anglia TWO (Figure 2.33). It is likely that most of the potential impacts will be highly localised, small scale and temporary with limited potential for interactions between wind farms.

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

- Aggregate extraction and dredging;
- Existing and planned construction of subsea cables and pipelines;
- Potential port and harbour development; and
- Oil and gas installations.

318. As with the case for other wind farms, it is likely that potential impacts will be highly localised, small scale and temporary with, therefore limited potential for interactions between Norfolk Vanguard and other activities.

2.2.2.5 Transboundary impacts

319. Given that the likely hydrodynamic and sedimentary impacts of Norfolk Vanguard will be restricted to near-field change only, transboundary impacts are unlikely to occur or are unlikely to be significant and therefore the Applicant proposes not to consider transboundary impacts for Marine Geology, Oceanography and Physical Processes further during the EIA. This is supported 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 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 (×)

2.2.3 Mitigation

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

2.2.4 Approach to assessment and data gathering

321. The Applicant has commissioned various surveys to develop a more detailed understanding of the seabed conditions within NV East, NV West and the provisional offshore cable corridor. These surveys will be undertaken in 2016, and include:

- A geophysical survey of the provisional offshore cable corridor and NV West (a survey was completed for NV East in October 2012);
- A geophysical survey around the existing met mast, to the north of NV East within the former Zone;
- A seabed mobility survey within NV East;
- Grab samples of surface sediments along the provisional offshore cable corridor, and within NV East and NV West (results of the grab samples from the wind farm sites will supplement existing zonal data); and

- Geotechnical site investigations (cone penetration testing and vibrocoring) along the provisional offshore cable corridor, and within NV East and NV West.

322. Existing data for the former Zone, East Anglia ONE and East Anglia THREE will be used as context for the assessment of impacts upon geology, oceanography and physical processes.

323. Assessment methodologies will be discussed and agreed with the appropriate statutory consultees 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);
- Guidance on Environmental Impact Assessment in Relation to Dredging Applications (Office of the Deputy Prime Minister, 2001); and
- Review of Cabling Techniques and Environmental Effects applicable to the Offshore Windfarm Industry (BERR, 2008).

324. In addition, there are a large number of external sources of data which could be used in describing the baseline and assessing the potential impacts upon physical processes. Such sources of data include metocean surveys commissioned by the Applicant, wave buoys (e.g. Cefas waveriders) and other data currently acquired via the British Oceanographic Data Centre (BODC).

2.3 Marine Water and Sediment Quality

2.3.1 Baseline

2.3.1.1 Data sources

325. The available site-specific physical environment datasets upon which this section is based include:

- National Marine Monitoring Programme (NMMP) 1994-2001 (Cefas, 2004b)
- Sediment analysis of benthic grab sampling in East Anglia THREE and FOUR
- Bathing water profiles (Environment Agency, 2016a and 2016b)

2.3.1.2 Water quality

326. Data from the NMMP sub-surface seawater monitoring stations (as shown in Figure 2.4) 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 in NV East (NMMP sample site 395, shown in the shaded cells of Table 2.3)

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

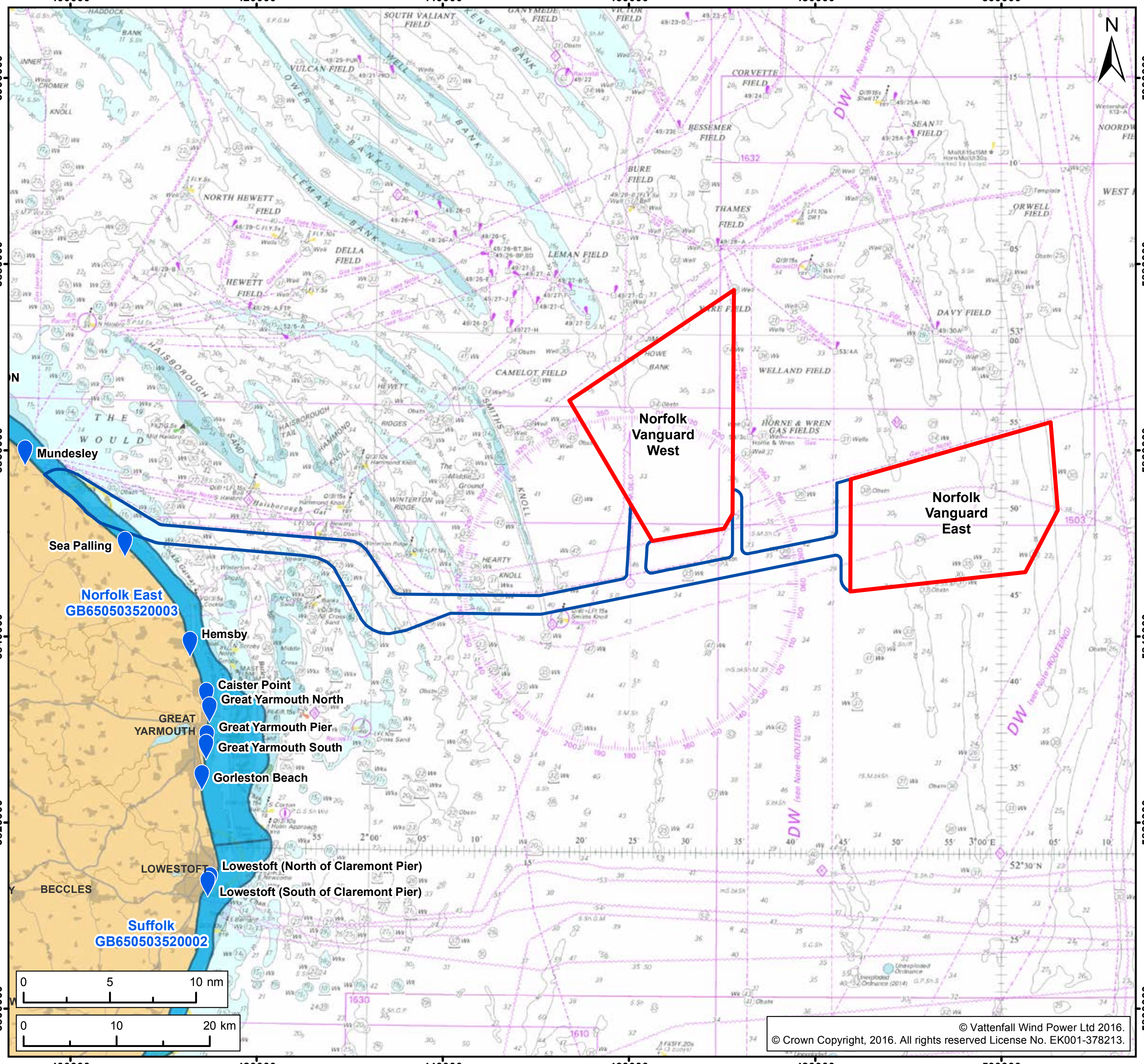
327. The levels of dissolved trace metals taken in NV East, fall within ranges of contaminant levels typically found in surface water of the North Sea (shown in Table 2.4).

Table 2.4 Summary of 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

328. There is no known data source relating to water quality within NV West itself. However the waters off the East Anglian coast are permanently mixed (Department for Business, Energy & Industrial Strategy, 2016) and therefore it is expected that NV West will have similar characteristics to NV East.

329. 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 landfall search area around Mundesley and 3.5km south of the landfall search area 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).



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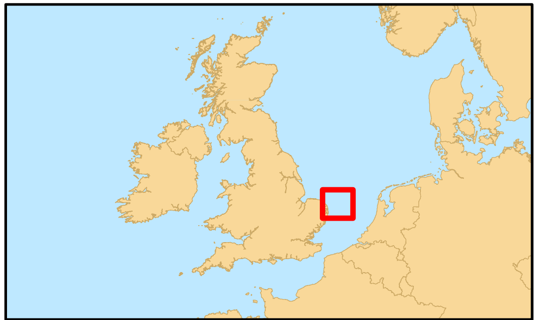

Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- Water Framework Directive Coastal Waterbody[1]
- Designated Bathing Waters[2]

[1] Environment Agency, 2016.
[2] European Environment Agency, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Marine Water Quality

Figure: 2.4 | Drawing No: PB4476-002-2-035

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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2.3.1.3 Sediment quality

330. The sediments over much of Norfolk Vanguard are coarse and low in organic content. Sediments of this nature are considered not to be good sinks for contaminants. The offshore project area does not overlap any disposal sites. There are active oil and gas wells within close proximity of NV West and the provisional offshore cable corridor (see Section 2.13.3.1). There is potential that these wells could be a source of contamination.

331. Grab sampling within NV East was undertaken in 2013 to inform the draft East Anglia FOUR PEI. Table 2.5 shows the results from one sample within NV East which was analysed for sediment contaminants, compared with guidance levels for sediment contamination; Cefas Action Levels (Cefas, 2000) and Canadian Sediment Quality Levels (CCME, 2002). Arsenic, Chromium and Nickel were found to be at levels which are deemed by Cefas to require further consideration (Action Level 1).

332. To date, there are no available data within NV West and the provisional offshore cable corridor. Further sampling will be undertaken in 2016 (see Section 2.3.4).

Table 2.5 Sediment contaminant levels within NV East compared with Cefas Action Levels (Cefas, 2000) and Canadian Sediment Quality Levels (CCME, 2002)

Contaminant (mg/kg)	Measurements within NV East	Cefas Action Level 1[6]	Cefas Action Level 2[7]	Canadian Sediment Quality TEL[8]	Canadian Sediment Quality PEL[9]
Arsenic	47.4	20	100	7.24	41.6
Cadmium	0.072	0.4	5	0.7	4.2
Chromium	118	40	400	52.3	160
Copper	29.3	40	400	18.7	108
Mercury	0.003	0.3	3	0.13	0.7
Nickel	64	20	200	15.9	42.8
Lead	31.3	50	500	30.2	112
Zinc	94.8	130	800	124	247
DDT	<0.004	0.1	1	N/A	N/A

[6] Cefas Action Levels were derived for the dredging industry. Sediment with levels greater than Action Level 1 require further consideration.
[7] 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
[8] TEL = adverse biological effects are expected to occur only rarely (in some sensitive species for example)
[9] PEL = adverse effects may be expected in a wider range of organisms

Contaminant (mg/kg)	Measurements within NV East	Cefas Action Level 1[6]	Cefas Action Level 2[7]	Canadian Sediment Quality TEL[8]	Canadian Sediment Quality PEL[9]
TBT	<0.004	0.1	1	N/A	N/A
PCBs (sum ICES 7)	<0.0001	0.01	None	N/A	N/A

2.3.2 Potential impacts

333. The potential for release and dispersion of sediments and any associated contaminants due to construction, O&M and decommissioning of Norfolk Vanguard has been informed by Section 2.2.

2.3.2.1 Potential impacts during construction

334. **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 1.4.2.2). Any sediment plumes are likely to settle out within a short distance 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).

335. There are no designated bathing waters located in the landfall search area; those closest are located approximately 3.1km and 3.5km away and are therefore unlikely to be affected by any increased suspended sediment during installation of the offshore export cables.

336. **Release of contaminated sediments:** Norfolk Vanguard is located 47km offshore and does not overlap any disposal site. There are a number of active and abandoned wells in close proximity to NV West and the provisional offshore cable corridor.

337. The results of sediment sampling within NV East indicate that the baseline levels have some potential to impact marine life but would not be considered to be unsuitable for disposal at sea.

338. Site specific survey of Norfolk Vanguard in 2016 will include analysis of contaminants from a proportion of samples and this will be discussed in the ES.

339. **Spillage of contaminants**: The Applicant is committed to the use of good practice techniques and procedures throughout all construction and O&M activities. 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.

340. Given that these standard procedures will 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 will be scoped out from further consideration within the EIA.

2.3.2.2 Potential impacts during operation

341. **Deterioration in water quality due to increased suspended sediment concentrations**: The localised changes in the tidal and wave regimes around each foundation structure have the potential to result in localised scour of the sea bed. As this effect will be highly localised it is not expected that there will be any significant change to water quality and so the Applicant proposes that this impact will be scoped out from further consideration within the EIA.

342. **Release of contaminated sediments:** There is potential for sediments which may be contaminated to be re-suspended by scouring effects. However, this effect will be highly localised and as previously discussed, no significantly contaminated sediments are expected in the Norfolk Vanguard areas.

343. Therefore, subject to consultation with relevant consultees (i.e. Cefas and Natural England) and feedback from this Scoping Report, this impact will be scoped out from further consideration within the EIA.

344. **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 and therefore subject to consultation with relevant consultees (i.e. Cefas and Natural England) and feedback from this Scoping Report, this impact will be scoped out from further consideration within the EIA.

2.3.2.3 Potential impacts during decommissioning

345. During decommissioning, the foundation structures will 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

346. **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.

347. **Interactions with other activities:** Proposed aggregate extraction to the north of the Norfolk Vanguard provisional offshore cable corridor to support sand engine coastal protection for the Bacton Gas Terminal could have potential to impact cumulatively with Norfolk Vanguard. However, due to the timescales of the aggregate dredging (currently planned for 2017) in relation to Norfolk Vanguard construction from 2023, 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.

2.3.2.5 Transboundary impacts

348. As with Marine Geology, Oceanography and Physical Processes (Section 2.2), due to the localised nature of any 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 impacts relating to marine water and sediment quality

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

scoped in (✓) and scoped out (×)

2.3.3 Mitigation

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

2.3.4 Approach to assessment and data gathering

350. As part of this benthic survey in 2016, a proportion of sub-samples will be analysed for contaminants and compared to Environmental Quality Standards (EQS). The requirement for this analysis will be discussed with key stakeholders through the EPP. Results will provide primary data for the EIA.

351. 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

352. 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, 2015). NOx emissions are falling more slowly (8.4%) (DEFRA, 2015). 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

353. Engine exhausts from construction, O&M and decommissioning vessels will 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 will 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).

354. Given the likely negligible increases of air pollutants on site and the distance from any shore-based receptors, it is proposed that 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, 2012a and 2012b).

2.4.2.1 Summary of potential impacts

Table 2.7 Summary of impacts relating to air quality

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

scoped in (✓) and scoped out (×)

2.5 Offshore Airborne Noise

2.5.1 Baseline

355. 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

356. There is potential for increases in airborne noise levels during offshore construction. Within the OWF sites the primary noise source will be pile driving during construction with vessels also contributing a low level of noise. Given the distance of Norfolk Vanguard from shore it is considered that offshore works will not result in significant airborne noise to onshore receptors. Any offshore receptors are likely to be transitory and the noise impact of construction works will be temporary and intermittent nature.

357. The main noise source during nearshore cable laying works will be the vessel noise which is unlikely to be distinguishable from the baseline conditions and these works will be short term.

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

359. 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

360. 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, 2012a and 2012b.

Table 2.8 Summary of 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
Impacts of airborne noise from nearshore works	x	x	x

scoped in (✓) and scoped out (×)

2.6 Benthic and Intertidal Ecology

2.6.1 Baseline

2.6.1.1 Data sources

361. The primary sources of information for this section are provided by studies undertaken for the ZEA report and to support the draft PEI of East Anglia FOUR and the East Anglia THREE ES.

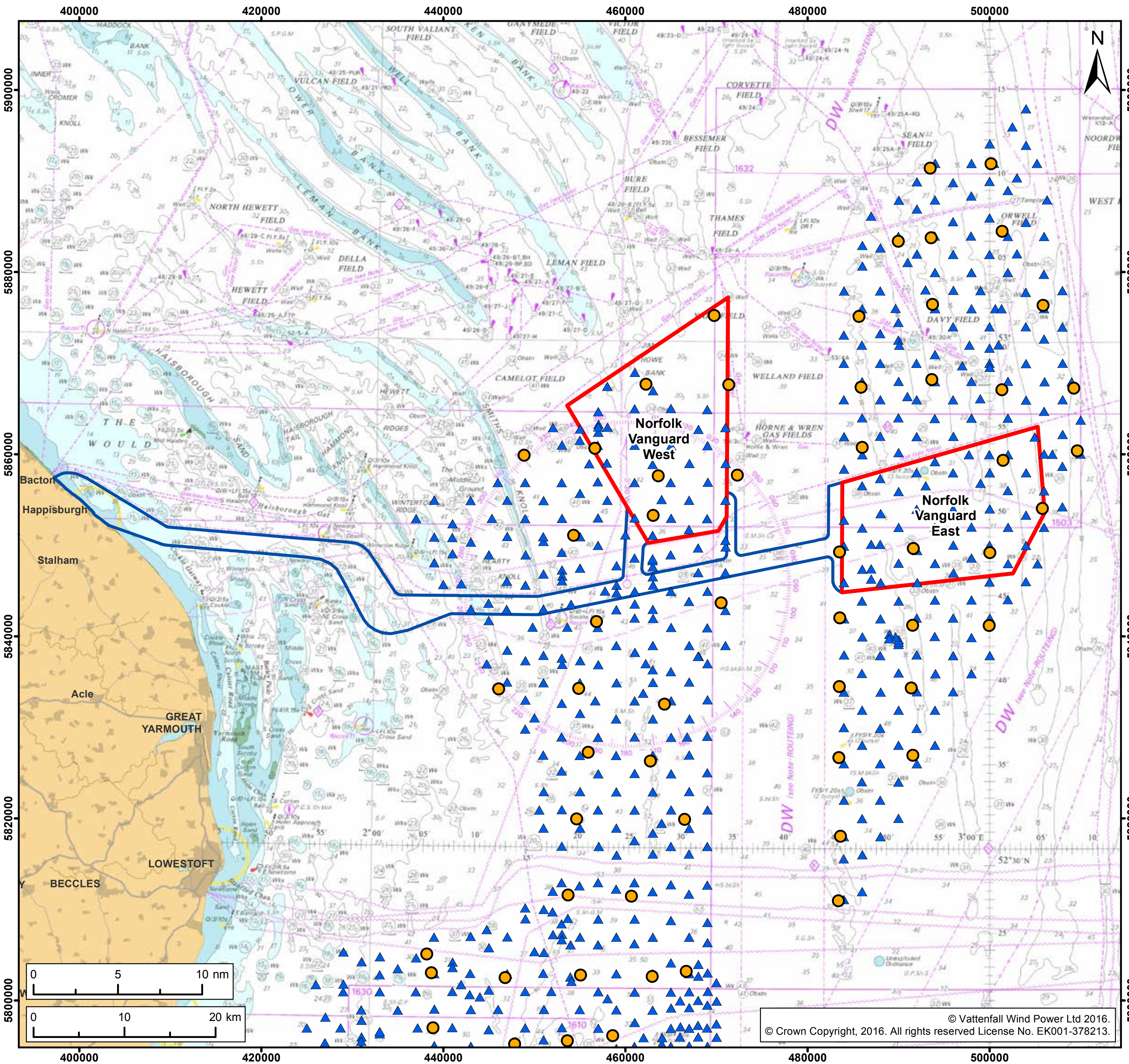
362. Benthic sampling of the former East Anglia Zone was conducted from September 2010 to January 2011 and included the Norfolk Vanguard OWF sites. In addition, further surveys were undertaken in the NV East site in 2013 as part of the then, East Anglia FOUR PEI. These surveys include a combination of benthic grabs, trawls and seabed imagery. In total there are 30 grab samples from NV West and 42 from NV East, as well as five epibenthic trawls in both NV East and NV West. The surveys undertaken are summarised in Table 2.9and sample locations are shown in Figure 2.5.

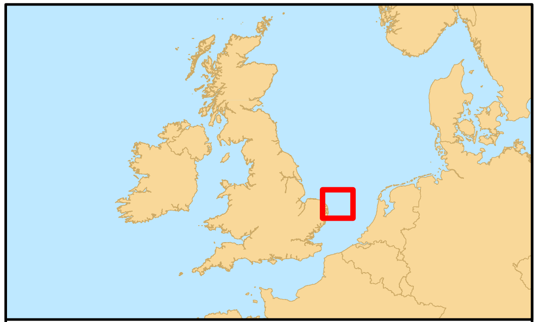
363. Existing information will be supplemented by the collection of grab samples and seabed imagery during survey in 2016 (Table 2.9).

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, trawls and video) by Fugro EMU Ltd reported in Appendix 10.4 of the East Anglia THREE ES (EATL, 2015)	East Anglia THREE and East Anglia FOUR and associated cable route options	2013
Geophysical survey by Fugro EMU Ltd (reporting will be provided in the ES for Norfolk Vanguard)	Norfolk Vanguard offshore project area	2016

Data	Coverage	Date
Benthic survey (grabs and video) by Fugro EMU Ltd (reporting will be provided in the ES for Norfolk Vanguard)	Norfolk Vanguard offshore project area	2016
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 Vanguard
- Provisional Offshore Cable Corridor
- Grab Stations[1]
- Trawl Locations[1]

[1] MESL, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Benthic Survey Locations

Figure: 2.5 | Drawing No: PB4476-002-2-009

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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2.6.1.2 Sediment types

364. During the ZEA surveys, a total of 564 benthic grab samples within the former Zone were analysed for sediment type. The western side of the Norfolk Vanguard OWF sites is generally comprised of coarser sediments than the eastern side, which is comprised of sand with patches of fine sediment (EAOW, 2012a). Analysis of the sediment showed it to be relatively homogeneous with varying proportions of sand, gravel and silt within each sample.

365. British Geological Survey (BGS) data (Figure 2.3) shows the sediments in NV West are predominately slightly gravelly sand and an area of slightly gravelly mud. Sediments in NV East are predominantly slightly gravelly sand.

366. The distribution of sediment is predominantly slightly gravelly sand and sand on the eastern end of the provisional offshore cable corridor, moving to a mixture of slightly gravelly sand, gravelly sand and sand along the central region. Closer to shore the sediment is mainly composed of sandy gravel (see Figure 2.3).

2.6.1.3 Infauna

367. A total of 643 benthic grabs 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, 42 were taken within NV East and 30 taken within NV West.

368. Within the former 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).

369. Within the top ten taxa recorded in the former 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 Zone was low with the majority of samples containing less than 210 individuals. 22 samples contained 701 or more individuals. The majority of samples supporting the high numbers of individuals were located in the western side of the former Zone, including overlap with NV West and the provisional offshore cable corridor. However the majority of sample locations within the offshore project area have low species abundance.

370. The majority of samples supporting relatively high biomass were located in the western side of the former Zone, including overlap with NV West and the provisional

offshore cable corridor. A sparse number of samples with relatively high biomass were found in the east of the former Zone, including NV East.

371. As with biomass and abundance, the majority of samples supporting relatively high taxonomic diversity were located in the western side of the former Zone, including overlap with NV West and the provisional offshore cable corridor. A sparse number of locations with relatively high diversity were found to the east of the former Zone, including NV East.

372. Multivariate analysis of the benthic infaunal data was carried out using the PRIMER V6 software package, this analysis identified 18 faunal groups across the Zone, and five of these groups (J, L, M, N and Q) were found within NV East and only four groups (K, N, M and Q) were found within NV West. The main characterising taxa were:

- Group J: the polychaete[10] worm *Spiophanes bombyx*;
- Group K: the polychaete worm *Scoloplos armiger*;
- Group L: the polychaete 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*.

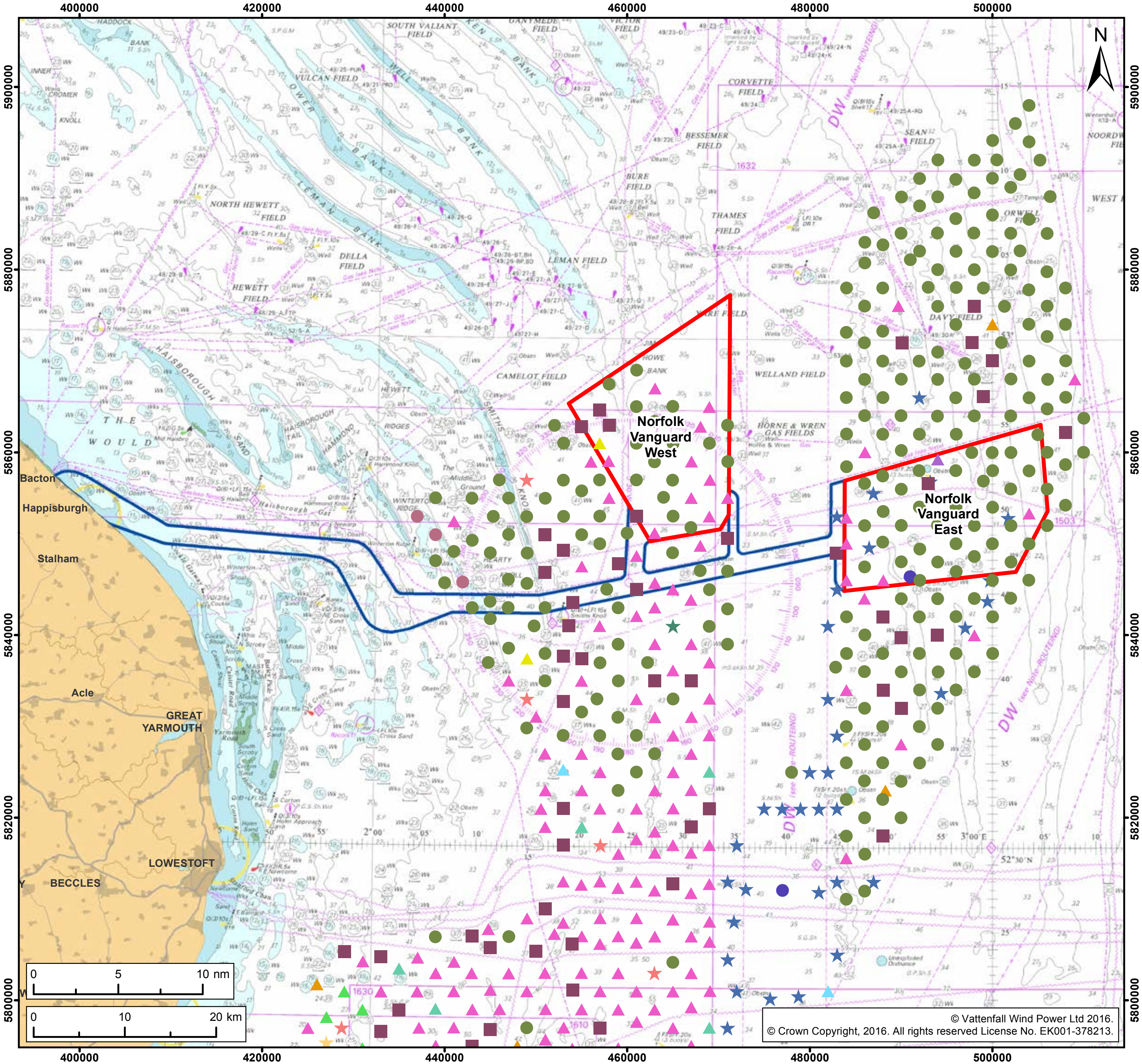
373. NV East infauna was dominated by Group N. Other groups within this area include C, J, L, M and Q.

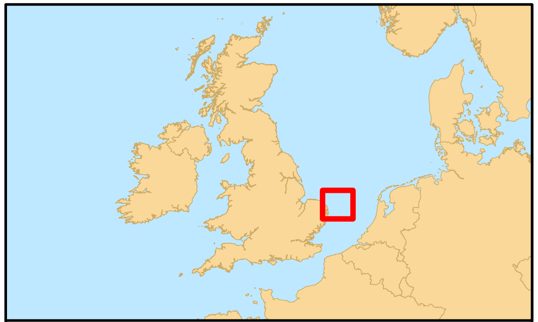
374. NV West infauna was also dominated by Group N with a high presence of Group M. Other groups within NV West include K and Q.

375. The area of the provisional offshore cable corridor that overlaps with survey areas for the former Zone is also dominated by Group N. Other groups within this area include L, M and Q. Grab samples will be collected throughout the provisional offshore cable corridor in 2016, and the data will be analysed and reported in the ES.

376. Infaunal communities across the former East Anglia Zone are shown in Figure 2.6.

[10] A class of annelid worms that have bristles ("chaetae") on each body segment





Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor

Faunal Groups[1]

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

[1] MESL, 2013, Fugro, 2013.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Infaunal Groups Across the Former East Anglia Zone

Figure: 2.6 Drawing No: PB4476-002-2-011

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

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2.6.1.4 Epifauna

377. A total of 78 epibenthic trawls were taken during the survey of the former East Anglia Zone, five trawls each were conducted in NV East and NV West. The zone surveys identified 95 taxa, with an average of 956 individuals and 24 taxa per sample. The distribution of taxonomic richness across both sites was highly variable with great diversity in NV East.

378. Epifaunal abundance ranged from 110 to 15,252 individuals per trawl within the former Zone, with the majority of trawls supporting less than 565 individuals. Epibenthic abundance ranges from approximately 110 to 4666 within NV West and from 110 to 2740 within NV East (based on abundance categories in EAOW, 2012a).

379. 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 Zone is broadly comparable with the benthic ecology in NV West.

380. Multivariate analysis of the ZEA epifaunal data identified four faunal groups. The Norfolk Vanguard offshore project area is dominated by one group, 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*.

2.6.1.5 Annex 1 habitats

381. There are two habitat types listed in Annex I of the Habitats Directive that occur in the former East Anglia Zone and potentially within the Norfolk Vanguard offshore project area: sandbanks and biogenic reefs.

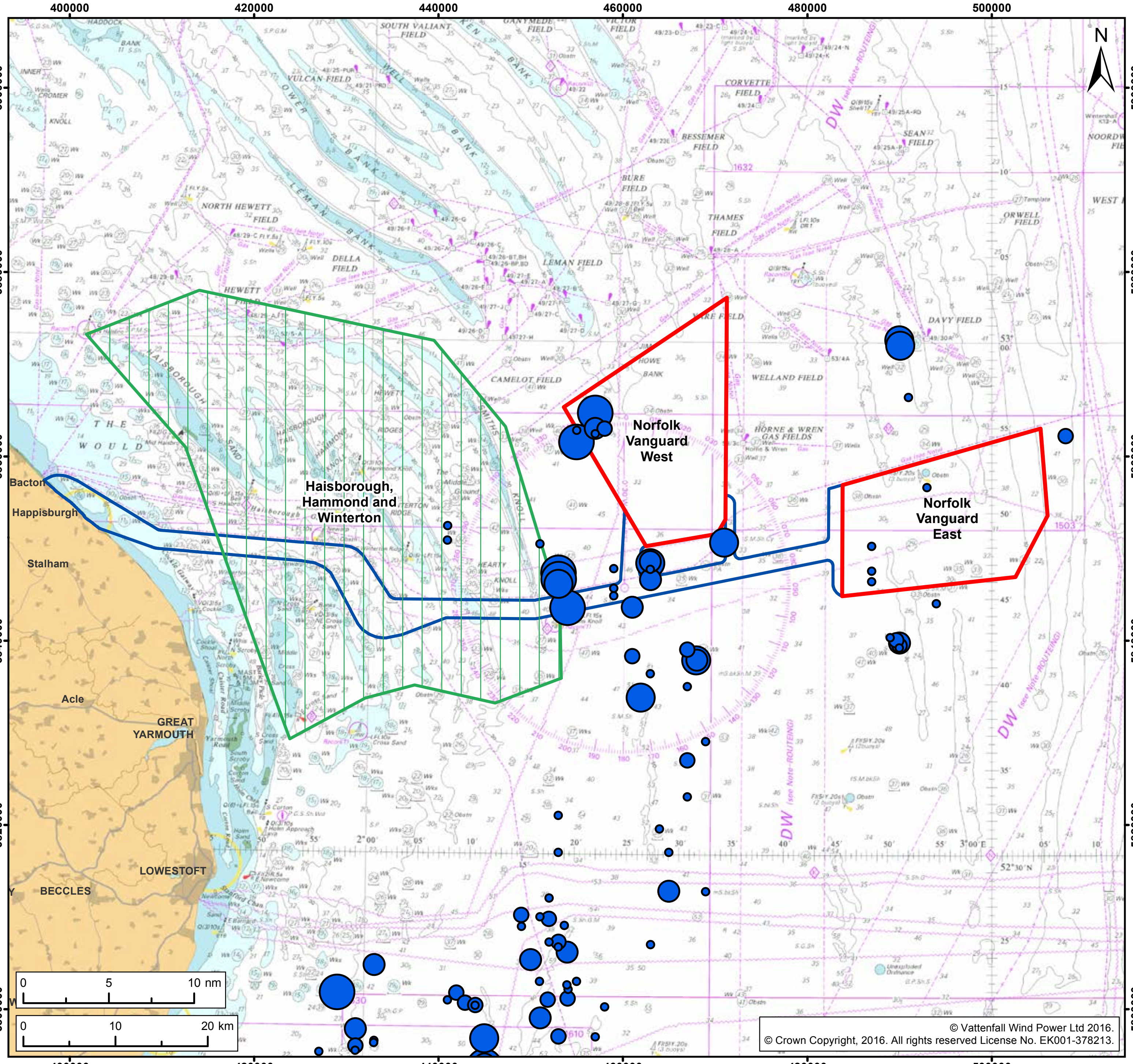
382. The Haisborough, Hammond and Winterton SCI to the west of NV West is designated for Annex I sandbanks and reefs (JNCC, 2016a). The provisional offshore cable corridor runs through this area. To date, no Annex I sandbanks have been identified within either of the OWF sites.

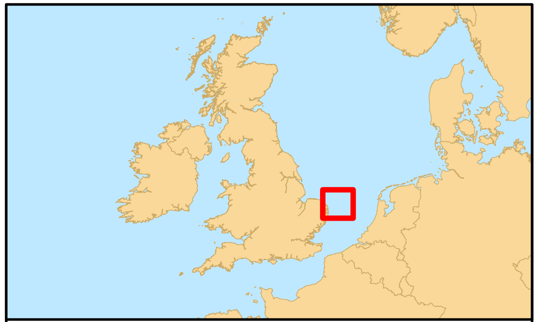
383. Potential reef structures identified during the benthic surveys within the former East Anglia Zone were biogenic aggregations made by the Ross worm *S. spinulosa*. *S. spinulosa* can form dense aggregations on the seabed, which can take the form of crusts or reef where aggregations are up to several 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 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).

384. 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 Zone, including parts of the provisional offshore cable corridor (see Figure 2.7), 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 recorded within NV East, NV West and the provisional offshore cable corridor.

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





Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- Sites of Community Importance (SCI)

Sabellaria Volumes[1]

- 0.00 - 0.30
- 0.31 - 1.00
- 1.00 - 3.00
- 3.01 - 5.00
- 5.01 - 10.00

[1] MESL, 2010.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

S. *Spinulosa* Across the Former East Anglia Zone

Figure: 2.7 Drawing No: PB4476-002-2-012

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	JE	GK	A4	1:600,000

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

VATTENFALL

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2.6.1.6 UK Post-2010 Biodiversity Framework

386. The UK Post-2010 Biodiversity Framework, published in July 2012, succeeded the UK Biodiversity Action Plan (BAP) 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.

387. The following habitats of principal importance are present within the former East Anglia Zone and Norfolk Vanguard provisional offshore cable corridor:

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

388. Habitat mapping during the ZEA identified small areas of mud habitats in deep water in the north west of the former Zone, with none being identified within either NV West or NV East (EAOW, 2012a).

389. As discussed above no aggregations of *S. spinulosa* reef were found within NV East, but have been found in both NV West and the provisional offshore cable corridor.

390. Subtidal sands and gravels potentially cover large areas of the site.

391. 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.

392. Four species of principle importance were identified in the ZEA surveys; mantis shrimp *Rissoides desmaresti*, spider crab *Achaeus cranchii*, the amphipod *Apherusa ovalipes*, and *Streptosyllis* spp. (EAOW, 2012a).

2.6.1.7 Marine Conservation Zone features

393. 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, 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. Further habitat mapping will be undertaken for the area of the MCZ that overlaps with the provisional offshore cable corridor, following the benthic and geophysical survey in 2016.

2.6.1.8 Intertidal

394. The intertidal zone within the landfall search area 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. 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

395. A range of potential impacts on benthic ecology may occur during the construction, operation and decommissioning of Norfolk Vanguard. 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[11].

2.6.2.1 Potential impacts during construction

396. **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 will be relatively small and seabed recovery is expected quickly following cessation of installation activities, given the likely tolerance and recoverability of the communities present.

397. **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.

398. **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.

399. **Re-mobilisation of contaminated sediments:** Sediment disturbance could lead to the mobilisation of contaminants (if present) that could be harmful to the benthos.

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

This will be assessed in the EIA based on the results of sediment sampling within Norfolk Vanguard.

400. **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 2.1.11 Shipping and Navigation). 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).

401. **Loss of habitat:** The installation of turbine foundations will result in a permanent loss of habitat. As the loss of habitat is an on-going impact this is considered under operation rather than construction to avoid double counting.

402. **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 and will be 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

403. **Physical disturbance:** There is potential for physical disturbance of the seabed from jack-up vessel legs during planned maintenance or, in the case or a cable failure, excavation of cables. In general, the impacts from planned maintenance should be temporary, localised and small scale and overall there would be less impact than during construction.

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

405. **Re-mobilisation of contaminated sediments:** Given the likely levels of sediment contamination no pathway exists for impacts from contaminants.

406. 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 2016 survey, this impact may be scoped out from further consideration within the EIA.

407. **Loss of habitat:** The presence of foundations on the seabed will result in a relatively small footprint of lost habitat in the context of the habitat available in the former Zone and the surrounding region. As previously discussed (Section 2.6.1.5) 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 small footprint.

408. **Colonisation of foundations:** The sub-sea structures (foundations and scour protection) are expected to be colonised by a range of species leading to a localised increase in biodiversity. The presence of the structures will 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 a clear 'reef effect' (OES, 2009, Lindeboom *et al*, 2011) or significant changes of the seabed beyond the vicinity of the structures themselves.

409. **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.

410. **Underwater noise and vibration:** Noise and vibration generated by the operational turbines 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, therefore it is proposed that this impact is scoped out of the EIA.

411. **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 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 proposed that the impact of EMF on benthic species and habitats is scoped out of the EIA due to the lack of evidence to suggest there is potential for 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

412. The potential impacts arising during the decommissioning phase are envisaged to be similar to those described for the construction phase.

2.6.2.4 Potential cumulative impacts

413. **Wind farms:** Potential cumulative impacts with proposed adjacent offshore wind farms, East Anglia THREE and Norfolk Boreas 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.

414. 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 Vanguard 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 arise however these are not expected to be significant.

415. **Other activities:** Proposed aggregate extraction to the north of the Norfolk Vanguard provisional offshore cable corridor to support sand engine coastal protection for the Bacton Gas Terminal could have potential to impact cumulatively with Norfolk Vanguard. Aggregate dredging is currently planned for 2017 with Norfolk Vanguard construction from 2023 and therefore 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 EIA if appropriate.

2.6.2.5 Transboundary impacts

416. 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 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
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 (×)

2.6.3 Mitigation

417. It is expected that the impacts upon the benthos will be small scale, localised and temporary. It is not considered that there are any highly sensitive receptors within the benthic communities. With the presence of *S. spinulosa* in NV West and the provisional cable corridor, infrastructure will be micro-sited to avoid impacts.

2.6.4 Approach to assessment and data gathering

418. A benthic survey campaign was undertaken in summer 2016 (including geophysical data, geotechnical data, subsampling for contaminants, grab sampling and drop down video). Geophysical data was collected across the offshore project area and grab sampling with drop down video targeted to ground truth each habitat identified by the geophysical data analysis. The survey methodology was agreed with the MMO and Natural England.

419. 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.

420. 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

421. Given that fish are mobile, data sets with large scale coverage are particularly relevant and useful for characterising the community. 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 have also been reviewed, 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.

422. Norfolk Vanguard lies within the International Council for the Exploration of the Sea (ICES) [12] rectangles 34F1, 34F2, 34F3 and 35F2. Data from ICES rectangles covering Norfolk Vanguard are discussed further in Section 2.10 and are also referred to below.

423. The available environmental datasets upon which this section is based are 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 - 2014
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	-

[12] 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 for the former East Anglia Zone

East Anglia FOUR

424. Otter trawls and beam trawls were undertaken to inform the former East Anglia FOUR draft PEI in February and May 2013, with the results of each survey being very similar. 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. 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).

425. A total of 16 species of fish were caught in the scientific beam trawl survey, undertaken only in May. Overall, solenette *Buglossidium luteum* was the most abundant species caught followed by sand goby *Pomatoschistus minutus*, with all other species found in relatively low numbers (BMM Ltd., 2013b).

East Anglia THREE

426. As with East Anglia FOUR discussed above, otter trawls and beam trawls were undertaken in February and May 2013, with the results of each survey being very similar. A total of 11 and 12 species were caught in the otter trawl survey in February and May respectively, and 16 and 18 species in the beam trawl. As with the East Anglia FOUR survey dab, plaice and whiting were the most abundant species recorded. All other species were caught in relatively low numbers (BMM Ltd, 2013c, 2013d).

427. A beam trawl survey was undertaken in May 2013. A total of 28 species of fish were caught; 20 within East Anglia THREE, and 27 along the export cable. 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

428. Table 2.12 gives an indication of the species found within ICES rectangles 34F1, 34F2, 34F3 and 35F2 (MMO, 2016). Only species where an average landed weight of over 0.1 tonnes, recorded between 2008 and 2014, are listed.

Table 2.12 Average landed weight (tonnes) for species recorded by UK fleets within ICES rectangles 34F1, 34F2, 34F3 and 35F2 (2008-2014) (MMO, 2016)

Common name	Latin name	Average landed weight (tonnes)
Sprat	*Sprattus sprattus*	16.9
Plaice	*Pleuronectes platessa*	7.0
Sole	*Solea solea*	2.0
Herring	*Clupea harengus*	1.5
Cod	*Gadus morhua*	0.5
Turbot	*Scophthalmus maximus*	0.4
Flounders/flukes sp.	*Platichthys sp.*	0.4
Dab	*Limanda limanda*	0.4
Brill	*Scophthalmus rhombus*	0.3
Spotted ray	*Raja montagui*	0.3
Blonde ray	*Raja brachyura*	0.3
Lesser spotted dogfish	*Scyliorhinus canicula*	0.2
Mackerel	*Scomber scombrus*	0.2
Thornback ray	*Raja clavata*	0.2
European Seabass	*Dicentrarchus labrax*	0.1
Common stingray	*Dasyatis pastinaca*	0.1
Gurnard sp.	*Triglidae sp.*	0.1
Whiting	*Merlangius merlangus*	0.1
Lemon sole	*Microstomus kitt*	0.1
Smoothhound	*Mustelus mustelus*	0.1

429. The landings data show that the most abundant species by weight across those ICES rectangles which overlap with Norfolk Vanguard are sprat *Sprattus sprattus.* Plaice, sole *Solea solea* and herring *Clupea harengus* are also recorded with over 1 tonne landed on average between 2008 and 2014. Bottom dwellers such as turbot *Scophthalmus maximus*, flounders *Platichthys* sp and dab are also found.

430. 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 principle 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 34F1, 34F2, 34F3 and 35F2, which overlap with the Norfolk Vanguard offshore project area, 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 and 35F2 (January 2011 – April 2016). Only species with CPUE >10 individuals per hour are shown (ICES, 2016)

Common name	Latin name	Average CPUE/hr (individuals)
Sprat	*Sprattus sprattus*	382
Whiting	*Merlangius merlangus*	345
Greater sandeel	*Hyperoplus lanceolatus*	192
Mackerel	*Scomber scombrus*	122
Herring	*Clupea harengus*	118
Raitt's sandeel	*Ammodytes marinus*	108
Horse mackerel	*Trachurus trachurus*	104
Dab	*Limanda limanda*	89
Lesser weever	*Echiichthys vipera*	89
European anchovy	*Engraulis encrasicolus*	65
Plaice	*Pleuronectes platessa*	63
Solenette	*Buglossidium luteum*	34
Common dragonet	*Callionymus lyra*	23
Sand goby	*Pomatoschistus minutus*	19
Lesser spotted dogfish	*Scyliorhinus canicula*	17
Gurnard	*Triglidae sp.*	16
European flounder	*Platichthys flesus*	15
Poor cod	*Trisopterus minutus*	14
Lemon sole	*Microstomus kitt*	11

431. The CPUE data from IBTS show that the most abundant species landed within the Norfolk Vanguard surrounding area are sprat, whiting, sandeel (*Hyperoplus lanceolatus* and *Ammodytes marinus*), mackerel (*Scomber scombrus* and *Trachurus trachurus*) and herring.

432. Of the listed species from both the landings by size and IBTS data, sprat, plaice, sole, mackerel and to a lesser extent cod (0.5 tonnes average between 2008 and 2014), are commercially important. As discussed in Section 2.10, these species are not only important to UK fisheries interests but also to the non-UK fleets that operate within the area.

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

Shellfish

434. Shellfish landings are relatively low although important to the inshore fishery, with the majority consisting of edible crab, *Cancer pagurus*. 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

435. The landings and IBTS 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*, small-spotted catshark *Scyliorhinus canicula*, thornback ray *Raja clavata*, common stingray *Dasyatis pastinaca* and 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).

436. Nursery areas have been defined for tope and thornback ray (Figure 2.13). 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

437. Diadromous species (i.e. those that migrate between fresh and salt water) of conservation importance in 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 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 nursey areas

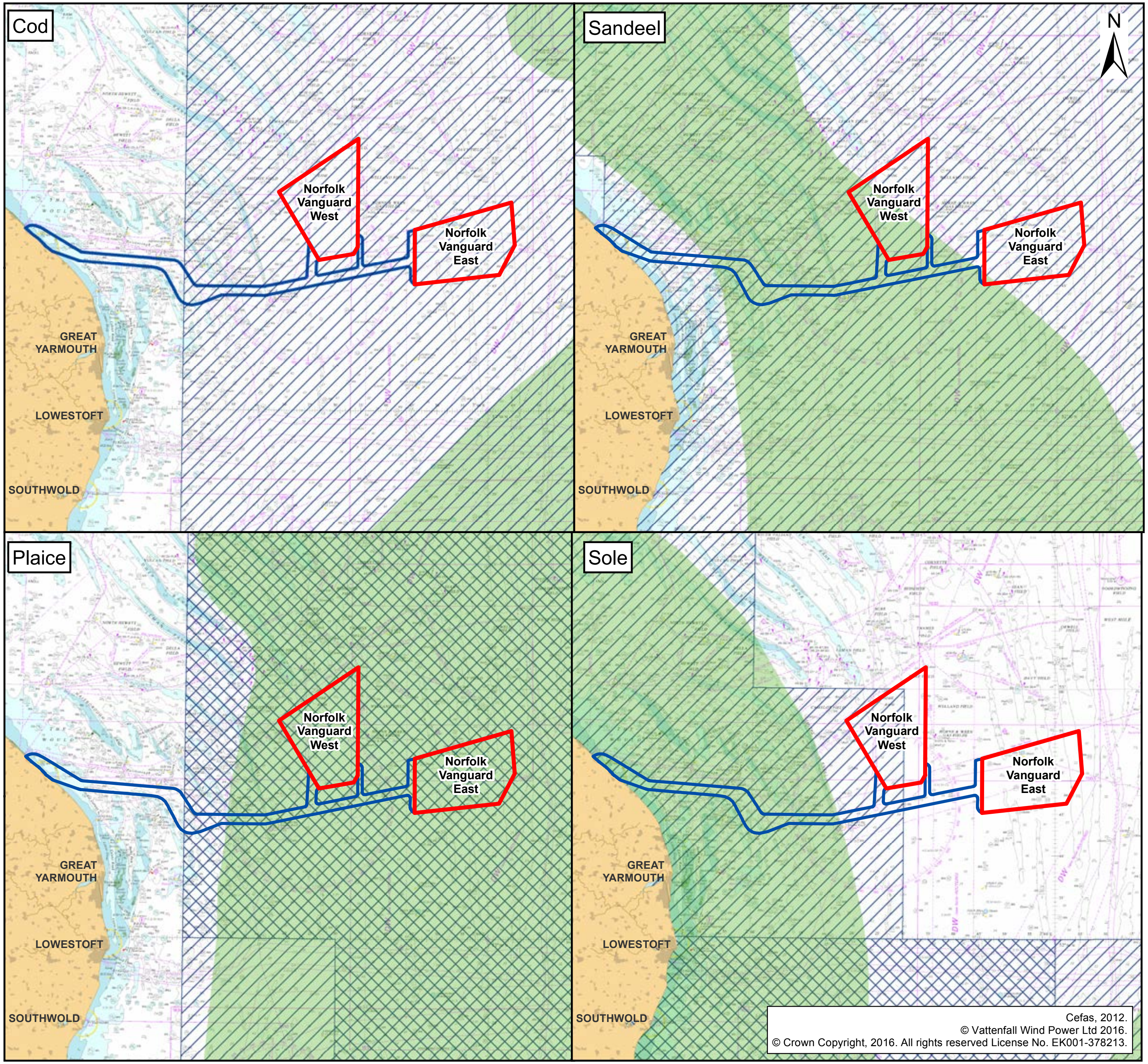
438. Those fish and shellfish species deemed to be potentially important within the Norfolk Vanguard offshore project area are presented in Table 2.15 . Their relative contribution to the landings and IBTS catch data presented earlier is also illustrated.

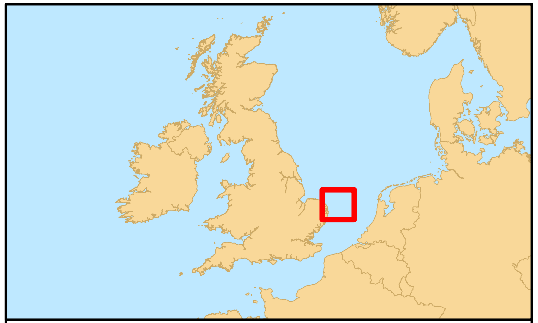
439. The spawning and nursery grounds for each of those species with grounds overlapping the offshore project area (where known) are shown in Figure 2.8 to Figure 2.13.

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

Species	Spawning	Nursery	Contribution to landings and IBTS catches	Conservation designations	Further Information
Plaice	High Intensity zone begins ~15nm along cable corridor from landfall and covers Norfolk Vanguard	Low intensity zone up to ~15nm along cable corridor from landfall	High	UK BAP, IUCN (least concern)	
Sole	High Intensity ground south of NV. Low intensity ground covering cable corridor and most of NV West.	Low intensity zone up to ~15nm along cable corridor from landfall	High	UK BAP	
Cod	Low intensity zone begins ~15nm along cable corridor from landfall and covers Norfolk Vanguard	Low intensity area covers Norfolk Vanguard	Medium	UK BAP, OSPAR, IUCN (vulnerable)	
Sandeel	Low intensity area covers Norfolk Vanguard	Low intensity area covers majority of Norfolk Vanguard	Medium	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	Begins ~15nm along cable corridor from landfall and covers Norfolk Vanguard	South and east of Norfolk Vanguard, covers small area of NV East	High	UK BAP	Important as prey to other fish, seabirds and marine mammals. Hearing specialist
Herring	Area extending south of the provisional offshore cable corridor	Low intensity area covers NV. Small area of high intensity south of cable corridor	High	UK BAP, IUCN (least concern)	Important as prey to other fish, seabirds and marine mammals Substrate specific demersal spawners (gravelly substrates). Hearing specialist
Nephrops	Area to the north of Norfolk Vanguard	Area to the north of Norfolk Vanguard	Low	IUCN (least concern)	Commercially important crustacean
Thornback ray	No data	Low intensity zone up to ~15nm along 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 cable corridor from landfall and covers Norfolk Vanguard	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)

Species	Spawning	Nursery	Contribution to landings and IBTS catches	Conservation designations	Further Information
Mackerel	No data	Low intensity area covers Norfolk Vanguard.	Medium	UK BAP, IUCN (least concern)	Potentially transiting the zone during migrations
Whiting	Low intensity begins ~15nm along cable corridor from landfall and covers Norfolk Vanguard	Low intensity area covers Norfolk Vanguard	High	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)





Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- Spawning Ground (Coull *et al.* 1998)

Spawning Ground (Intensity)

- High Intensity (Ellis *et al.* 2010)
- Low Intensity (Ellis *et al.* 2010)

0 10 20 nm

0 20 40 km

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Spawning Grounds for Cod, Sandeel, Plaice and Sole

Figure: 2.8 Drawing No: PB4476-002-2-019

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	JE	GK	A4	1:1,250,000

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

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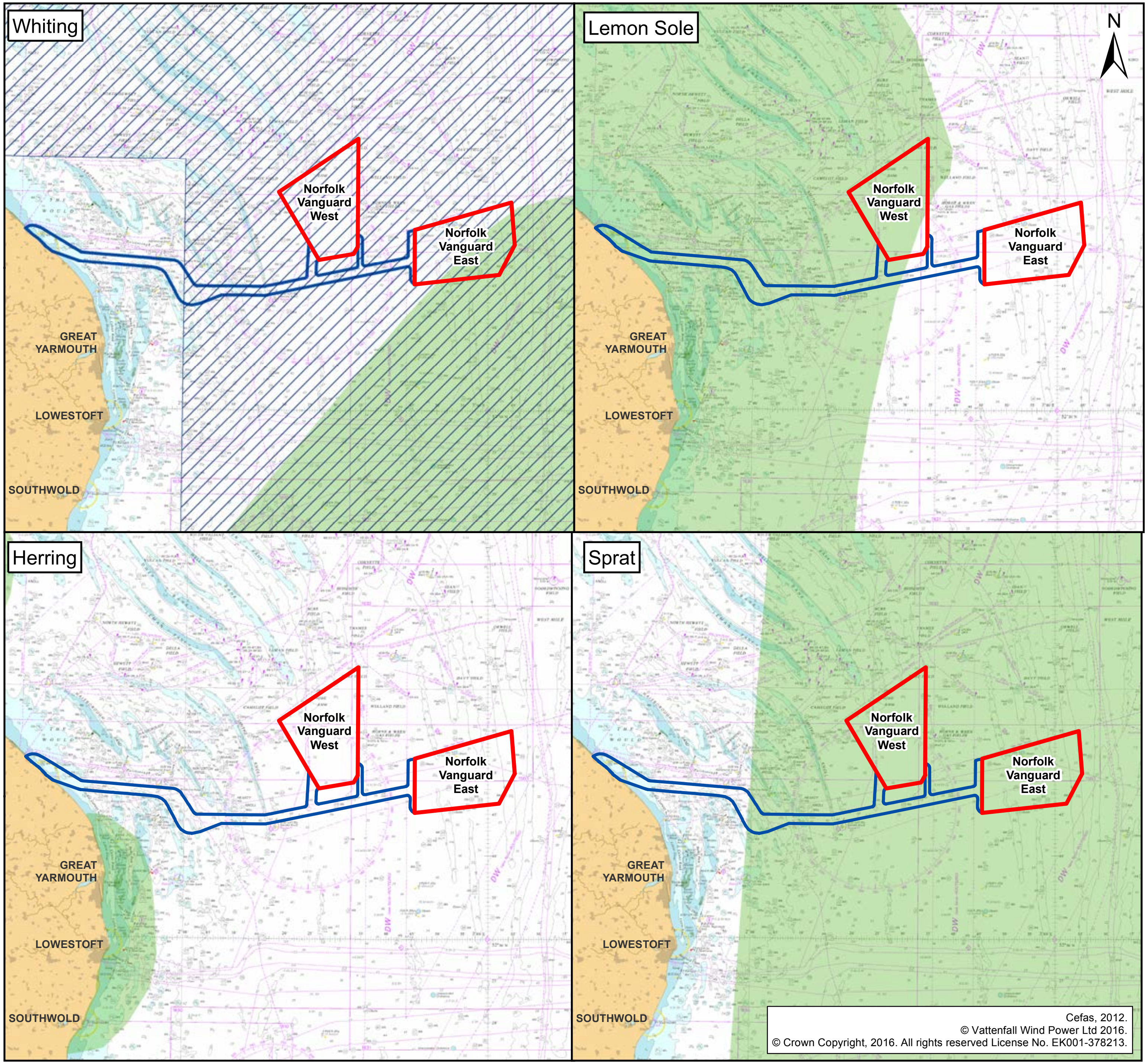

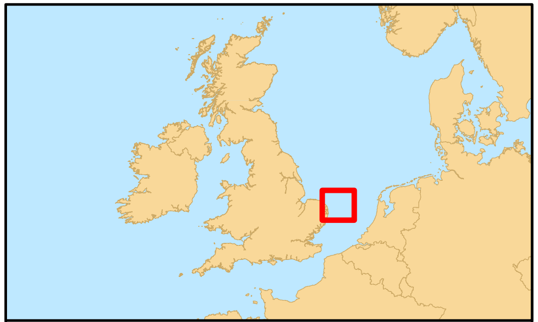

Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- Spawning Ground (Coull *et al.* 1998)

Spawning Ground (Intensity)

- Low Intensity (Ellis *et al.* 2010)

0 10 20 nm

0 20 40 km

Project: Norfolk Vanguard

Report: Environmental Impact Assessment Scoping Report

Title: Spawning Grounds for Whiting, Lemon Sole, Herring and Sprat

Figure: 2.9 Drawing No: PB4476-002-2-020

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	13/07/16	JE	GK	A4	1:1,250,000

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

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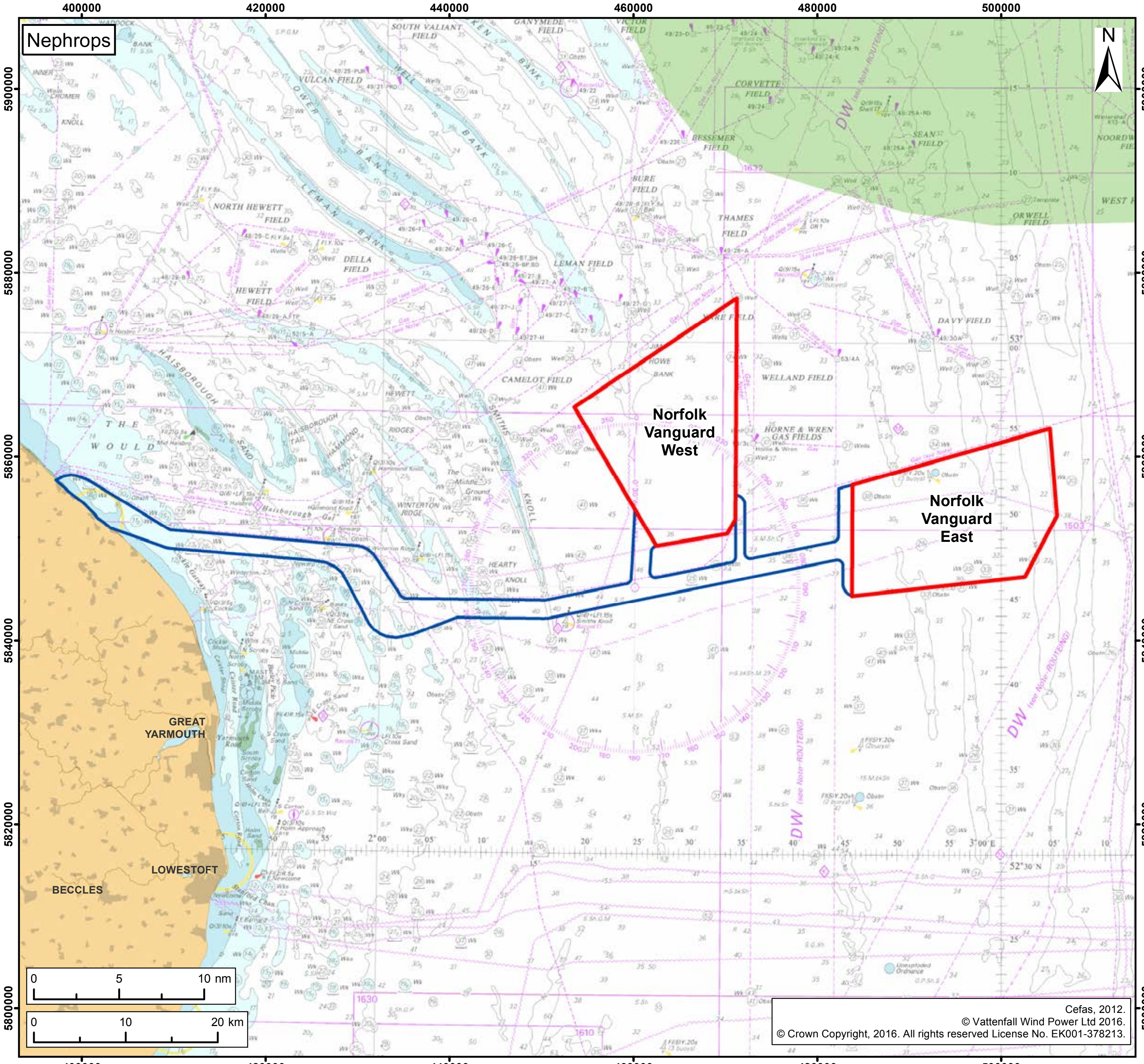

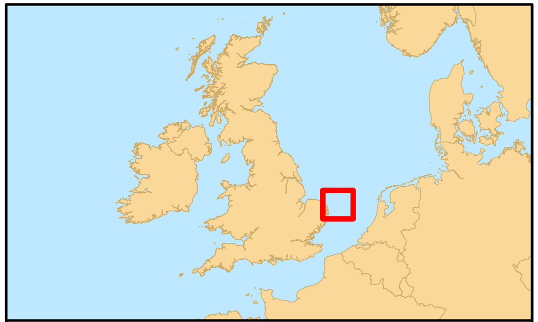

Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- Spawning Ground (Coull *et al.* 1998)

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Spawning Grounds for Nephrops

Figure: 2.10 | Drawing No: PB4476-002-2-021

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	JE	GK	A4	1:600,000

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

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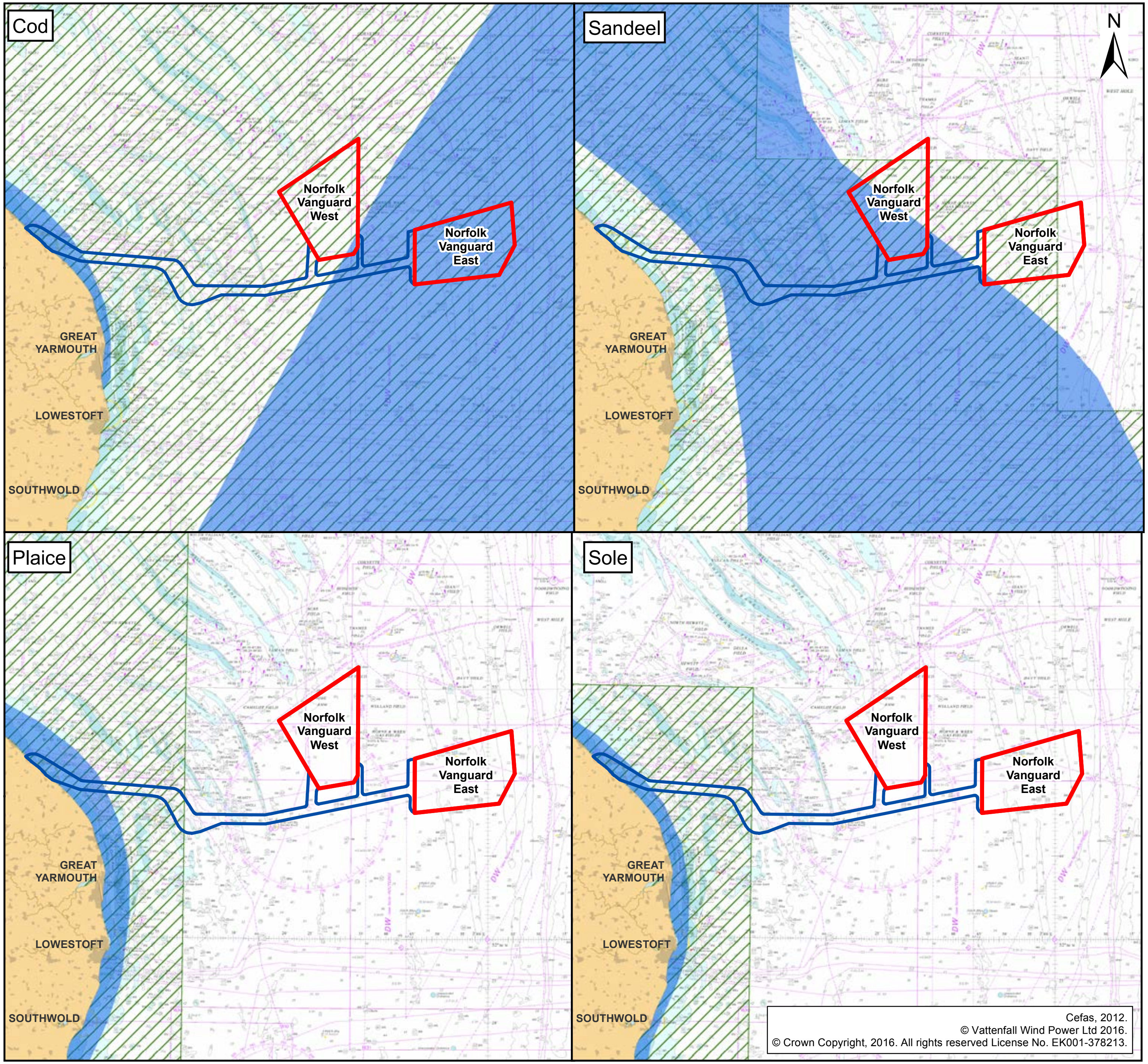

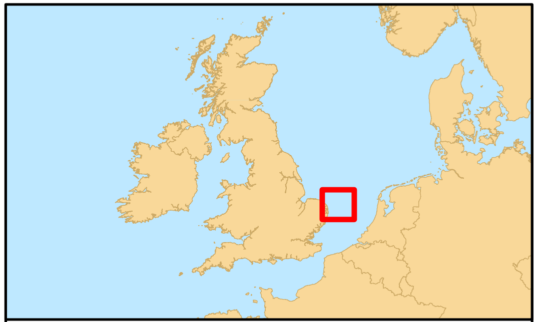

Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- Nursery Ground (Coull *et al.* 1998)

Nursery Ground (Intensity)

- High Intensity (Ellis *et al.* 2010)
- Low Intensity (Ellis *et al.* 2010)

0 10 20 nm

0 20 40 km

Project: Norfolk Vanguard

Report: Environmental Impact Assessment Scoping Report

Title: Nursery Ground for Cod, Sandeel, Plaice and Sole

Figure: 2.11 Drawing No: PB4476-002-2-022

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	13/07/16	JE	GK	A4	1:1,250,000

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

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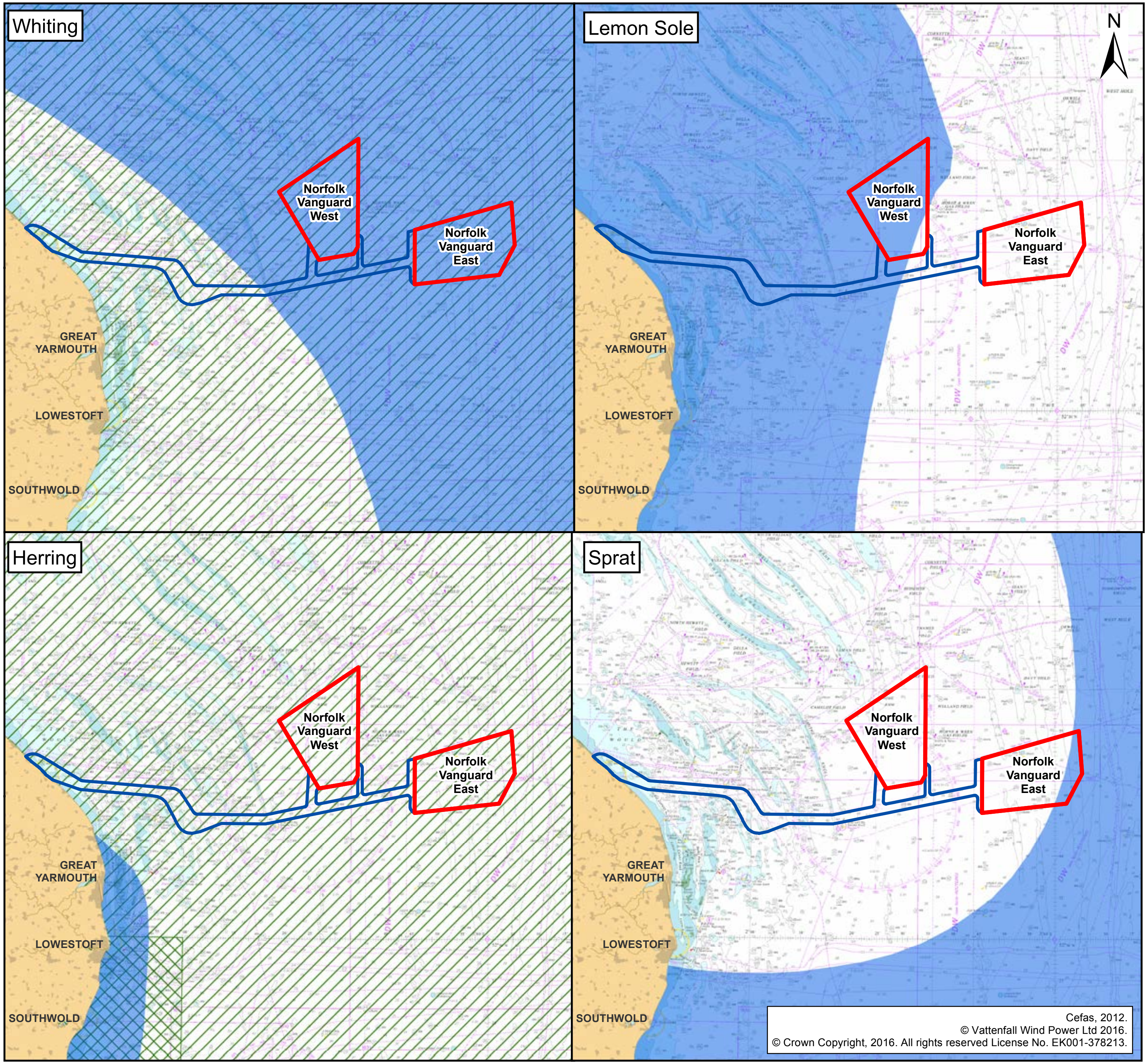

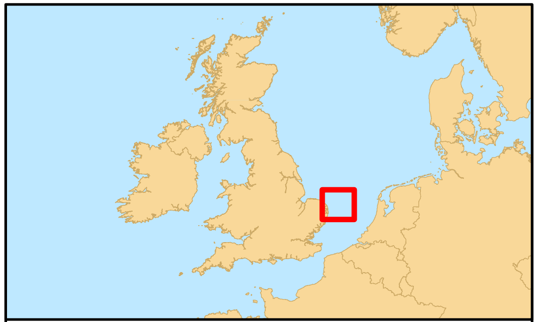

Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- Nursery Ground (Coull *et al.* 1998)

Nursery Ground (Intensity)

- High Intensity (Ellis *et al.* 2010)
- Low Intensity (Ellis *et al.* 2010)

0 10 20 nm

0 20 40 km

Project: Norfolk Vanguard

Report: Environmental Impact Assessment Scoping Report

Title: Nursery Ground for Whiting, Lemon Sole, Herring and Sprat

Figure: 2.12 Drawing No: PB4476-002-2-023

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	13/07/16	JE	GK	A4	1:1,250,000

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

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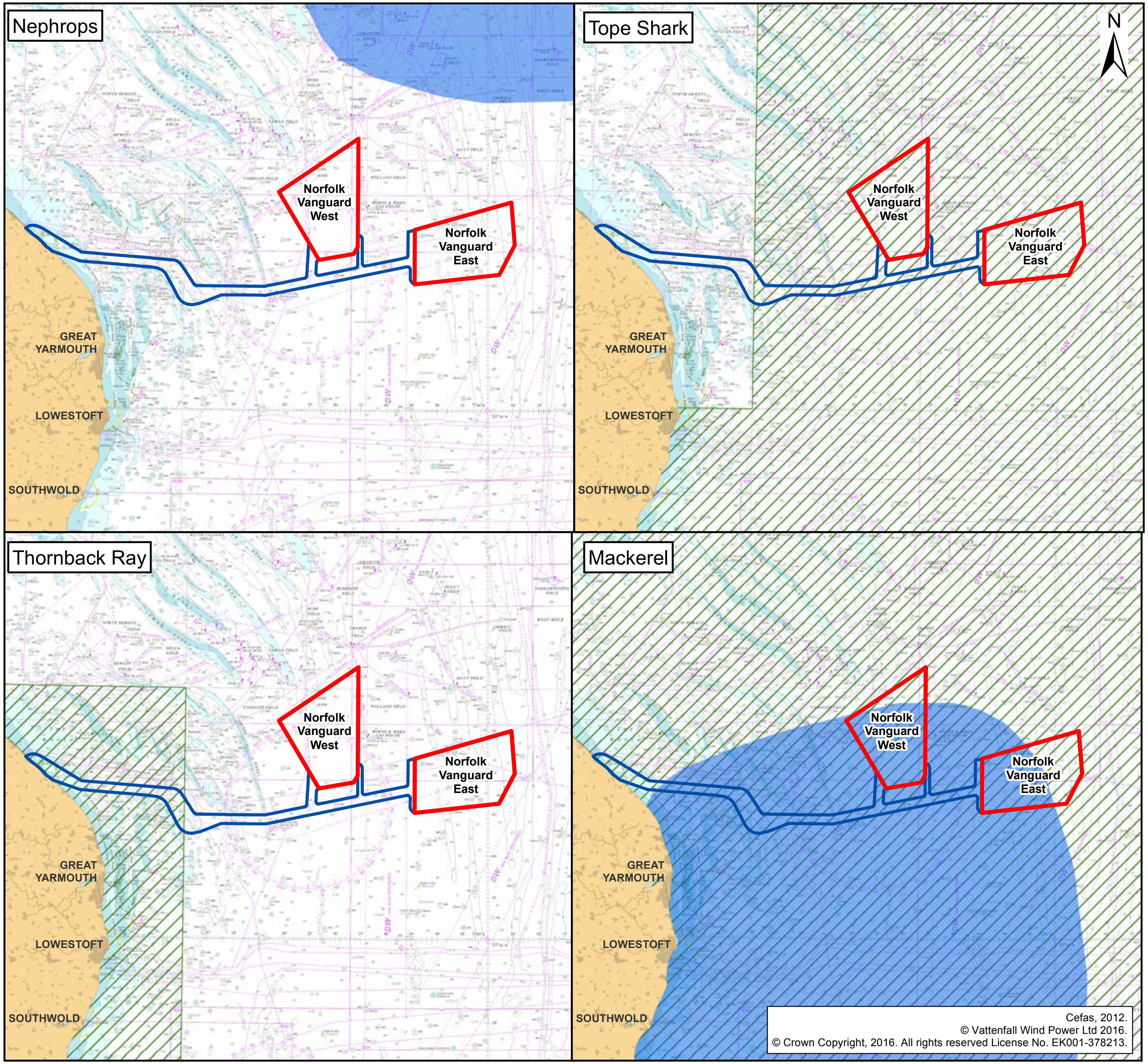

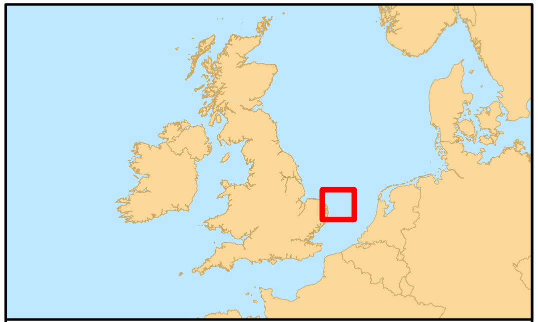

Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- Nursery Ground (Coull *et al.* 1998)

Nursery Ground (Intensity)

- Low Intensity (Ellis *et al.* 2010)

0 10 20 nm

0 20 40 km

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Nursery Grounds for Nephrops, Tope Shark, Thornback Ray and Mackerel

Figure: 2.13 Drawing No: PB4476-002-2-024

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	13/07/16	JE	GK	A4	1:1,250,000

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

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2.7.2 Potential impacts

2.7.2.1 Potential impacts during construction

440. **Physical Disturbance:** There will be physical disturbance of the seabed during construction from the installation of cables and foundations, thorough placement of jack up barge legs, spud cans and anchors/chains and potentially seabed preparation (if gravity base structures are used). This has potential to impact demersal (bottom or near bottom dwelling) fish and shellfish as well as potentially impact upon spawning or nursery grounds. Disturbance will 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).

441. **Increased suspended sediments and smothering:** The construction activities listed above 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 seen 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 of site specific physical processes assessment.

442. **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 2013 as part of the former East Anglia FOUR PEI revealed only three contaminants present above Cefas Action Level 1; Arsenic, Nickel and Chromium. This will be assessed further in the EIA based on the results of sediment sampling within Norfolk Vanguard.

443. **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).

444. 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.

445. 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

446. 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.

447. **Physical Disturbance:** Routine maintenance activities may require jack-up or anchoring of vessels and there will be some seabed disturbance as a result. Any disturbance will be localised, temporary and overall impacts will be lower than for construction.

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

449. **Re-suspension of contaminants:** Given the recommendation for construction above, it is recommended that this potential impact should be scoped out of further consideration within the EIA.

450. **Noise and vibration disturbance:** Operational noise will 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 Vanguard it is not likely that this will be a significant source of noise or impact.

451. Operational turbines will produce noise and vibrations which will 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 Vanguard, it is not expected that operational noise levels from Norfolk Vanguard would cause a significant impact.

452. **Loss of habitat:** The construction of the wind farm will 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 will represent a small percentage of the development area and will be dependent upon the foundation type chosen and need for cable protection; the magnitude of any impact will be relatively small. As discussed previously, the seabed is relatively homogeneous across the offshore project area and therefore there will be sufficient alternative habitat available to fish and shellfish.

453. **Fish aggregation:** The presence of wind farm infrastructure (in the form of turbine towers and foundations, scour protection and cable protection) will create new habitats which will 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). To date, there is no clear evidence of any gross changes in local fish communities as a result operational wind farms. Any change is expected to be of low magnitude and limited to the immediate vicinity of each wind turbine foundation.

454. **Electromagnetic fields (EMF):** Some species of fish utilise electromagnetic fields 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

455. 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 will be lower as there will be no piling).

2.7.2.4 Potential cumulative impacts

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

457. 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 Vanguard 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 other developments in the southern North Sea.

458. **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 will be significant cumulative impacts, all potential impacts (i.e. those listed for Norfolk Vanguard in isolation) will be assessed as part of the EIA.

2.7.2.5 Transboundary impacts

459. 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 impacts relating to fish ecology

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

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

scoped in (✓) and scoped out (×)

2.7.3 Mitigation

460. The impacts of fish are anticipated to be localised and temporary and it is considered unlikely that mitigation will be appropriate. This will 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

461. In accordance with the Cefas (2004) 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.

462. 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 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.

463. 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

464. Marine mammal data have been collected during the extensive aerial surveys for ornithology (see Section 2.9) across the former Zone and the site specific surveys across Norfolk Vanguard from September 2015. The following surveys encompass or overlap with Norfolk Vanguard:

- The Crown Estate Enabling Action data (video aerial survey) from November 2009 to March 2010, completed by HiDef Aerial Surveying Ltd;
- APEM aerial survey data of the former Zone from April 2010 to April 2011;
- APEM aerial survey data of the East Anglia FOUR site with 4km buffer between March 2012 and February 2014;
- APEM aerial survey data of NV East with 4km buffer from September 2015 to April 2016; and
- APEM aerial survey data of NV West with 4km buffer ongoing since September 2015 (end date to be agreed with stakeholders).

465. In addition, the surveys for other offshore wind farms in the former Zone; East Anglia ONE (boat based surveys May 2010-April 2011 and APEM aerial surveys April 2010-October 2011) and East Anglia THREE (APEM aerial surveys September 2011-August 2013) provide useful context.

466. Further to the surveys within the former Zone, a range of information is available and will be incorporated in the EIA, including:

- 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 & 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);
- Atlas of Cetacean distribution in northwest European waters (Reid *et al,* 2008);
- Management Units for cetaceans in UK waters (IAMMWG 2015);
- UK grey and seal usage maps (Jones *et al.* 2013); and

- Special Committee on Seals (SCOS) annual reporting of scientific advice on matters related to the management of seal populations (SCOS, 2015).

467. Consultation with key marine mammal stakeholders will be ongoing during the EIA through the EPP and will include discussion of the best available information to use, for example, to define reference populations for the assessment.

2.8.1.2 Cetaceans

468. During the 2009-2011 surveys, low numbers of cetaceans were recorded across the 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, which accounted for 38% of sightings with a further 53% listed as 'small cetaceans'. A further 6% of aerial sightings were identified as 'patterned dolphins'[13] (likely to be white beaked dolphin *Lagenorhynchus albirostris*) (EAOW, 2012a).

469. 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 Zone (2010-2011). The results show low densities across the majority of the Zone, including within Norfolk Vanguard. 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 east of NV East. This may be related to foraging activity around shallow sub-tidal sand banks.

470. 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 2.5% identified as either a porpoise or a dolphin (EAOW 2012a).

471. 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 (6%) and Risso's dolphin *Grampus griseus* (2%) as well as unidentified dolphin species (2%). 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.

472. During the 24 months of East Anglia THREE aerial surveys (adjacent to NV East with overlapping 4km buffers), 341 cetaceans in total were recorded within the site and buffer area, 149 of which (44%) were positively identified as harbour porpoise, and a

[13] 'Patterned dolphins' could cover Atlantic white-sided, common and white beaked dolphin.

further 188 (55%) identified as either a porpoise or a dolphin (East Anglia THREE Ltd (EATL) 2015). Four white beaked dolphin were also recorded.

473. Cetacean species/groups recorded within NV East and NV West (plus 4km buffer areas) during September 2015 to April 2016 include:

- Harbour porpoise (0 to 46 individuals per month);
- Dolphin sp. (two records; 11 individuals and one individual);
- Unidentified small cetacean (4 to 78 individuals per month);
- White beaked dolphin (one individual during the survey period); and
- Seal (one individual during the survey period).

474. Further interrogation of the Norfolk Vanguard data will be undertaken during the EIA.

475. The available data within the former 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 harbour porpoise is the most abundant cetacean species present within this region, with other species scarce or absent (Reid *et al*, 2003).

476. For conservation and management purposes in the UK populations of marine mammals have been divided into Management Units (MUs, IAMMWG 2015). NV 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 commonly found in UK waters.

Designated sites and conservation importance

477. 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 *Tursiops truncatus* and harbour porpoise *Phocoena phocoena* are all listed under Annex II of the Habitats Directive and are afforded protection through the designation of Natura 2000 sites. Harbour porpoise is also listed on the OSPAR list of threatened and declining species (OSPAR, 2008) and both species of seal and many species of cetaceans are listed as UK Biodiversity Framework priority marine species (JNCC, 2012). Generally, use of the southern North Sea by cetacean species is relatively limited as compared with waters to the north and west of the UK.

478. The Southern North Sea pSAC 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, 2015b). JNCC (2015b) 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 Vanguard will therefore be based on the harbour porpoise North Sea Management Unit (MU) reference population (IAMMWG, 2015) unless further information becomes available.

479. During the Habitats Regulations Assessment (HRA) Screening 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 Vanguard.

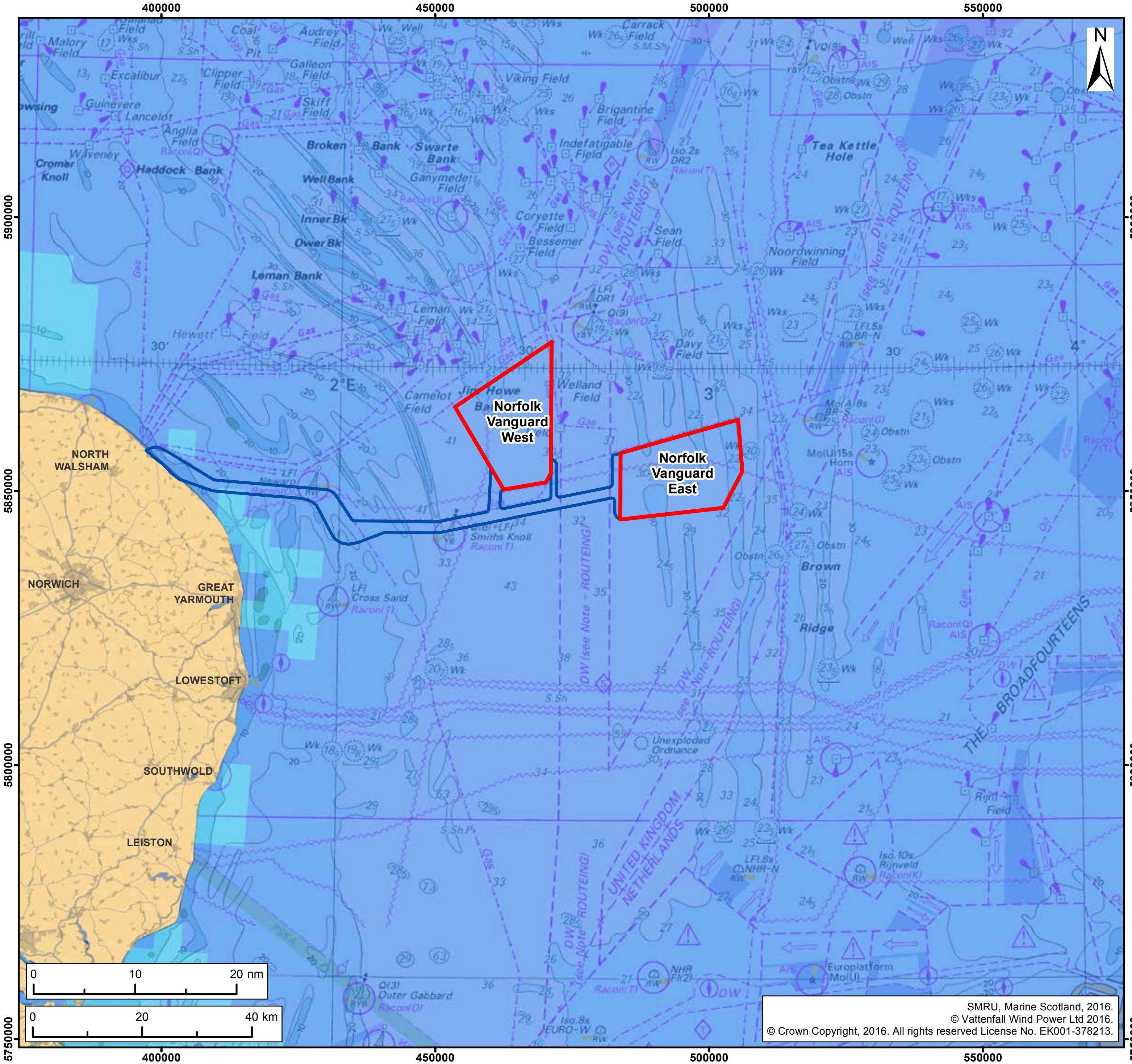
2.8.1.3 Pinnipeds

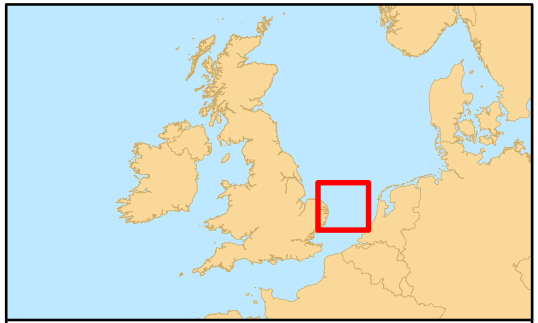
480. The exact landfall area for Norfolk Vanguard will be decided through ongoing site selection work, incorporating consultation responses, as well as environmental and engineering constraints. The landfall search area, shown in Figure 1.2 is around Bacton in the north to Eccles-on-Sea in the south. This is approximately 10km from the Horsey seal haul out site to the south of the landfall search area 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).

481. Grey seal generally forage up to about 50km from their haul out sites and harbour seal shorter distances (generally 25 to 45km) although both species are known to undertake longer trips (Thompson & Miller 1990, McConnell *et al,* 1999 and Cunningham *et al,* 2009). Tagging studies undertaken by 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.

482. NV West and NV East are approximately 47km and 70km, respectively, from the nearest haul out sites. The OWF sites may therefore be within foraging range of harbour and grey seal. However during the aerial survey data for the ZEA (2009-11), only 8 individuals were recorded in June 2009 and 10 individuals in July/August 2009. During the East Anglia ONE surveys (see Section 2.9.1.1) only three seals were recorded and during East Anglia THREE surveys (see Section 2.9.1.1) two individuals were recorded. During September 2015 to April 2016 surveys within NV East and NV West (plus 4km buffer areas) one individual seal was recorded. It is noted that aerial surveys are not the most appropriate method to determining at sea densities of seals, however Figure 2.14 and Figure 2.15 confirm grey seal and harbour seal use of the provisional offshore cable corridor and OWF sites 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.* (2013). This mapping is based on analysis of at telemetry and haul out data by the Sea Mammal Research Unit (SMRU).

483. MUs boundaries for both species of seal are defined out to 12nm, however, the NV landfall and cable route will be located in the South east England MU (IAMMWG, 2013).





Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor

Grey Seal (Halichoerus grypus) at-sea estimated usage

- 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

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Mean Grey Seal At-Sea Usage around Norfolk Vanguard Offshore Project Area

Figure: 2.14 Drawing No: PB4476-002-2-014

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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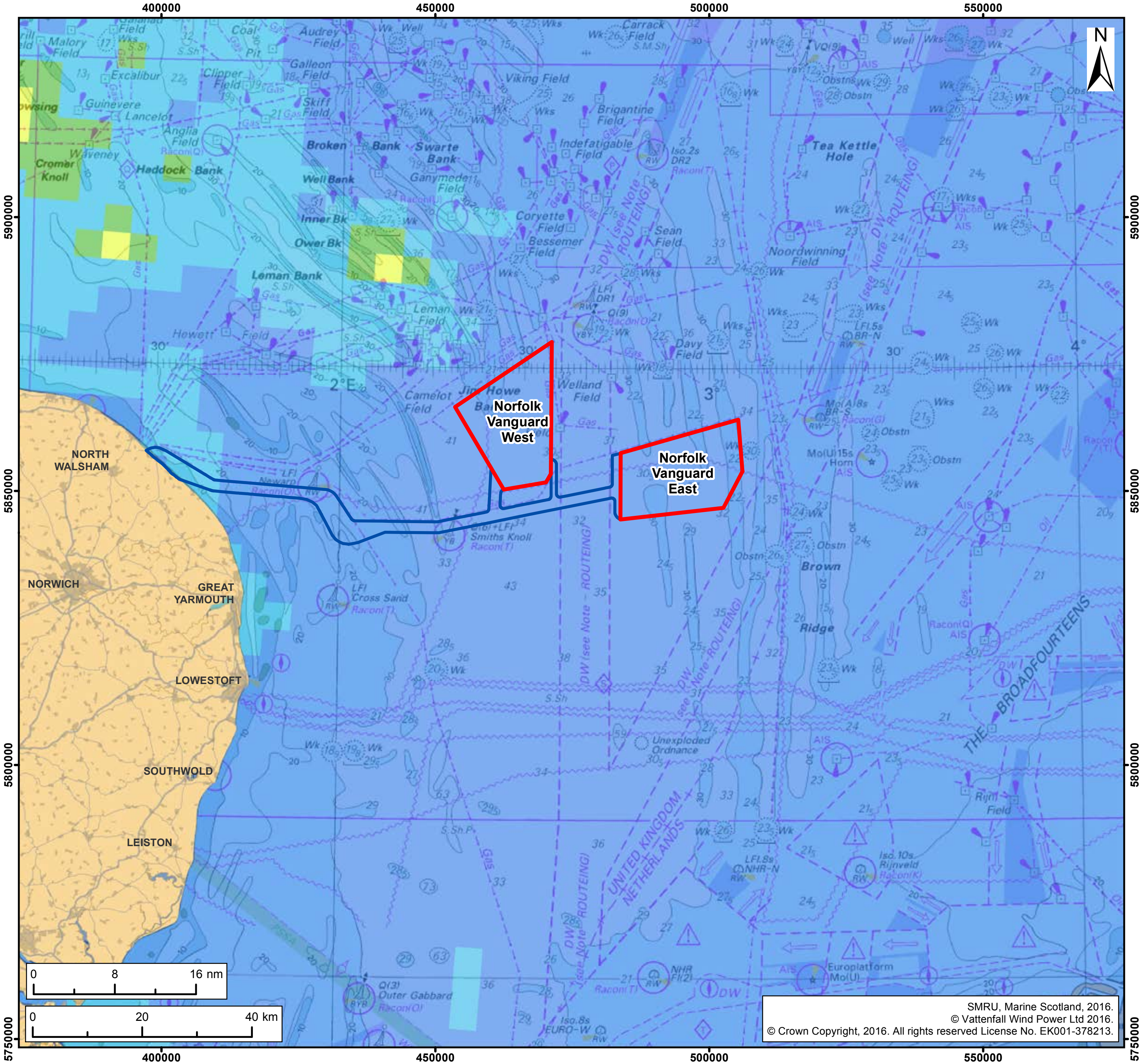

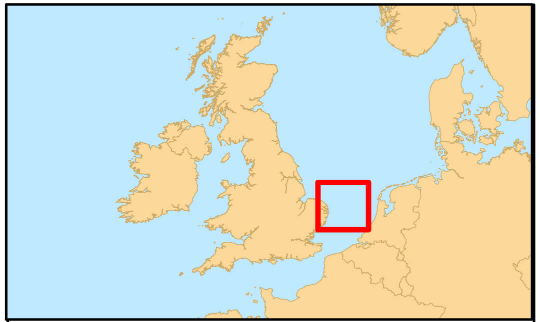

Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor

Harbour seal (Phoca vitulina) at-sea estimated usage

- 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

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

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

Figure: 2.15 Drawing No: PB4476-002-2-015

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	JE	GK	A4	1:1,000,000

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

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Designated sites and conservation importance

484. Grey seal *Halichoerus grypus,* harbour seal *Phoca vitulina,* bottlenose dolphin *Tursiops truncatus* and harbour porpoise *Phocoena phocoena* are all listed under Annex II of the Habitats Directive.

485. 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.

486. The Wash SAC, designated for harbour seal, is the closest SAC to the site at approximately 80km from NV West and 27km from the offshore cable corridor. There are no designated sites for grey seal in the south east of England.

487. 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 Norfolk Vanguard.

2.8.2 Potential impacts

2.8.2.1 Potential impacts during construction

488. **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; and Brandt *et al.,* 2011) and for the duration of piling activities (although intermittently due to breaks in between piles). In very close proximity to piling activities (e.g. tens of metres for high hammer energies), injuries and in extreme cases, fatalities can occur (Nedwell *et al* 2007).

489. 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 and subject to a great deal of study within the industry (Nedwell *et al*., 2007, Scheidat *et al*., 2011).

490. 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.

491. 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 develop 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.

492. With the application of soft-start piling (whereby the energy of the hammer is slowly ramped up causing marine mammals to flee the immediate area of piling) it is not expected that mammals will suffer physical injuries. With respect to avoidance, there may be large areas of sea which mammals avoid; however given the low numbers of individuals (both seals and cetaceans) within the former Zone, the impact upon the marine mammals is likely to be low.

493. 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 and Henriksen, 2009).

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

495. **Impacts upon prey species:** Piling noise has the potential to injure or to displace fish species that are sensitive to noise impacts. The presence of sensitive fish species at Norfolk Vanguard is discussed in Section 2.6.1. With the use of soft-start for piling it is considered that there will be no injury impacts as fish will flee the area, therefore the key concern is with displacement impacts.

496. The impact upon the fish is not expected to have a significant resultant impact on marine mammals given the small number of marine mammals at Norfolk Vanguard and the surrounding area. However due to the potential for cumulative impacts, this will be considered further during the EIA.

497. **Vessel Interaction:** Collisions between construction vessels and marine mammals are possible, however the low number of marine mammals in Norfolk Vanguard and the export cable corridor mean the risk is relatively low.

498. At present the type and number of vessels to be used in the construction of Norfolk Vanguard is unknown. The risk of collision with marine mammals will be given further consideration in the EIA.

499. **Disturbance at seal haul out sites:** Increased activity around landfall, including increased vessel activity could have potential to disturb seals from haul out sites. However due to the distance of the landfall search area to a significant haul out site (minimum 10km), it is expected that there would be no discernible effect and therefore this is scoped out of the assessment.

500. **Changes to water quality:** Accidental release of contaminants, increased suspended sediment or mobilisation of sediment contaminants if contained in those sediments could have potential to impact on marine mammals. The risk of accidental release of contaminants (e.g. through spillage) will 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 will be localised and is therefore unlikely to have an effect on the success of marine mammal feeding. It is proposed that this impact should be scoped out from further consideration within the EIA.

501. **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

502. **Underwater noise:** Noise generated by the operational turbines can be conducted through the tower and foundations into the water. Additional noise sources may include engine noise of maintenance and supply vessels. This operational underwater noise has the potential to cause disturbance to marine mammals.

503. 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 and Edwards e*t al.,* 2007). Operational noise is not considered to be able to mask acoustic communication by seals and porpoises (Tougaard, 2009).

504. 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.

505. Due to the increased size range of wind turbines proposed at Norfolk Vanguard, compared with existing operational wind farms, the potential operational noise will be given further consideration in the EIA.

506. **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.

507. **Vessel Interactions:** At present the type and number of O&M vessels is unknown but consideration will be given in the assessment to collision risk with marine mammals during the impact assessment.

508. **Physical Barrier Effects:** Norfolk Vanguard is not located on any known migration routes for marine mammals; spacing between wind turbines is not expected to impinge animal movement, and both seals and porpoise have been shown to forage within operational wind farm sites (Russell *et al.* 2014; Marine Scotland 2012; Teilmann *et al.*, 2006, Lindeboom *et al.*, 2011). It is therefore proposed that this impact should be scoped out from further consideration within the EIA.

509. **Electromagnetic Fields:** 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 electromagnetic fields (Gill *et al.* 2005). It is therefore proposed that this impact should be scoped out from further consideration within the EIA.

510. **Changes to water quality:** Accidental release of contaminants, increased suspended sediment, or mobilisation of sediment contaminants if contained in those sediments could have potential to impact on marine mammals. The risk of accidental release of contaminants (e.g. through spillage) will 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 will be highly localised and is therefore unlikely to have an effect on the success of marine

mammal feeding. It is therefore proposed that this impact should be scoped out from further consideration within the EIA.

511. **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

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

2.8.2.4 Potential cumulative impacts

513. **Offshore wind:** The impacts of Norfolk Vanguard are likely to be small in isolation, with respect to marine mammals. This is largely due to the fact that usage of the area by marine mammals is low. However, 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 Vanguard to be part of a significant cumulative impact. The cumulative impact assessment would consider projects within the former Zone and across the southern North Sea.

514. Potential impacts on Natura 2000 sites designated for marine mammals, in particular the Southern North Sea pSAC, will be considered within the EIA and in the HRA. This will draw on information from the ES in relation to the cumulative impacts, where applicable.

515. The key cumulative impact is likely to come from underwater noise from pile driving. As previously discussed, 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 migration routes or consecutive piling programmes displacing marine mammals from large areas for sustained periods.

516. It is necessary to consider that even if a piling programme is scheduled for many months, the actual duration of pile driving will 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 publically available information, liaison with other developers

where possible, particularly within the former East Anglia Zone, as well as consultation with the Regulators and stakeholders.

517. **Other activities:** There is the potential for other activities occurring in the region surrounding Norfolk Vanguard to create cumulative impacts, these include aggregate dredging, shipping and oil and gas exploration and development. As discussed above, the impacts of Norfolk Vanguard alone are likely to be minor. Some potential cumulative impacts are unlikely to be significant, for instance behavioural disturbance from noise associated with dredging area operations will not have a spatial footprint on the scale of pile driving and there will 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

518. 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 there is potential for transboundary impacts especially with regard to noise.

519. In addition, there is potential for Norfolk Vanguard to impact on marine mammals from international designated sites (see Section 2.8.1).

520. 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 2.17 Summary of impacts relating to marine mammal ecology

Potential impacts	Construction	Operation	Decommissioning
Underwater noise	✓	✓	✓
Impacts upon prey species	✓	✓	✓
Vessel interactions	✓	✓	✓
Physical Barrier effects	×	×	×
EMF	×	×	×
Disturbance at haul out sites	×	×	×
Changes to water quality	×	×	×
Potential impacts on sites of Marine Conservation Interest	✓	✓	✓

Potential impacts	Construction	Operation	Decommissioning
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓

scoped in (✓) and scoped out (×)

2.8.3 Mitigation

521. A marine mammal mitigation plan (MMMP) will be prepared in consultation with key stakeholders, based on the latest guidance.

522. 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 possible.

523. Where possible, mitigation will 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

524. As previously discussed, aerial surveys are currently being undertaken across NV West (including a 4km buffer). In addition there is 8 months of data for NV East and 24 months of data for the former East Anglia FOUR site, which will be analysed during the EIA taking into account the slightly revised boundary between East Anglia FOUR and NV East. This will be considered against wider data sources within the former Zone as well as available information for the southern North Sea.

525. Underwater noise modelling will be undertaken using the best available information, in particular relating to criteria for predicting the effects of noise impacts on marine mammals (e.g. Southall *et al*, 2007) and Lucke *et al*, 2009).

2.9 Offshore Ornithology

526. 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 are considered in Section 3.7.

2.9.1 Baseline

2.9.1.1 Data sources

Site specific surveys

527. The former East Anglia Zone has been subject to extensive surveys for ornithology, starting with 18 months of high resolution aerial survey data across the former 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.

528. Between March 2012 and February 2014, 24 months of aerial survey were completed for the former East Anglia FOUR site (including a 4km buffer) to support the draft PEI. Analysis of these data is not currently available but will be incorporated in the assessment for NV East (taking into account the slightly revised site boundary) (see Section 2.9.4).

529. In September 2015, monthly high-resolution aerial surveys of NV East and NV West (with a 4km buffer) commenced. In April 2016, it was agreed with Natural England and the MMO that due to the large number of existing surveys for NV East since 2009, no further surveys are required. Therefore, the older survey data from March 2012 and February 2014 which encompass NV East will be supplemented by eight monthly surveys from September 2015 to April 2016. Interim interrogation was undertaken of the NV East data for September to November 2015 to inform consultation with Natural England and the MMO regarding the ongoing survey scope (APEM, 2016 unpublished). Table 2.18 outlines the seabird species recorded during this period.

530. Aerial surveys of NV West are ongoing and the end date will be agreed with key stakeholders through the EPP. This is expected to provide 24 months of aerial survey data (September 2015 to August 2017) and the results from these surveys will be reviewed in consultation with key stakeholders through the EPP. These data will be analysed during the Norfolk Vanguard Assessment.

531. In addition, contextual information can be drawn from East Anglia THREE surveys which are adjacent to NV East (completed between 2011 to 2013), as well as East Anglia ONE surveys (from 2010 to 2011) further south within the former Zone. Evidence from the previous EIAs of East Anglia ONE (EAOW, 2012b) and East Anglia THREE (EAOW, 2015), indicates that the key species of concern for the impact assessments are migrant and non-breeding seabirds. Table 2.18 provides an

overview of the species recorded within the East Anglia THREE and East Anglia ONE surveys.

2.9.1.2 Overview of ornithology within the former East Anglia Zone

Table 2.18 Seabird species recorded during surveys within the former Zone (2009-2015)

Species	Scientific (Latin) name	ZEA surveys (Nov 2009 – April 2011)	East Anglia ONE surveys (2010-11)	East Anglia THREE surveys (2011-13)	NV East (+ 4km buffer) from Sept 2015 – April 2016	NV West (+ 4km buffer) from Sept - Nov 2015
Wildfowl & Divers						
Red-throated diver	*Gavia stellata*	✓	✓	✓	✓	
Black-throated diver	*Gavia arctica*			✓		
Great northern diver	*Gavia immer*			✓		
Gulls						
Black-headed gull	*Chroicocephalus ridibundus*	✓	✓	✓	✓	✓
Common gull	*Larus canus*	✓	✓	✓	✓	✓
Great black-backed gull	*Larus marinus*	✓	✓	✓	✓	✓
Herring gull	*Larus argentatus*	✓	✓	✓	✓	✓
Lesser black-backed gull	*Larus fuscus*	✓	✓	✓	✓	✓
Kittiwake	*Rissa tridactyla*	✓	✓	✓	✓	✓
Little gull	*Hydrocoloeus minutus*			✓	✓	✓
Sabine's gull	*Xema sabini*			✓		
Auks						
Guillemot	*Uria aalge*	✓	✓	✓	✓	✓
Little auk	*Alle alle*			✓		
Puffin	*Fratercula arctica*		✓	✓	✓	✓
Razorbill	*Alca torda*	✓	✓	✓	✓	✓
Others						

Species	Scientific (Latin) name	ZEA surveys (Nov 2009 – April 2011)	East Anglia ONE surveys (2010-11)	East Anglia THREE surveys (2011-13)	NV East (+ 4km buffer) from Sept 2015 – April 2016	NV West (+ 4km buffer) from Sept - Nov 2015
'Commic' tern[14]	Unidentified tern species				✓	
Arctic Skua	*Stercorarius parasiticus*			✓	✓	✓
Common scoter	*Melanitta nigra*	✓				
Cormorant	*Phalacrocorax carbo*	✓				✓
Fulmar	*Fulmarus glacialis*	✓	✓	✓	✓	✓
Gannet	*Morus bassanus*	✓	✓	✓	✓	✓
Great skua	*Stercorarius skua*	✓	✓	✓	✓	✓
Long-tailed skua	*Stercorarius longicaudus*			✓		
Shag	*Phalacrocorax aristotelis*	✓				

532. Data analysis during the Norfolk Vanguard EIA will consider seasonal differences in site usage by each key species (see Section 2.9.4) as well as the importance of the site for the life stages of each species. Table 2.19 provides an overview of relevant seasons for each species based on information from Furness (2015), where available.

533. 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 the EPP (see Section 2.9.4). The conservation status (Table 2.20) of each species will also be taken into consideration.

Table 2.19 Species specific definitions of biological seasons (from Furness, 2015).

Species	Breeding	Migration-free breeding	Migration - autumn	Winter	Migration - spring	Non-breeding
Wildfowl & Divers						
Red-throated diver	Mar-Aug	May-Aug	Sep-Nov	Dec-Jan	Feb-Apr	-

[14] Commic tern is the term used where an arctic tern and common tern could not be distinguished at distance

Species	Breeding	Migration-free breeding	Migration - autumn	Winter	Migration - spring	Non-breeding
Black-throated diver	Not included in Furness 2015					
Great northern diver	-	-	Sep-Nov	Dec-Feb	Mar-May	Sep-May
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					
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	-
'Commic' tern	May-Aug	Jun	Jul-Sep	-	Apr-May	-

Species	Breeding	Migration-free breeding	Migration - autumn	Winter	Migration - spring	Non-breeding
Arctic Skua	May-Jul	Jun-Jul	Aug-Oct	-	Apr-May	-
Common scoter	Not included in Furness 2015					
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	-
Great skua	May-Aug	May-Jul	Aug-Oct	Nov-Feb	Mar-Apr	-
Long-tailed skua	Not included in Furness 2015					
Shag	Not included in Furness 2015					

Table 2.20 Summary of Nature Conservation Value

Species	Conservation Status
Wildfowl & Divers	
Red-throated diver	Birds of Conservation Concern (BoCC) Amber listed, Birds Directive Migratory Species, Birds Directive Annex 1, 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

Species	Conservation Status
Kittiwake	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status
Little gull	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 Amber listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status
Razorbill	BoCC Amber listed, Birds Directive Migratory Species, IUCN Red List 'Near Threatened' status
Others	
'Commic' tern	BoCC Amber listed, Birds Directive Migratory Species, Birds Directive Annex 1 (Arctic & common tern)
Arctic Skua	BoCC Red listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status
Common scoter	BoCC Red listed, Birds Directive Migratory Species, IUCN Red List 'Least Concern' status
Cormorant	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	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

534. The Greater Wash Marine potential SPA (pSPA) has been identified from Bridlington Bay in the north to approximately Great Yarmouth in the south (Natural England, 2015b) which overlaps with the provisional offshore cable corridor. During the EIA, a review of wider SPAs and Ramsar sites will be undertaken to consider potential connectivity with Norfolk Vanguard. HRA screening will be undertaken in consultation with key ornithology stakeholders through the EPP.

Greater Wash Marine potential Special Protection Area (pSPA)

535. 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, 2016b);
- Areas of importance for non-breeding red-throated diver *G. stellata*; and
- Areas of importance for non-breeding little gull *H. minutus*.

2.9.2 Potential impacts

2.9.2.1 Potential impacts during construction

536. **Disturbance and displacement**: Construction activities (e.g. pile driving, increased boat traffic) at Norfolk Vanguard will result in noise and vibration. The noise associated with the construction activities has the potential to disturb and displace bird species from the site for the duration of installation activities.

537. The presence of plant and personnel on site and potentially floodlights during night time working may cause localised disturbance throughout construction. In all cases, such disturbance impacts are likely to be temporary and occur only when construction activities are being undertaken. Therefore, birds may readily re-distribute in periods of less intense or no activity during the construction period.

538. 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), timing of construction activities and behaviour (whether birds are breeding or migrating) and the assessment will be informed by reviews of species sensitivity (e.g. Garthe & Hüppop 2004).

539. **Indirect impacts through effects on habitats and prey species within the OWF sites**: Noise from construction activities has the potential to disturb fish which are prey species for birds foraging within the offshore project area. The key source of noise will be from pile driving (if piled foundations are used) which can cause avoidance behaviour in susceptible fish (see Section 2.7). The potential for impact will be determined by the susceptibility of the species present to noise impacts and whether those species are prey targeted by the birds at Norfolk Vanguard.

540. **Indirect impacts through effects on habitats and prey species within the provisional offshore cable corridor:** Cable laying activities have potential to cause

disturbance for prey species and their habitats. Disturbance effects on prey are likely to be short term, temporary and localised around the cable placement. The resultant indirect impact on any foraging birds (if present) is likely to be indiscernible and it is therefore proposed that this impact should be scoped out from further consideration within the EIA.

2.9.2.2 Potential impacts during operation

541. **Disturbance and displacement:** The movement of O&M vessels, and the presence of turbines and offshore platforms, may affect bird abundance and distribution during the operational life of the wind farm.

542. Given that potential impacts along the cable route would be highly localised and episodic (i.e. limited to any maintenance or repair operations) it is proposed that this impact should be scoped out from further consideration, with the focus on the OWF sites only.

543. The predicted potential effects of displacement on sensitive species will be assessed using matrices that 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.

544. **Indirect impacts through effects on habitats and prey species:** Indirect displacement of birds may occur during the operational phase if there are impacts on prey species (Section 2.7) and the habitats of prey species (Section 2.6). These indirect effects include those resulting from the production of underwater noise (e.g. the turning of the wind turbines), electro-magnetic fields (EMF) 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 and EMF may cause fish and mobile invertebrates to avoid the operational area and also affect their physiology and behaviour. Suspended sediments may cause fish and mobile invertebrates to avoid the operational area and may smother and hide immobile benthic prey. These mechanisms could result in fewer prey being available within the operational area to foraging seabirds. Changes in fish and invertebrate communities due to changes in presence of hard substrate (resulting in colonisation by epifauna) may also occur.

545. **Collision risk:** There is a risk that birds can collide with turbines as they fly through the wind farm. The susceptibility of a species to collision risk depends upon physiological and behavioural characteristics of birds in addition to the project design specifications. Collision risk modelling (CRM) will be undertaken using industry-standard approaches (Band, 2012) to predict potential mortality levels from

this impact. The population-level impacts of this potential additional mortality will be considered.

546. **Barrier effect:** During operation, birds may change their flight path to avoid crossing through a wind farm, resulting in the wind farm acting as a barrier to free movement and increasing energetic costs of foraging flights and migration (DECC, 2009). 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 energy expenditure (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).

547. The distance of Norfolk Vanguard from the coast, together with the distance from large seabird breeding colonies (Mitchell *et al* 2004), means that the area is likely be of low importance during the breeding period and therefore the likelihood of significant increases in flight distances are 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 Potential impacts during decommissioning

548. 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 will be lower and there will therefore be less indirect impact upon birds through potential disturbance of prey species.

2.9.2.4 Potential cumulative impacts

549. **Offshore wind:** Given the scale of development in the southern North Sea with operational, consented and planned offshore wind farms, there is potential for cumulative impacts upon birds. Given that many birds species are highly mobile there is 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 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 Boreas and any further SPR wind farms which enter the consenting process during the period of the Norfolk Vanguard EIA. Also, other wind farms along the east coast of Britain are likely to be relevant to some seabird species in relation to the

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 they will be dependent upon the individual sensitivities of each species and most importantly where the birds are from and their potential therefore to interact with other wind farms (i.e. on migratory or foraging travel).

550. **Other activities**: There is potential for other marine industries to have cumulative impacts with Norfolk Vanguard. 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

551. Due to the wide-ranging nature of some seabird species, there is potential for Norfolk Vanguard to have impacts on birds 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 impacts relating to offshore ornithology

Potential impacts	Construction	Operation	Decommissioning
Disturbance and displacement	✓	✓	✓
Indirect impacts through effects on habitats and prey species within the OWF sites	✓	✓	✓
Indirect impacts through effects on habitats and prey species within the provisional offshore cable corridor	✓	×	×
Collision risk	×	✓	×
Barrier effect	×	✓	×
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓

scoped in (✓) and scoped out (×)

2.9.3 Mitigation

552. The need for mitigation (and the feasibility of this) will be dependent on the results of site specific survey and the impact assessment. Consultation with key ornithological stakeholders through the EPP will be ongoing throughout the EIA process and will include discussion of the need for mitigation and the feasibility of potential options.

2.9.4 Approach to assessment and data gathering

553. The 2012-2014 East Anglia FOUR survey data, the September 2015 to April 2016 NV East data and the ongoing data collection since September 2015 for NV West (outlined in Section 2.9.1.1) will be the key data source for the ornithology site characterisation and quantification of parameters for the impact assessment (e.g. CRM).

554. The aerial surveys gather information about the species of bird (or groups if specific species identification is not possible), location, numbers, sex and age (where possible), flight heights and direction. The EIA will identify the nature of the use of the site by the birds recorded i.e. seasonal differences, whether foraging, overwintering, migrating or other activities in order to determine the importance of the site relative to the wider area for seabirds throughout the year.

555. Detailed analysis will include abundance and density estimates (with associated confidence intervals and levels of precision). GPS locations of all the birds recorded will be used to clip the distributions recorded during the East Anglia FOUR surveys to align with the refined boundaries of NV East. Where possible, flight height data (collected for all flying bird sightings) will be used in the CRM, as will generic flight data (Johnston *et al.* 2014a, 2014b), subject to discussion with stakeholders.

556. Additional contextual information will come from studies undertaken for the former Zone, East Anglia ONE and East Anglia THREE 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.

557. 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 the EPP.

558. 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 impacts listed above. The impact assessment will be undertaken in line with guidance by IEEM (2010) and expert opinion.

2.10 Commercial Fisheries

2.10.1 Baseline

2.10.1.1 Data sources

559. Norfolk Vanguard lies within the ICES rectangles 34F1, 34F2, 34F3 and 35F2. 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 is based are listed in Table 2.22.

Table 2.22: Available site-specific ichthyology datasets

Data	Coverage	Date
Landings data (MMO, 2016)	ICES Rectangles 34F1, 34F2, 34F3, 35F2	2008 - 2014
International Bottom Trawl Survey (IBTS) CPUE (ICES, 2016)	ICES Rectangles 34F1, 34F2, 34F3, 35F2	2011 – 2016
Spawning and nursery grounds (Coull et al, 1998)	North Sea	-
Spawning and nursery grounds (Ellis, 2012)	North Sea	-
Dutch Annual Effort by Method	ICES Rectangles, 34F1, 34F2, 34F3, 35F2	2001 - 2010
Dutch VMS Landing Value Data	ICES Rectangles, 34F1, 34F2, 34F3, 35F2	2006 - 2010
UK Annual Effort by Method	ICES Rectangles, 34F1, 34F2, 34F3, 35F2	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

2.10.1.2 Commercial fisheries status

560. As presented in Figure 2.16, Dutch registered fishing vessels are responsible for the majority of the effort[15] in ICES rectangles 34F2, 34F3 and 35F2 (97.8%, 99.2 and 99.1% respectively) with a UK registered fishing vessels responsible for the majority of the effort in ICES rectangle 34F1 (98.8%). A few Belgian registered fishing vessels are also operating in the area.

561. 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 2.17, landings data within the Norfolk Vanguard offshore project

[15] 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

area are one of the highest annual landing values, with the peak in ICES rectangle 34F2 area. The majority of this effort is from beam trawlers. Analysis of 2010 VMS data was undertaken for the ZEA which shows landings value of €20 million by Dutch vessels from fishing within Development Areas[16] 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). For ICES rectangles 34F3 and 35F2 (which include both NV East and NV West) average annual landings by Dutch vessels were lower than 34F2. For ICES rectangles 34F1 (which includes the provisional offshore cable corridor) average landings across the area were less than €10,000.

562. 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.

563. 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 Vanguard; ICES rectangles 34F1, 34F2, 34F3 and 35F2 (which include the cable corridor and both NV East and NV West) accounted for average annual UK landings of £2,235, £144,661, £768,591 and £420,003 respectively (see Figure 2.18).

564. 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 2.16).

565. Average annual landings into UK ports, broken down by method, are shown in Figure 2.20. The majority of the Dutch vessels are beam trawlers (Figure 2.19) which were recorded as principally targeting sole and plaice in the autumn and winter (EAOW, 2012a).

566. The provisional offshore cable corridor crosses (from west to east) the ICES rectangles 34F1 and 34F2. As shown in Figure 2.16, the inshore activity is dominated by UK vessels utilising primarily pots in 34F1 and 35F1 but also longlines and gill nets within 33F1.

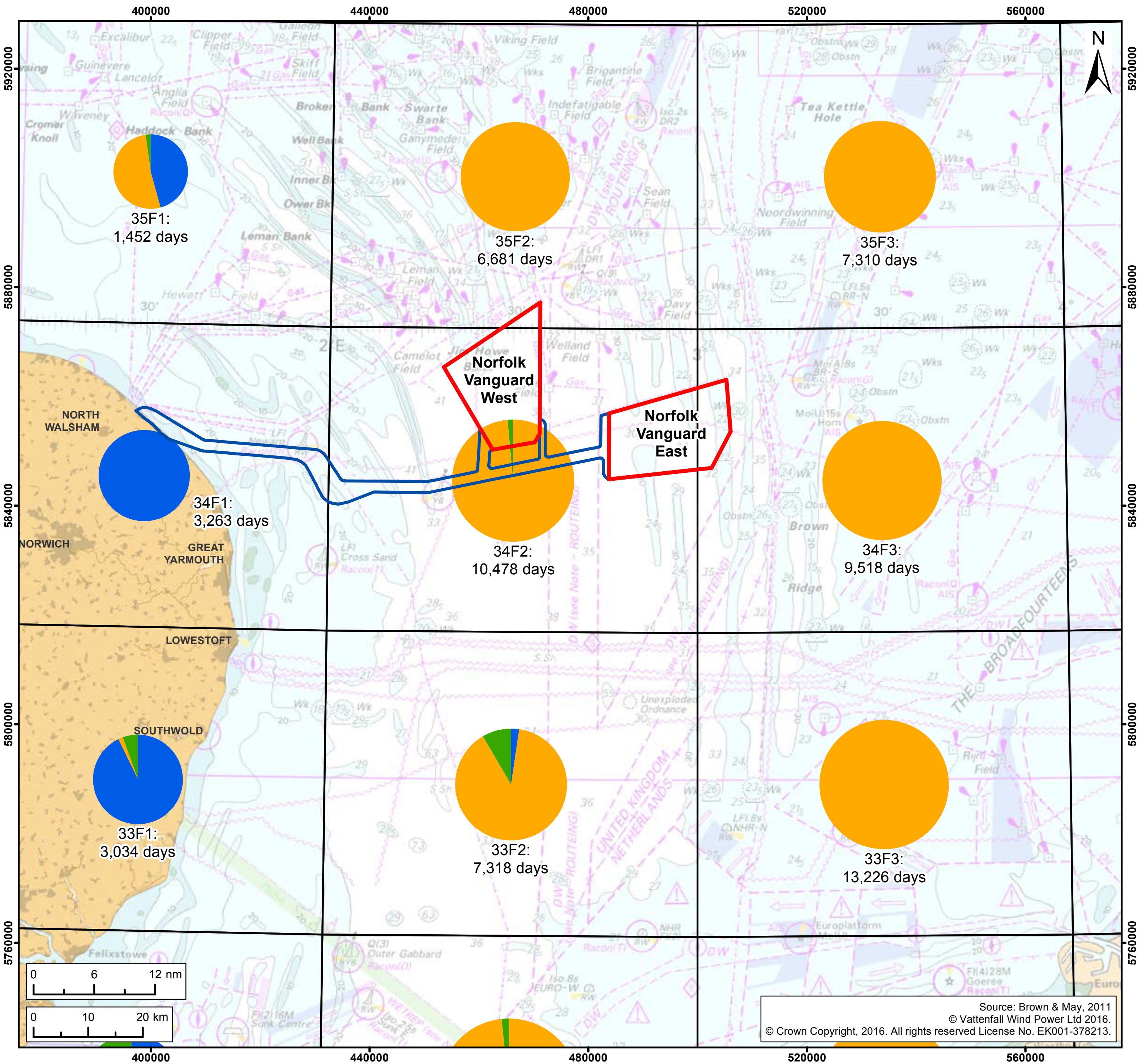
567. Where UK registered vessels are found further offshore, their preferred methods are longlines and beam trawls. The landings results between 2008 and 2014 presented in Section 2.7 suggest that these methods target plaice, sole and sprat.

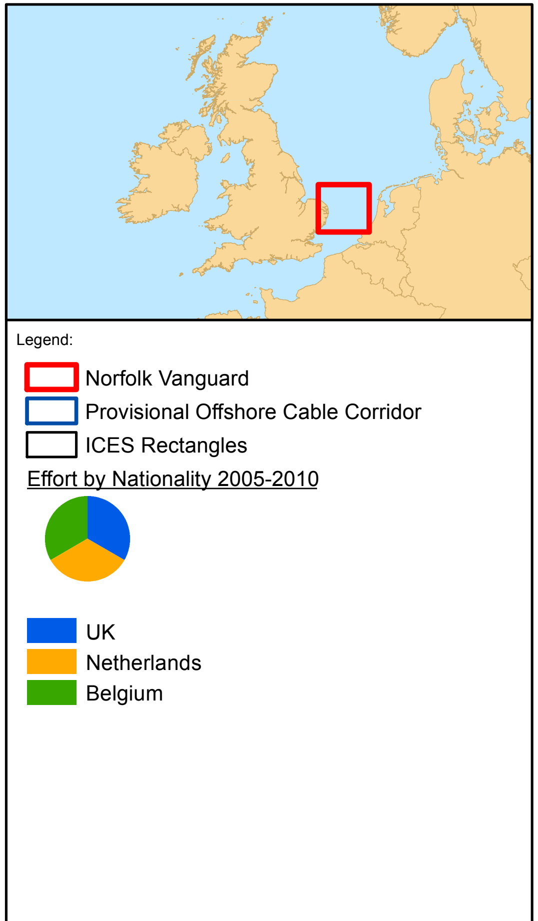
[16] The Development Areas being those parts of the Zone that were identified as being areas of potential future development, as shown in the ZEA report.

568. 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.

569. 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).

570. 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 VWPL and the former EAOW on siting areas for development within the former Zone to reduce potential for impacts (see Section 1.5).





Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Fishing Method by Nationality

Figure: 2.16 | Drawing No: PB4476-002-2-029

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	18/07/16	JE	GK	A4	1:1,000,000

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

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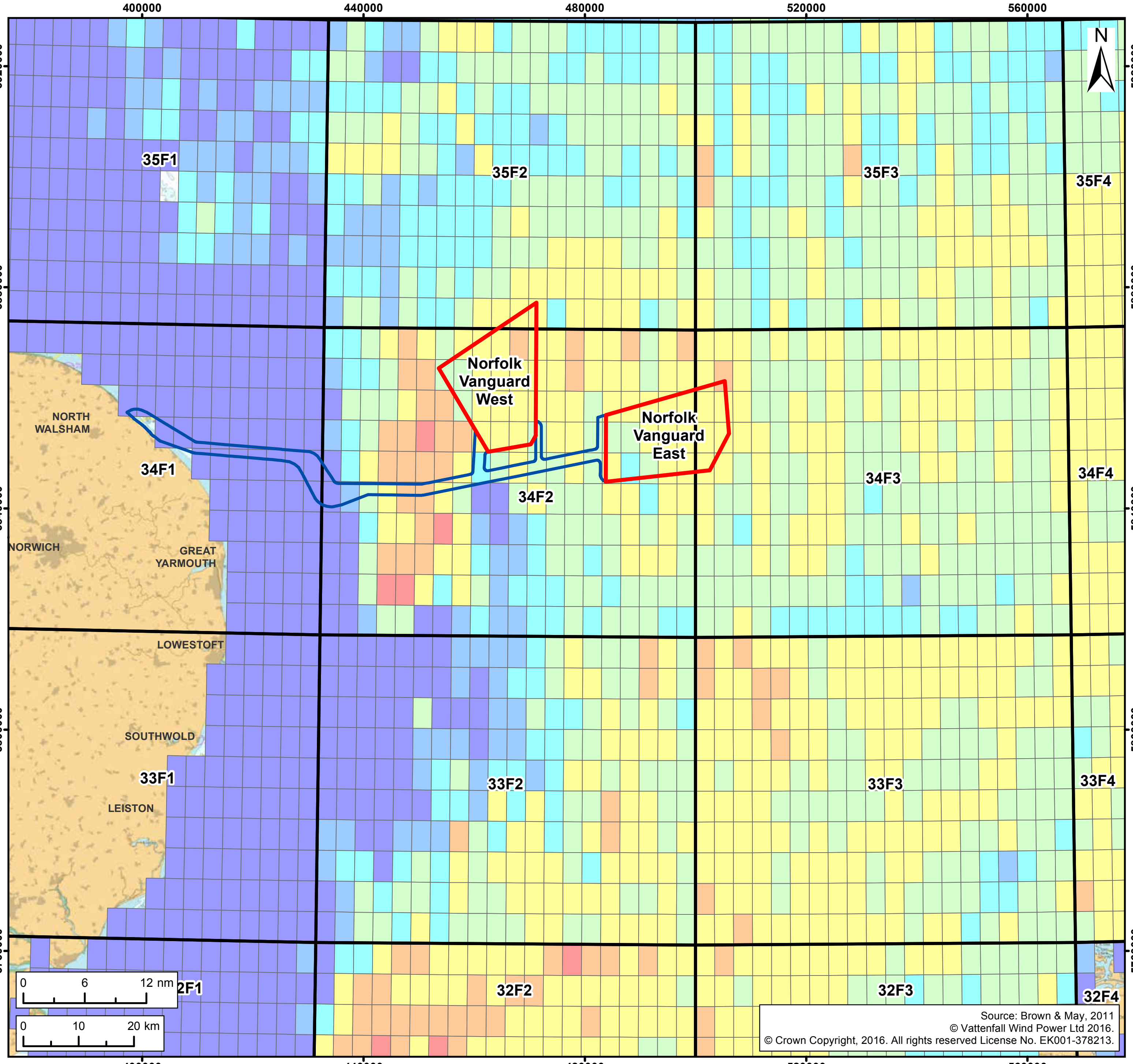

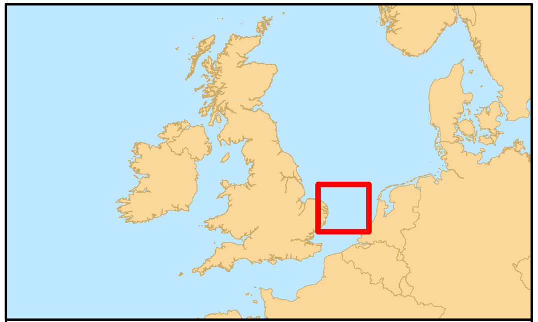

Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- 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 Vanguard	Environmental Impact Assessment Scoping Report

Title:

Dutch VMS Landings Values

Figure: 2.17 | Drawing No: PB4476-002-2-028

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	18/07/16	JE	GK	A4	1:1,000,000

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

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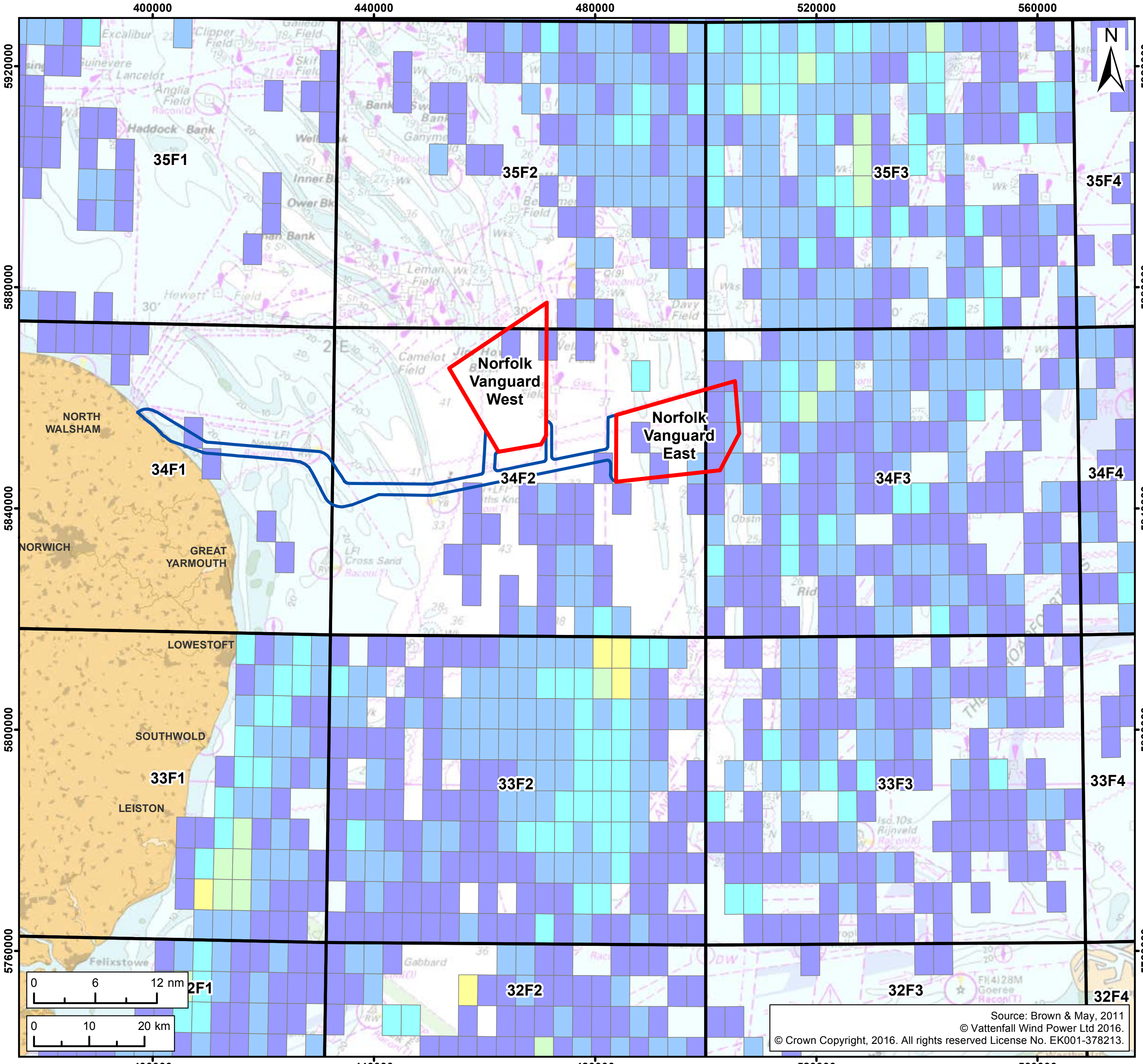

Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- 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 Vanguard	Environmental Impact Assessment Scoping Report

Title:

VMS Landings Values (UK >15m)

Figure: 2.18 Drawing No: PB4476-002-2-026

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	JE	GK	A4	1:1,000,000

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

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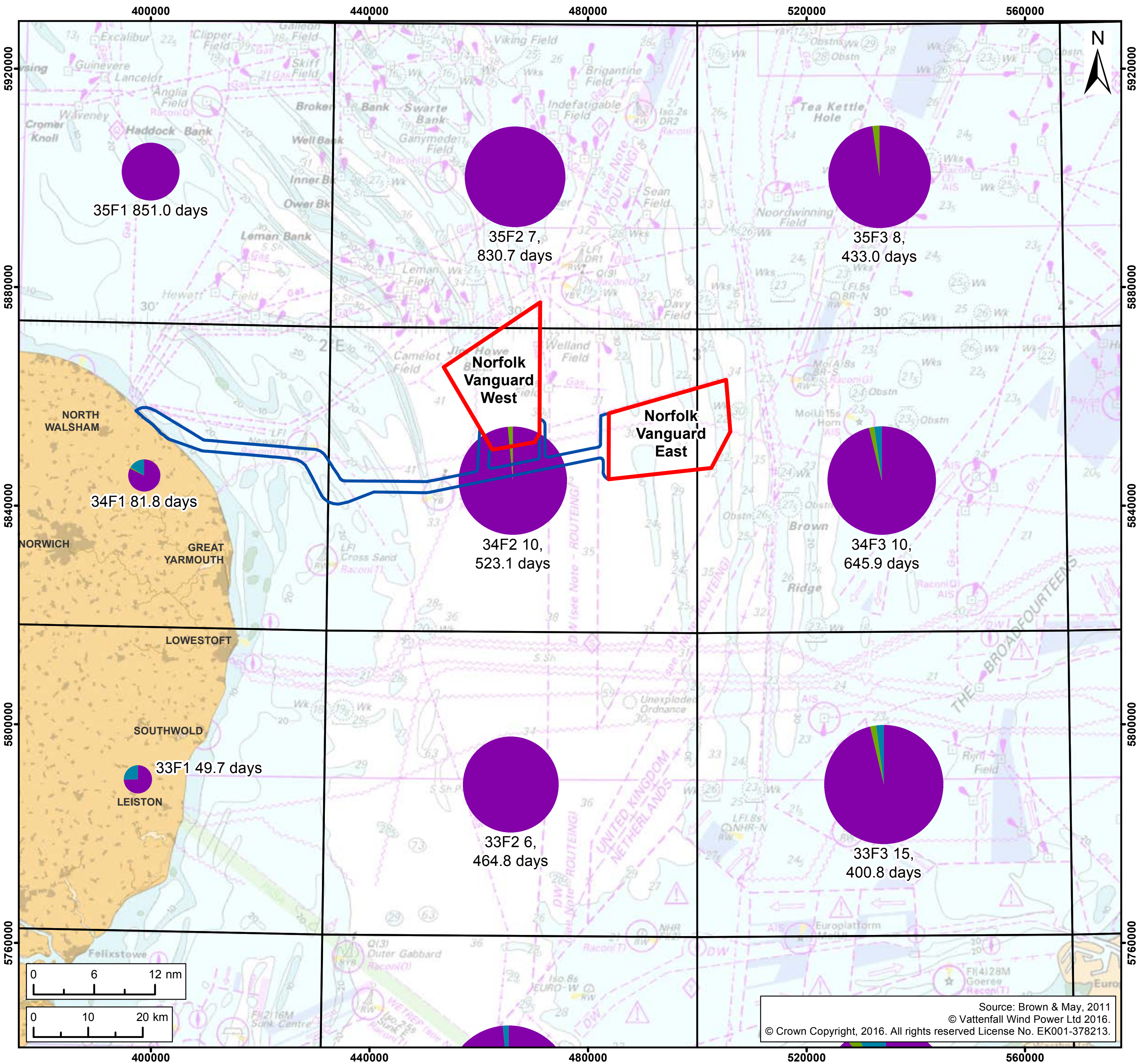

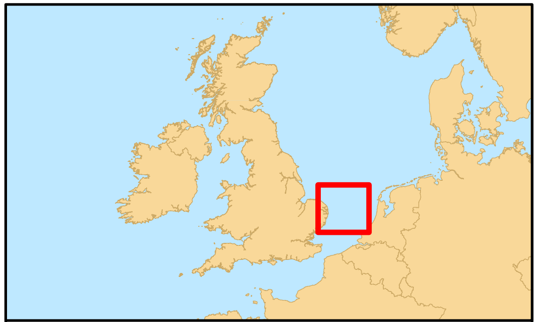

Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- ICES Rectangles

Dutch Annual Effort by Method (2001-2010)

- Beam Trawls
- Demersal Trawls
- Other Methods

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Dutch Annual Effort by Method (2001-2010)

Figure: 2.19 Drawing No: PB4476-002-2-027

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	JE	GK	A4	1:1,000,000

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

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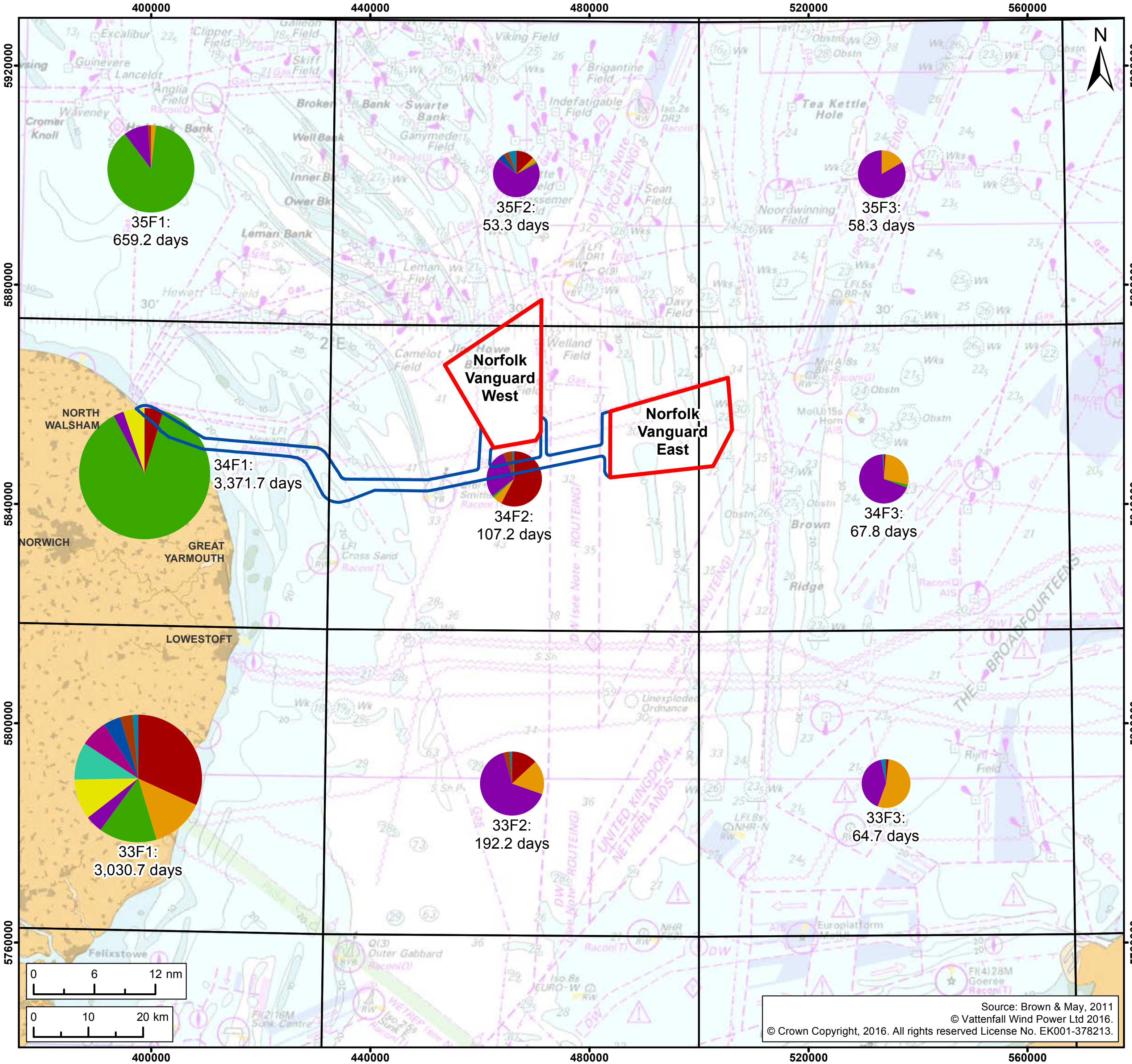

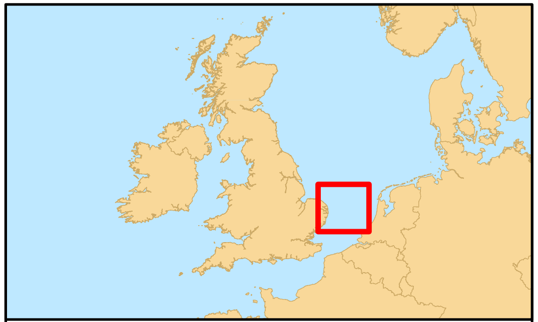

Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- 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 Vanguard	Environmental Impact Assessment Scoping Report

Title: UK Annual Effort by Method (2001-2010)

Figure: 2.20 | Drawing No: PB4476-002-2-025

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	18/07/16	JE	GK	A4	1:1,000,000

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

571. **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 impact on the fishery operating in the area.

572. **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 will be advised to maintain a safe distance from the offshore cable laying vessel.

573. **Displacement of fishing activity:** Displacement during the construction period may lead to increased use of other areas outside Norfolk Vanguard.

574. **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.

575. **Increased steaming times:** The construction of Norfolk Vanguard 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

576. **Impacts on commercially exploited species:** As discussed in Section 2.7, monitoring studies conducted in existing offshore wind farms in the North Sea, such as Kentish Flats in the UK (Vattenfall, 2009) and Horns Rev in Denmark (DTU Aqua, 2011) indicate that there have been minor or no changes to the abundance, distribution or observed behaviour of the fish resource at the sites that could be related to the construction or operation of the wind farms, with any changes recorded being considered to be indistinguishable from natural variability in the case of Kentish Flats (Vattenfall, 2009).

577. **Loss of or restricted access to traditional fishing grounds:** Due to the physical footprint of Norfolk Vanguard infrastructure, some seabed which was previously able to be fished will be inaccessible. This area is likely be very small and is expected

to be restricted to the area of the foundations themselves. 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.

578. **Displacement of fishing activity:** Whilst this potential impact will be considered within the EIA; there is not expected to be any significant effects of loss of fishing area during the operational phase.

579. **Loss of or damage to fishing gear:** All cables should 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.

580. **Increased collision risk:** Navigational safety issues will be covered by the NRA as part of the impact assessment for shipping and navigation and will be discussed and agreed with the relevant stakeholders.

581. **Increased steaming times:** During the operational phase, it is not anticipated that there will 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

582. 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 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

583. **Interactions with other wind farms:** Cumulative impacts from the development of Norfolk Vanguard 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. Given the scale of fishing effort and landings values for the Dutch registered vessels, there is clearly potential for cumulative impacts upon this receptor. In addition, there is potential for cumulative impacts upon fisheries across the region from other offshore wind farms, out with the former Zone.

584. **Interactions with other activities:** Cumulative impacts upon commercial fisheries may occur between Norfolk Vanguard 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

585. There is potential for transboundary impacts upon fisheries, particularly with regard to the issue of impacts on Dutch vessels and the displacement of fishing effort, potentially in to international waters.

2.10.2.6 Summary of potential impacts

Table 2.23 Summary of 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	×	✓	✓
Increased collision risk (to be covered by NRA)	✓	✓	✓
Increased steaming times	✓	✓	✓
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓

scoped in (✓) and scoped out (×)

2.10.3 Mitigation

586. The Applicant is committed to working with the fishing industry and has appointed a Fisheries Liaison Officer in line with the approach taken for East Anglia ONE and East Anglia THREE.

587. Mitigation measures and monitoring options will be agreed with local, national and international fishing bodies as appropriate and will follow 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

588. Cefas guidance (Cefas, 2004) 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.

589. 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.

590. 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).

591. 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. In addition, a Commercial Fisheries Working Group (CFWG) was set up with representatives from each of the local ports.

592. With regards to Norfolk Vanguard, 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 as well as to obtain their opinion on the proposed development. 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) and therefore there is potential for these activities to be under-estimated in scale and importance.

593. The impact of the construction, operation and decommissioning of Norfolk Vanguard on the fishing industry and any economic impacts will also be assessed and discussed, drawing on knowledge and studies from existing wind farms and relevant data from East Anglia ONE and East Anglia THREE. 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

594. The available shipping and navigation datasets upon which this section is based are listed in Table 2.24. Planned datasets, for use as part of the final EIA are also listed in Table 2.24.

Table 2.24 Available and planned shipping and navigation datasets

Data	Coverage	Date
Available		
Marine traffic survey Automatic Identification System (AIS) data collected from Met Mast.	Norfolk Vanguard Sites	July 2015
Marine traffic survey data (AIS, radar and visual observations) collected from dedicated survey vessels as part of former East Anglia FOUR EIA.	NV East Site.	14 days Sept. 2012 14 days May 2013 14 days Aug. 2013 14 Days Mar. – Apr. 2014
Marine Accident Investigation Branch (MAIB) maritime incident data.	Norfolk Vanguard Sites	2004 – 2014
Royal National Lifeboat Institute (RNLI) maritime incident data.	Norfolk Vanguard Sites	2004 – 2014
Marine aggregates dredging data (licensed and active areas) from	Southern North Sea	2016

Data	Coverage	Date
The Crown Estate.		
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	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	2008 – 2012
Planned		
Marine Traffic Survey Data (AIS, radar and visual observations) collected from vessel based surveys and AIS receivers located on met masts and shore-based receivers.	Norfolk Vanguard Sites	28 days duration collected within 24 months of application submission.

2.11.1.2 Baseline Overview

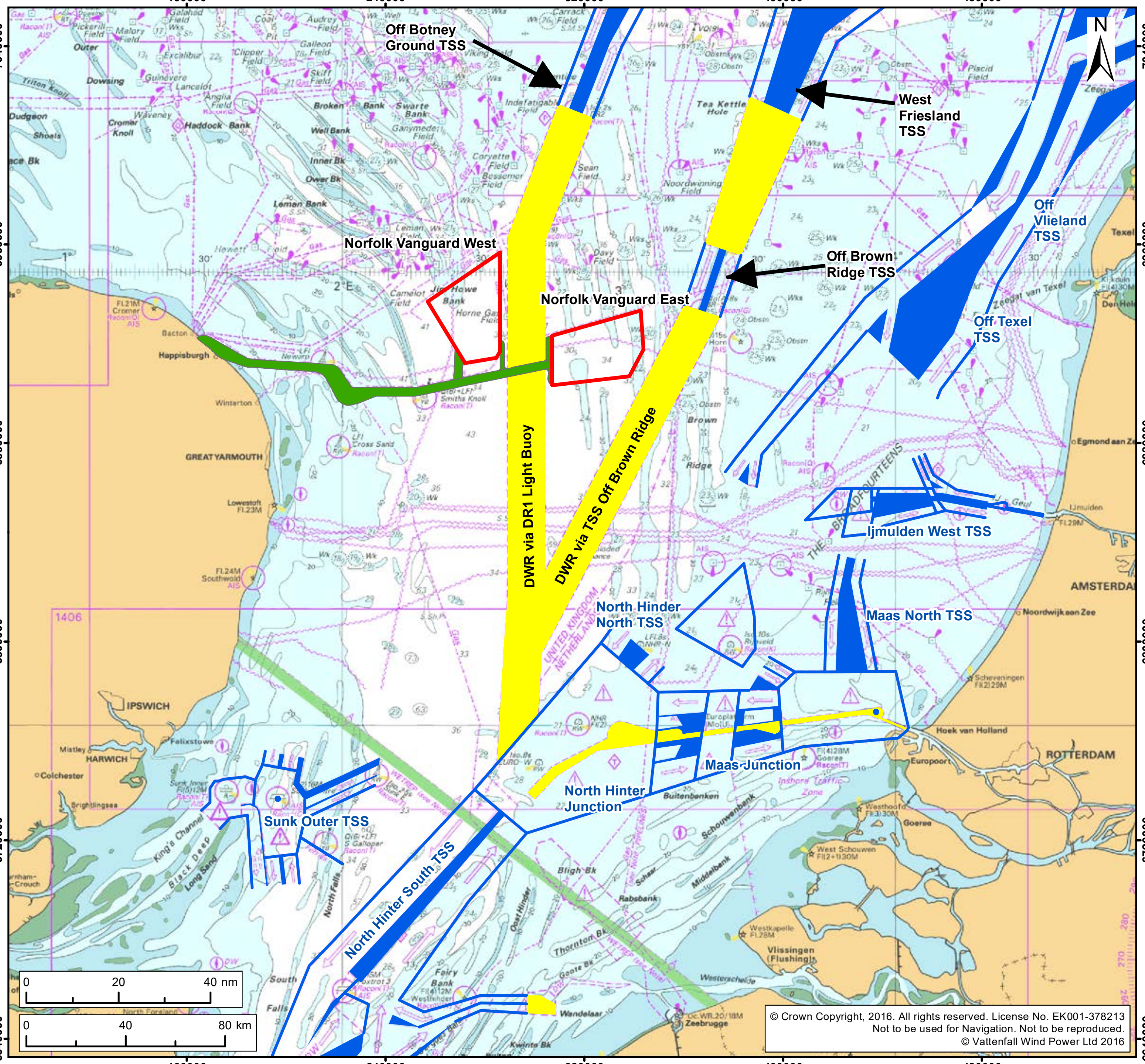
595. The region of the southern North Sea, containing NV West and NV East, includes a high density of shipping activity and some notable navigational features within a 10 nautical miles (nm) buffer around the proposed project but also any features within proximity which may influence traffic transiting to and from the project area. Cargo

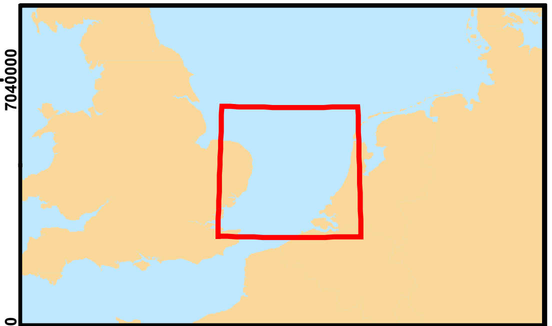
vessels, commercial ferries, fishing vessels and Oil & Gas (O&G) support vessels are among those transiting the region, with Deep Water Routes (DWRs) passing close to the Norfolk Vanguard sites.

2.11.1.3 Navigational Features

596. The main navigational features in close proximity to the proposed project are the International Maritime Organisation (IMO) Routeing Measures. There are two Deep Water Routes (DWRs) which pass close to Norfolk Vanguard as shown in Figure 2.21.

597. The edge of the DR1 Light Buoy DWR passes approximately 1nm from the eastern edge of Norfolk Vanguard West (NV West) and approximately 1nm from the western edge of Norfolk Vanguard East (NV East). The Off Brown Ridge DWR also passes 2nm to the east of NV East. There are no restrictions under IMO regulations regarding when a vessel may enter or exit a DWR nor how a vessel chooses to transit across it. Alternatively a Traffic Separation Scheme (TSS) is more regulated by Rule 10 of the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972) which states that vessels must follow the general direction of traffic within their lane, generally enter and exit at the termination points of the TSS or cross at a 90 degree angle to the flow of traffic.





Legend

- Norfolk Vanguard
- Provisional Offshore Cable Corridor

IMO Routeing Measures

- Deep Water Route (DWR)
- Traffic Seperation Scheme (TSS)

Project: Norfolk Vanguard	Report: Environmental Impact Assessment Scoping Report
Title: Navigational Overview	
Figure: 2.21	Drawing No: A3848-VAT-2.21

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	15/09/2016	DS	SB	A4	1:2,250,000

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

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598. The DWRs are mainly used by bulk carriers, general cargo vessels and chemical tankers passing north south through the southern North Sea. The DR1 Light Buoy connects the Off Botney Ground TSS to the North Hinder Junction which links the North Hinder North TSS and North Hinder South TSS. Vessels using the full length of the DWR are mostly tankers, although the majority of vessels enter and exit the DWR at varying points depending upon their ports of departure and destination.

599. The second DWR (the Off-Brown Ridge) is to the east of NV East. This DWR connects the Off Brown Ridge TSS with the DR1 Light Buoy DWR to the south of the proposed project. This DWR has a similar breakdown of vessel types to the DR1 Light-Buoy DWR.

600. There are a number of existing O&G Fields within the region. These fields are located, in the majority, to the north of the proposed project. These include:

- The Horne & Wren Field including the Horne & Wren installation located to the east of NV West, on the boundary of the DR1 Light Buoy DWR. As standard a 500m safety zone is applied around the installation.
- The Yare gas well (also within a 500m safety zone) is located on the northernmost point of NV West.
- The Arthur Field contains three wells with the closest located 1.7nm to the west of NV West. All three wells have 500m safety zones.

601. All three of these operations are tied into the larger Thames gas field and are currently in their decommissioning phase; it is assumed each of these developments will require vessel access.

602. Further work will be done within the NRA and ER to identify any new oil or gas developments.

603. There are no charted anchorages or marine aggregate extraction areas within the project study area.

604. The potential provisional offshore cable corridors run east from the proposed project as shown in Figure 2.21.

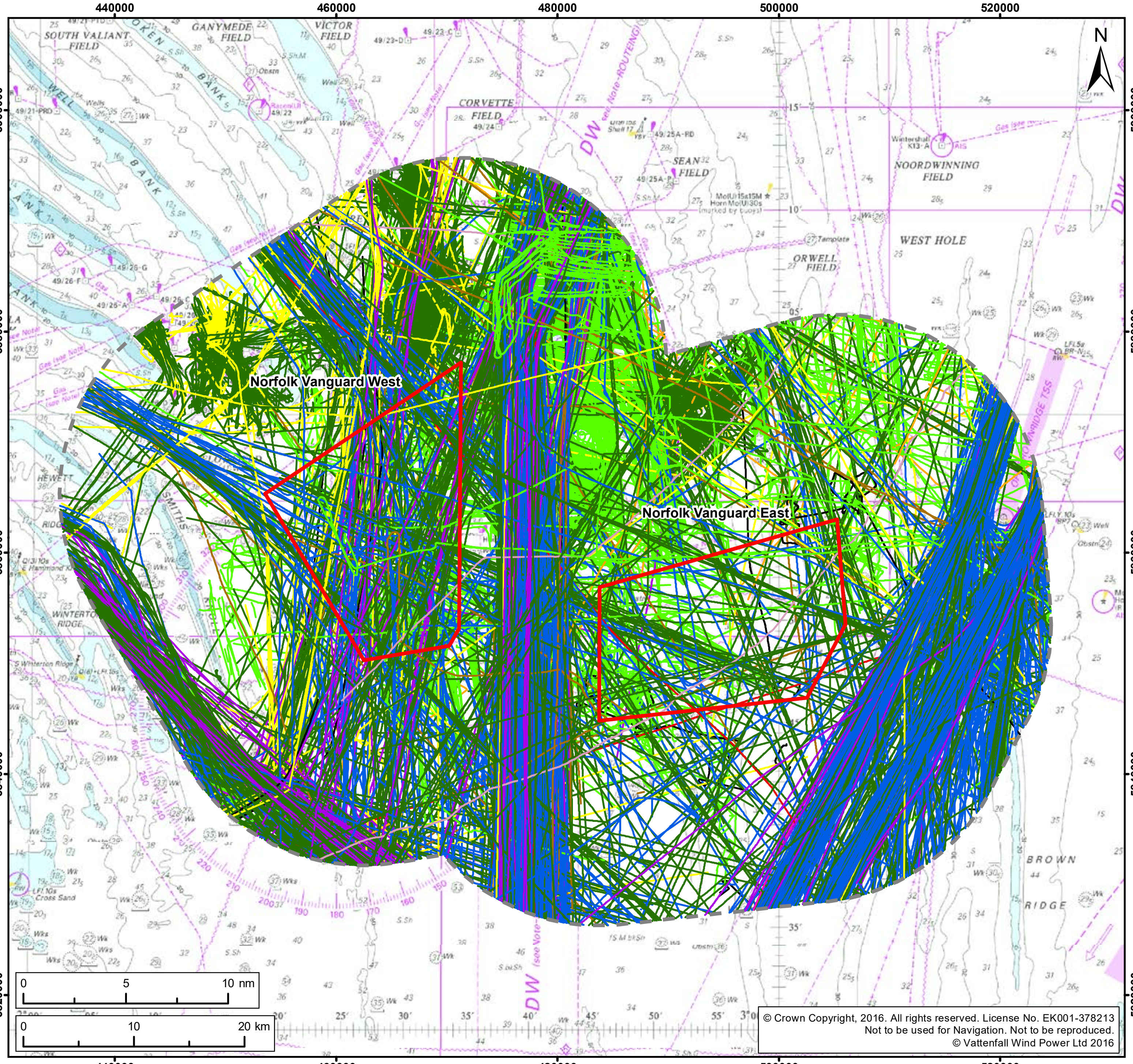
605. The corridor is crossed by a number of vessel routes including the DWR where the cable route passes between NV West and NV East.

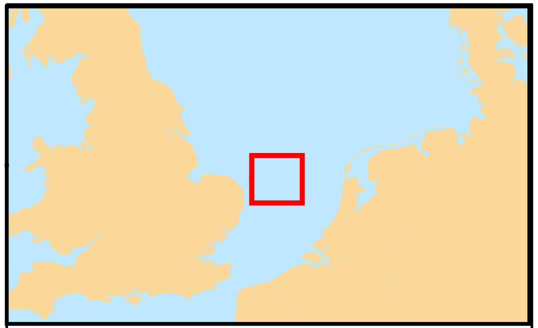
606. Other near shore routes including cargo, tanker, passenger and other routes passing the potential provisional offshore cable corridor in a south east – north west direction. It is noted that the traffic routeing is dictated by the sand banks within the area and can include vessels routeing to seek shelter during adverse weather.

607. There are no chartered anchorages within the potential provisional offshore cable corridor. However the area could be used for general vessel anchoring (out with chartered areas), emergency anchoring and adverse weather anchoring. Further assessment will be undertaken within the NRA.

2.11.1.4 Commercial Shipping

608. The proposed project is located in the southern North Sea which is relatively busy in terms of commercial shipping with a number of routes operating through the study area. Figure 2.22 shows Automatic Identification System (AIS) data from 26th June to 26th July 2015 (31 days). The figure excludes any temporary traffic recorded.





Legend

- Norfolk Vanguard
- 10nm Buffer of Norfolk Vanguard Site Boundary

AIS Vessel Type

- Unspecified
- Fishing
- Military
- Dredger/Subsea
- HSC
- Tug
- Passenger
- Cargo
- Tanker
- Other
- Recreational

31 days of AIS data collected from Northern Met Mast between 26th June and 26th July 2015

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

AIS Tracks Within 10nm of Norfolk Vanguard Excluding Non-Routine Traffic

Figure: 2.22 Drawing No: A3848-VAT-2.22

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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609. Traffic in the study area comprises mainly of tankers and cargo vessels, although there are also a number of regular passenger ferries and fishing vessels.

610. Figure 2.23 demonstrates the breakdown of traffic types within the study area (10nm buffer).

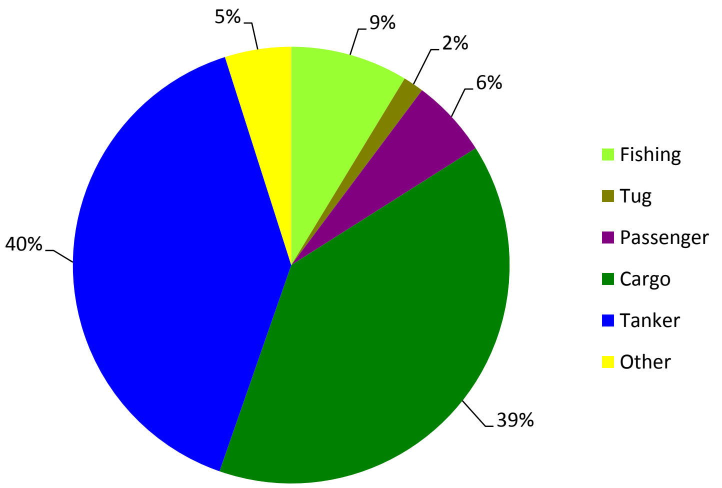


Figure 2.23 AIS vessel type distribution for study area (10nm Buffer)

611. There are a number of shipping routes that pass through Norfolk Vanguard on both north to south and east to west transits. The AIS data shows that NV West contains more transits and routes than NV East. When compared to usage of the nearby DWRs, the overall traffic levels on these routes is comparatively lower but widespread given the limited restrictions on transits. Routes transiting east to west (or vice versa) are defined outside of the study area by both the presence of sand banks off the east coast of the UK and by routeing measures on approach to mainland European ports.

612. The traffic passing through Norfolk Vanguard is primarily trading between UK east coast ports (such as Humber, Tees, Great Yarmouth and Southampton) and continental European ports (such as Rotterdam, Ijmuiden, Antwerp and Hamburg). Countries such as Norway and Russia are also represented as destinations for shipping in the vicinity of the proposed project, with much of the associated traffic using the two DWRs passing close to the site.

613. The main passenger ferry traffic through the area comes from two Ro-Ro vessels transiting between Hull and Rotterdam (P&O). There is also regular ferry traffic between Newcastle and Ijmuiden (DFDS), and between Hook of Holland (Hoek van Holland) and Killingholme (Stena Line).

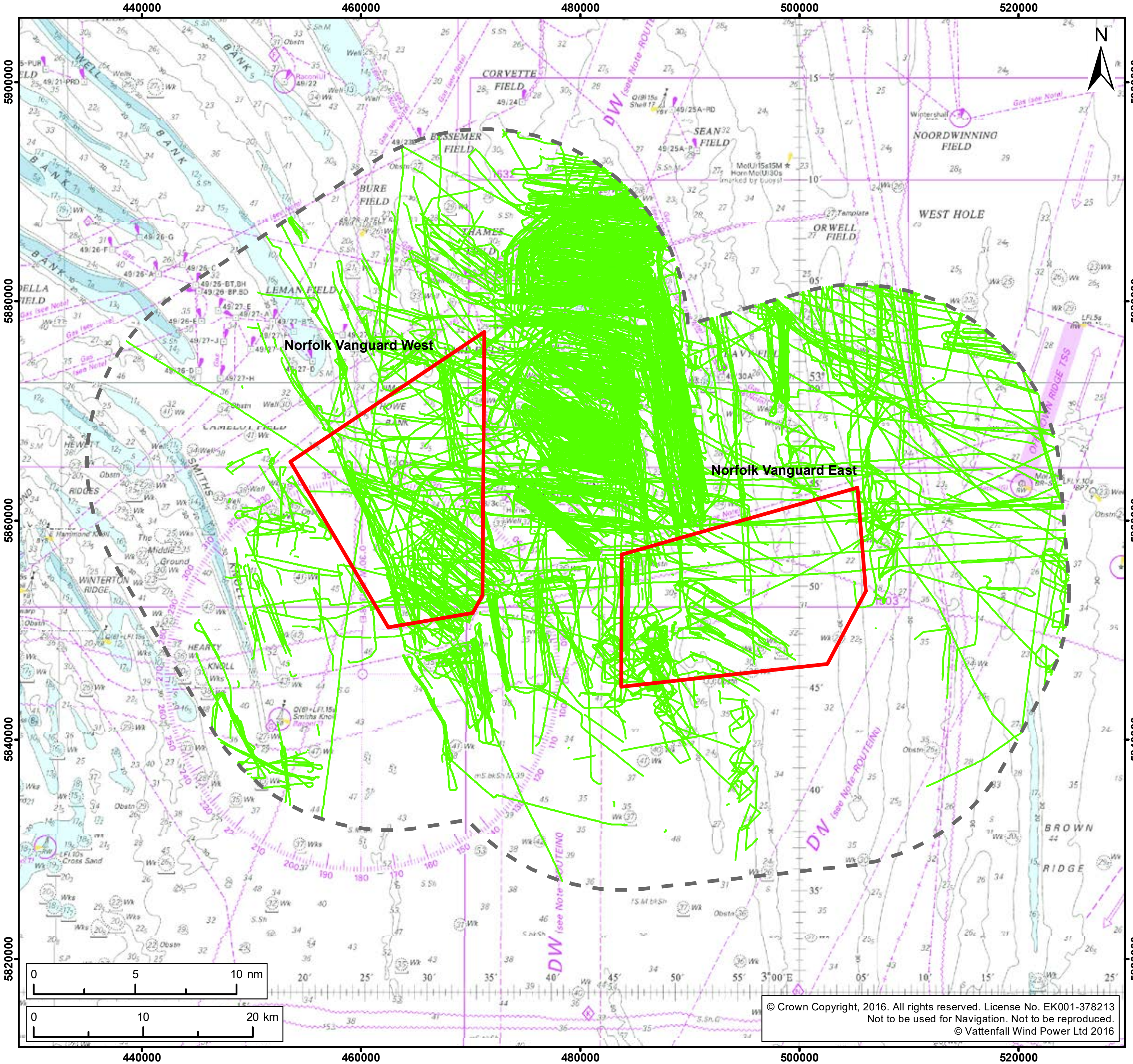
614. There are a number of vessel movements to the north of Norfolk Vanguard associated with supply and standby of the offshore installations. A route also passes north south through NV West from Great Yarmouth to the Thames field. No movements are shown to the Horne & Wren installation; however it is noted that the survey period used within this report only covered 31 days.

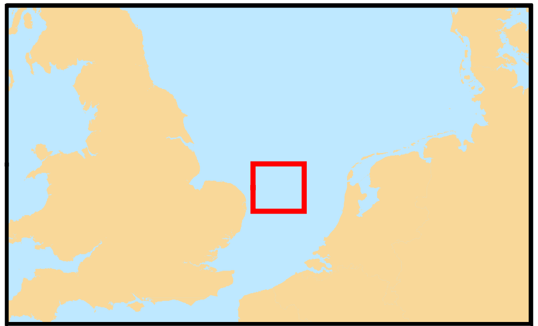
615. Vessels range in size from small general cargo vessels and offshore support vessels of under 100m length and 1,500 deadweight tonnes (DWT) to large container vessels and crude oil tankers of over 300m length and 100,000DWT.

2.11.1.5 Fishing Vessels

616. Vessels under 15m length will not have been captured within the data used for this scoping exercise unless they voluntarily carry AIS. However vessels under 15m are likely to be limited given the distances from both ports within the UK and mainland Europe. Figure 2.24 shows that the proposed project site has moderate levels of AIS fishing vessel activity, which is distributed across the whole of the site

617. Vessel Monitoring System (VMS 2009) and sightings data (2005-2009) were also considered and showed the majority of fishing fleets operating in the region are from The Netherlands, with Belgium, UK and France also having a notable presence. There is limited activity from other countries including Denmark, Germany and Ireland.





Legend

- Norfolk Vanguard
- 10nm Buffer of Norfolk Vanguard Site Boundary

AIS Vessel Type

- Fishing

31 days of AIS fishing data collected from Northern Met Mast between 26th June and 26th July 2015.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: AIS Fishing Tracks

Figure: 2.24 Drawing No: A3848-VAT-2.24

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	15/09/2016	DS	SB	A4	1:500,000

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

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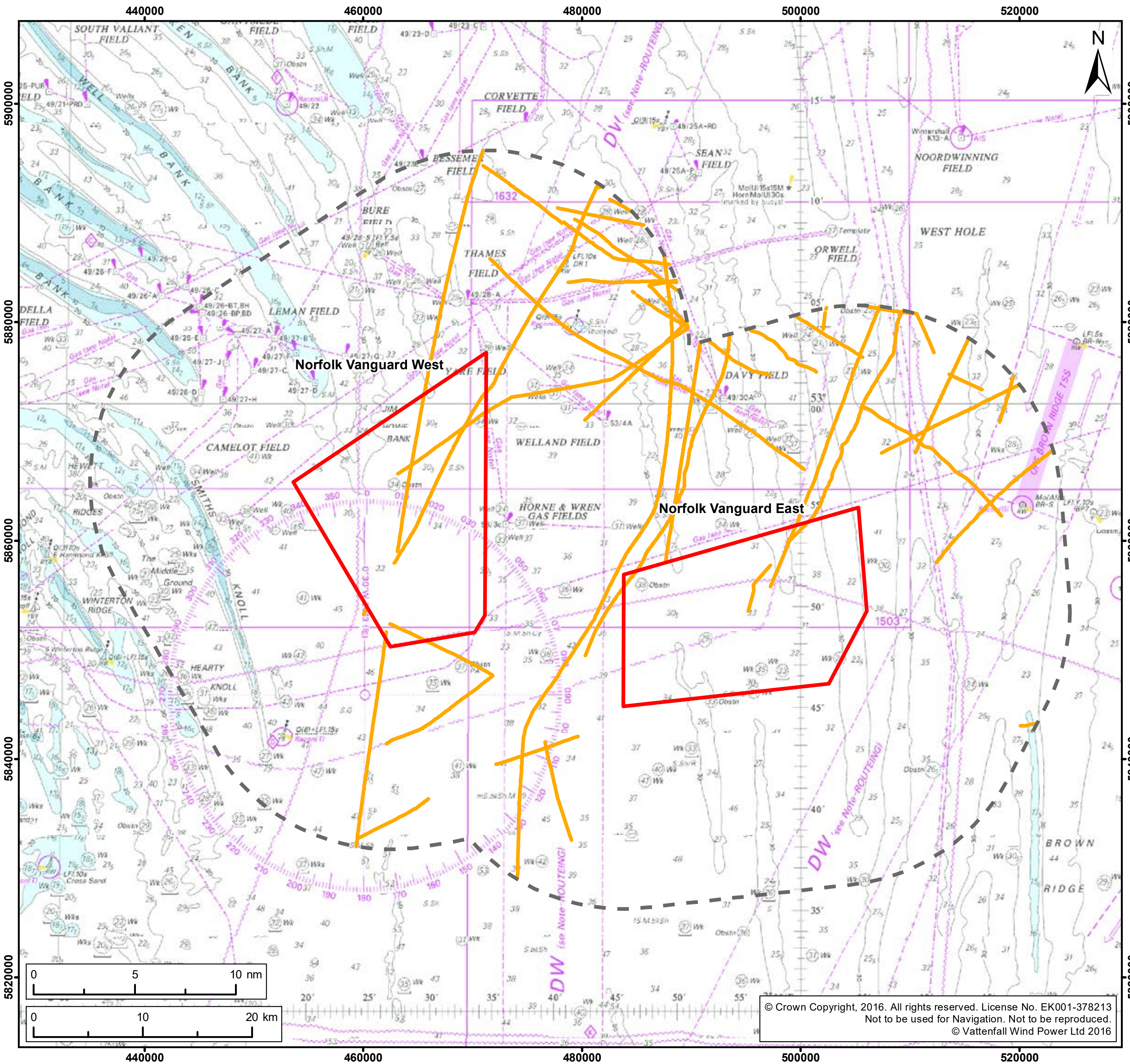
2.11.1.6 Recreational vessels

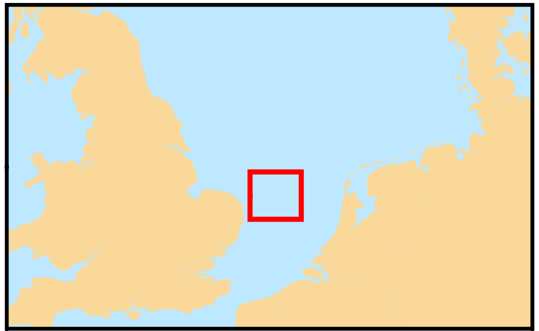
618. Recreational vessel movements are likely to be under represented within the data used for this scoping exercise unless they voluntarily carry AIS. Figure 2.25 and Figure 2.26 show the AIS data captured and the Royal Yachting Association (RYA) UK sailing areas and cruising routes (RYA, 2009). It is noted that recreational vessels over 24m in length have been classified as passenger vessels (as per European Union Legislation) and have therefore not been included in recreational analysis but within the commercial section.

619. The site is located well to the east of the general sailing and racing areas identified by the RYA Coastal Atlas, off the east coast of England.

620. There are no RYA cruising routes indicated to pass through the site, with a medium-use route between Humber and Ijmuiden passing closest at approximately two nautical miles to the south of the red line boundary of NV East and two-and-a-half nautical miles to the south of the red line boundary of NV West.

621. Given the distance from shore and known cruising routes it is unlikely that the marine traffic survey would show a significant increase in recreational movements from that represented within Figure 2.25.





Legend

Norfolk Vanguard

10nm Buffer of Norfolk Vanguard Site Boundary

AIS Vessel Type

Recreational

AIS recreational data collected from Northern Met Mast between 26th June and 26th July 2015.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: AIS Recreational Tracks

Figure: 2.25 | Drawing No: A3848-VAT-2.25

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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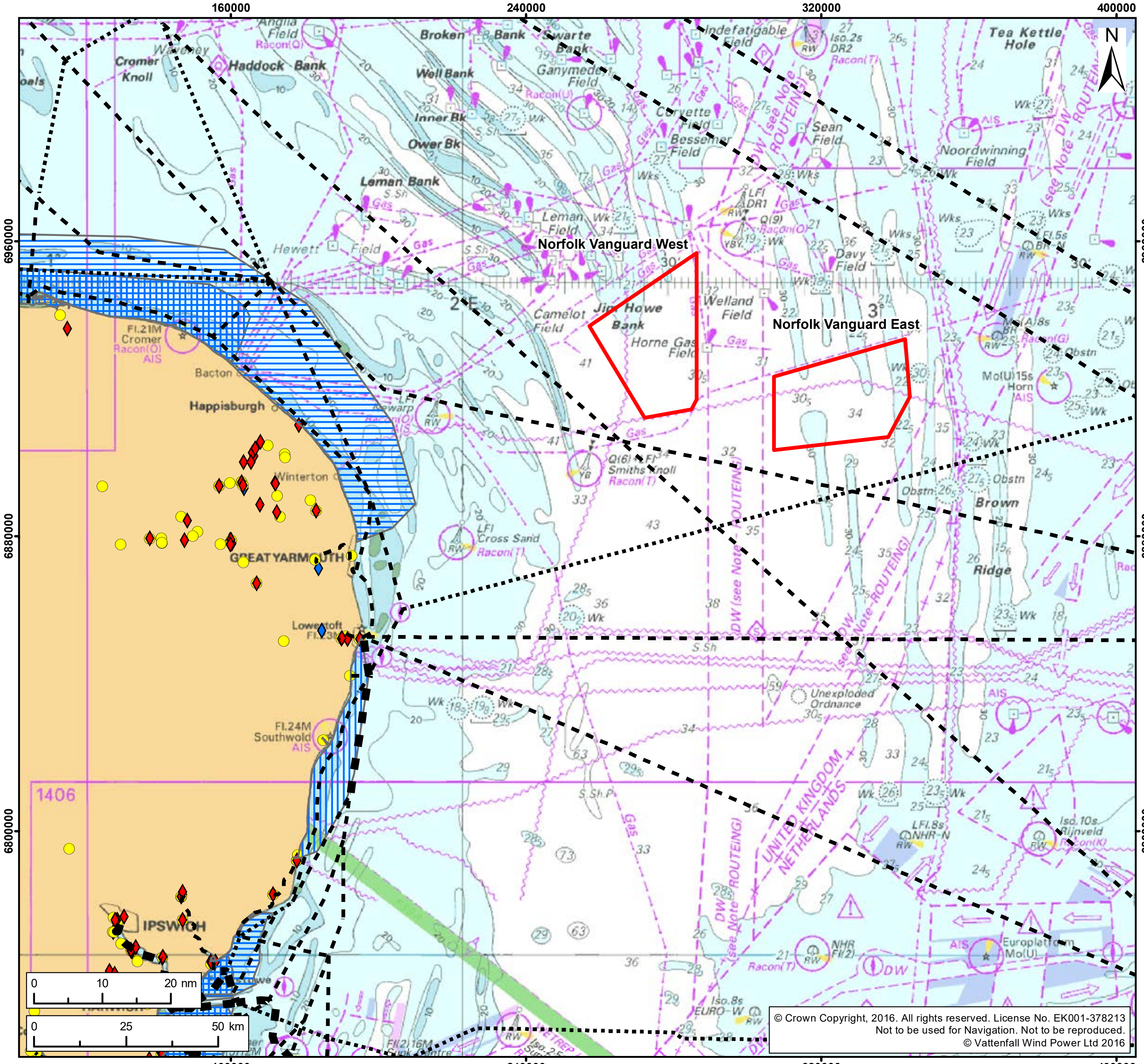

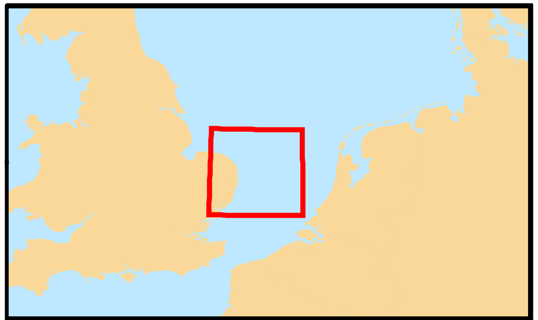

Legend

- Norfolk Vanguard

RYA Cruising Routes

- Heavy use
- Medium use
- Light use

RYA Areas

- Sailing Area
- Racing Area

RYA Facilities

- Training Centre
- Club
- Marina

RYA data collected from The Royal Yachting Association (RYA) UK Coastal Atlas of Recreational Boating, second edition (2009).

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Overview of Recreational Features

Figure: 2.26 | Drawing No: A3848-VAT-2.26

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	15/09/2016	DS	SB	A4	1:1,500,000

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

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2.11.2 Potential impacts

622. The sections below summarise the potential impacts of the proposed project on navigational receptors identified as part of the baseline assessment. This section includes a summary of the likely impacts however it should be noted that a full baseline assessment as part of the NRA may identify additional impacts from receptors that could not have been identified using the data considered within this Scoping Report.

2.11.2.1 Potential impacts during construction

623. **Vessel routeing:** From the desk top review of AIS data it was identified that there are transit routes currently passing through the sites which are likely to be displaced during construction including displacement due to presence of safety zones around partially constructed structures.

624. The AIS data shows that the routes are used primarily by cargo vessels and tankers; however recreational, oil and gas supply/standby vessels and fishing vessels are also included and may be impacted.

625. **Displacement of third party marine activities:** O&G operators and cable maintenance vessels currently route within and in proximity to the red line boundary of the sites. Vessels passing within the sites are likely to be temporarily displaced during the construction activity including as a result of the presence of 500m safety zones.

626. Fishing vessels (engaged in fishing) and recreational users are also likely to be displaced given the risks associated with passing in proximity to construction activities and as a result of the presence of temporary safety zones.

627. **Increased collision risk:** Construction activities within the proposed project, including construction vessels and safety zones, may displace commercial vessels, commercial fishing vessels (in transit) and recreational vessels, leading to an increase in vessel-to-vessel collision risk.

628. Vessels operating on-site are expected to include, but are not limited to, heavy lift construction vessels, crew transfer vessels, barges, jack-up vessels, cable installation vessels and tugs. When they are restricted in their ability to manoeuvre or undertaking sensitive operations they will have advisory safety zones around them, again temporarily displacing other vessels.

629. Experience shows that it is unlikely that vessels would deliberately pass between on-going construction activities within the sites, with passage plans instead altered to take the presence of hazards into account. The extent of this and the impact the

proposed project may have upon navigational receptors (i.e. increased voyage distances and times) would depend upon the phase and extent of development. The displacement of traffic to outside the site and subsequent reduction in sea room may lead to a change in the number of vessel-to-vessel encounters and subsequently a change in the collision risk.

630. **Allision risk:** The physical presence of partially constructed structures within the site would cause additional allision risk for all vessels including commercial vessels, recreational craft and commercial fishing vessels.

631. Fishing vessels navigating between ports and fishing grounds would be exposed to allision risks in the same way as commercial vessels, but vessels actively fishing within the site could be subject to a further risk of allision from partially constructed turbines given the exposure to them.

632. The physical presence of partially constructed structures within the sites would also increase allision risk to all vessels not under command (NUC) including commercial vessels, recreational users and commercial fishing vessels in an emergency situation (including machinery related problems or navigational system errors).

633. The physical presence of partially constructed structures may also cause a gear snagging risk for commercial fishing vessels with potential for gear to be damaged or vessel stability impacted.

634. **Interaction with partially constructed subsea cables:** The physical presence of partially installed cables (which may be exposed or partially buried) could result in an increased risk of anchor snagging for commercial vessels and commercial fishing vessels (in transit). This impact would be associated with the export and inter array cables.

635. In addition, the physical presence of partially installed cables (which may be exposed or partially buried) could result in an increased risk of commercial vessel gear snagging, with potential for gear to be damaged or vessel stability impacted.

636. **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 prosed project area during construction.

2.11.2.2 Potential impacts during operation

637. **Vessel routeing:** From the desk top review of AIS data it was identified that there are transit routes currently passing through the sites which are likely to be displaced during the operational phase. The extent of this is dependent on the design of the

sites. This would be influenced by the number and alignment of wind turbines within NV East and NV West as well as whether the sites will be completely or partially filled.

638. The routes are used primarily by cargo vessels and tankers; however recreational, supply/standby vessels and fishing vessels may also be impacted. Temporary maintenance safety zones around a structure could also displace traffic.

639. **Displacement of third party activities:** O&G operators and cable maintenance vessels currently route within and in proximity to the red line boundary of the sites. Large commercial vessels passing within the sites are likely to be displaced during the operation phase dependent on the design and number of structures within the sites. It is noted that separate agreements may be required to allow access for these larger maintenance vessels to existing infrastructure (e.g. oil and gas platforms, pipelines and wells) but that these agreements will need to consider marine vessel movements.

640. **Increased collision risk:** The physical presence of the proposed project may displace operators' own vessels, commercial shipping, fishing vessels and recreational vessels, leading to an increased vessel-to-vessel collision risk.

641. The following modelling scenarios will be considered during the NRA:

- Base case without wind farm;
- Base case with wind farm;
- Future case without wind farm (assuming 10% increase in traffic); and
- Future case with wind farm (assuming 10% increase in traffic) vessel-to-vessel only.

642. The future case increase may be altered from 10% during the NRA process if consultation feedback demonstrates that this may change significantly.

643. **Allision risk:** The physical presence of the proposed project may cause additional vessel-to-structure allision risk for all vessels including commercial vessels, recreational users and commercial fishing vessels.

644. The presence of the proposed project may also increase allision risk to vessels NUC, including commercial vessels, recreational users and commercial fishing vessels in an emergency situation (including machinery related problems and drifting).

645. Recreational vessels passing in the vicinity of the turbines will 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.

646. **Interference with marine navigational equipment:** The physical presence of structures within the site may create interference on the effectiveness or the operation of marine navigational equipment.

647. This includes the potential for radar interference effects on vessels passing in proximity to wind turbines, including those larger vessels using the IMO DWRs which are at a minimum of one nautical mile from the Norfolk Vanguard site boundary. This could lead to increased vessel collision risks, especially in reduced visibility. This distance shall be reviewed during the EIA process to assess the proximity of turbines from the red line boundary of the sites.

648. The burial of direct current cables within the proposed cable route may create interference on a vessel's magnetic compass from the electromagnetic field (EMF) created by the cables.

649. **Interaction with subsea cables:** As part of the embedded mitigation planned cables will be either buried or protected by rock placement or mattressing to ensure that they do not pose a risk to vessel anchoring or use of gear within the area. This will also include mitigations to ensure that they are maintained throughout the life of the project and do not become exposed.

650. **Impacts on emergency response resources:** Operational activities associated with the proposed project may diminish emergency response capability (including SAR and pollution response) within the southern North Sea area during construction.

2.11.2.3 Potential impacts during decommissioning

651. **Vessel routeing**: From the desk top review of AIS data it was identified that there are routes that are likely to be displaced during decommissioning, including by the presence of safety zones.

652. **Displacement of third party marine activities:** Fishing vessels (engaged in fishing) and recreational users are also likely to be displaced given the risks associated with operating in proximity to decommissioning activities and the presence of 500m safety zones.

653. **Increased collision risk:** Decommissioning activities within the proposed project, including decommissioning vessels and safety zones, may displace commercial vessels, commercial fishing vessels (in transit) and recreational vessels, leading to an increase in vessel-to-vessel collision risk.

654. **Allision risk:** The physical presence of decommissioned structures within the proposed project would cause additional allision risk for commercial vessels, recreational craft and commercial fishing vessels.

655. The physical presence of partially decommissioned or left *in situ* infrastructure may also cause a gear snagging risk for commercial fishing vessels.

656. **Interaction with partially decommissioned subsea cables:** The physical presence of partially decommissioned cables (which may be exposed or partially buried) or left *in situ* cables could result in an increased risk of anchor snagging for commercial vessels and commercial fishing vessels (in transit). This impact would be associated with the export and inter array cables.

657. In addition, the physical presence of partially decommissioned cables (which may be exposed or partially buried) could result in an increased risk of commercial vessel gear snagging, with potential for gear to be damaged or vessel stability impacted.

658. **Impacts on emergency response resources:** Decommissioning activities associated with the proposed project may diminish emergency response capability (including SAR and pollution response) within the southern North Sea area during decommissioning.

2.11.2.4 Potential cumulative impacts

659. **Interactions with other wind farms:** The proposed project in combination with the presence of and construction of future offshore wind farms in the region (including other sites in the former East Anglia Zone, the UK and Europe), may have the potential to alter the routeing of vessels in the southern North Sea. An assessment of cumulative, in-combination and transboundary shipping and navigation impacts would be carried out as part of the Navigational Risk Assessment that would be reported in the ES.

660. **Interactions with other activities:** In combination impacts will be considered for shipping and navigation receptors, including other offshore developments, as well as associated with other marine operations. However it should be noted that fishing, recreational and marine aggregate dredging transits would be considered as part of the baseline assessment.

2.11.2.5 Transboundary Impact Assessment

661. 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 impacts relating to shipping and navigation

Potential impacts	Construction	Operation	Decommissioning
Vessel Routeing	✓	✓	✓
Displacement of Third Party 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 (×)

2.11.3 Mitigation

662. There are a range of measures that could be applied to mitigate the impacts of a wind farm development (including through site design). The following are potential measures that could be applied to a particular project, as appropriate to the level and type of risk determined during the EIA:

- Compliance with MCA Marine Guidance Note 543 (M+F) (MGN 543 M+F) including site and wind turbine design;
- Marked 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;
- 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;
- Inter-array 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

663. Data sources (as listed in Table 2.24) will be considered with a study area of 10nm around the project. However given the international nature of vessel routeing, cumulative and transboundary impacts may be considered out with this if a pathway is identified to either of NV East and NV West sites.

664. Marine traffic survey data would be the primary source assessed within the NRA and ES. A minimum of 28 days of marine traffic survey data would be used (collected within 24 months of submission) and would include AIS, radar and visual observations collected from vessel based surveys and AIS receivers located on meteorological masts and shore based receivers. The marine traffic survey data would consider seasonal variations including a comparison with the desk-based sources listed in Section 2.11.1.1.

665. 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. Other non-mandatory vessel types may also carry AIS A and B (a cost efficient version for non-mandatory vessels) on a voluntary basis and would also be recorded and assessed as part of the NRA and ES.

666. Consultation with navigational or cumulative stakeholders throughout the proposed project would be used to provide supplementary information. Consultees would include:

- Maritime and Coastguard Agency;
- Department for Transport;
- Ministry of Defence and Civil Aviation Authority.
- Trinity House;
- Chamber of Shipping;
- Royal National Lifeboat Institute;
- Royal Yachting Association;

- Cruising Association;
- Ports on the east coast of the UK (such as Great Yarmouth and Lowestoft);
- Regular operators identified as part of the survey;
- Local stakeholders such as 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

667. The assessment methodology would principally be based on the following:

- MCA MGN 543 (M+F) Offshore Renewable Energy Installations Guidance on UK Navigational Practice, Safety and Emergency Response Issues (MCA, 2016);
- Department of Energy & Climate Change Methodology for Assessing the Marine Navigational Safety Risks of Offshore Renewable Energy Installations (DECC 2013b).

668. Other guidance used within the assessment includes:

- 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 2008b);
- DECC Guidance Notes on Safety Zones (DECC, 2007 as updated);
- 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).

669. The NRA would follow a different assessment process from the EIA; although the approaches are very similar. The result of both would be an assessment of the risk posed by the proposed project to navigation and the mitigation required to minimise those risks. The MCA require that the DECC Methodology (DECC, 2013b) including the IMO Formal Safety Assessment (FSA) is used as a template for preparing an NRA.

670. 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 followed by the FSA in line with the IMO FSA Process (IMO, 2002) and the DECC guidance (DECC, 2013b).

671. A shipping and navigation receptor can only be sensitive if there is a pathway through which an impact could be transmitted between the source and the receptor. When a receptor is exposed to an impact, the overall 'severity of consequence' to the receptor is determined and the process incorporates a degree of subjectivity and professional judgement. Consequently assessments for shipping and navigation

receptors use the following criteria, in line with baseline data and expert opinion, to assess:

- Outputs of the hazard workshop involving national and local stakeholders;
- Level of stakeholder concern;
- Vessel type (including persons/cargo on board) and routes in proximity to structures; and
- Lessons learnt from existing developments.

672. 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 are therefore detailed within this chapter.

673. The assessment of potential risks and impacts on shipping and navigation would also be made with specific reference to the relevant NPS.

674. 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).

675. 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

676. Information to support the scoping study for Norfolk Vanguard has primarily come from the ZEA for the former East Anglia Zone (EAOW, 2012a). 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

677. Archaeological features include maritime sites (wrecks and wreckage from prehistory to the present), aviation sites and submerged prehistoric archaeological sites (Figure 2.27).

678. There are no designated sites within NV East, NV West or the provisional offshore cable corridor.

679. With regard to prehistory there are no known sites located in NV East, NV West or the provisional offshore cable corridor. The baseline characterisation of the former 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).

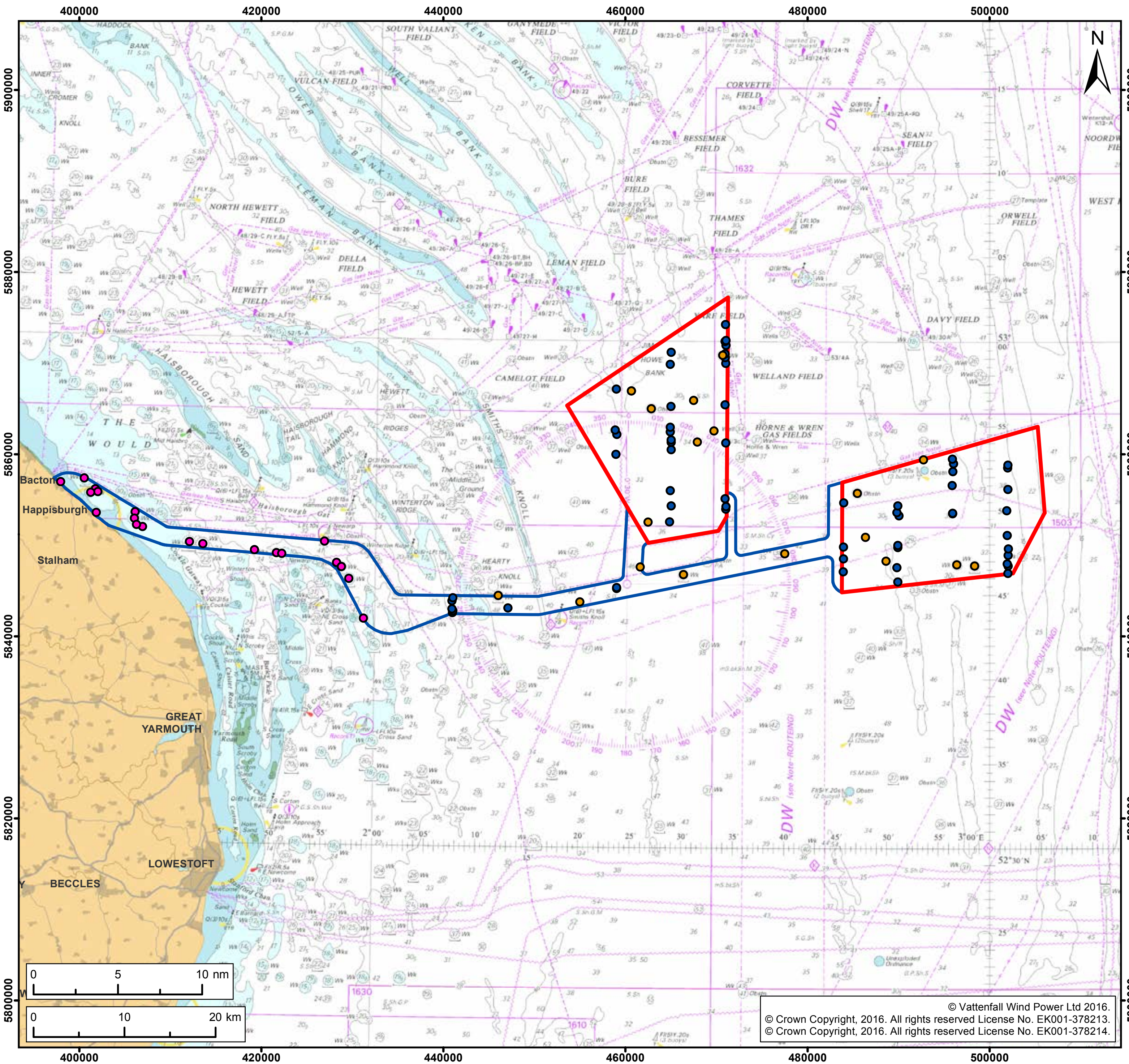
680. Within NV East there are six sites identified in the ZEA as maritime or aviation sites and 27 additional geophysical anomalies that have been classified as being of uncertain origin and possible archaeological interest.

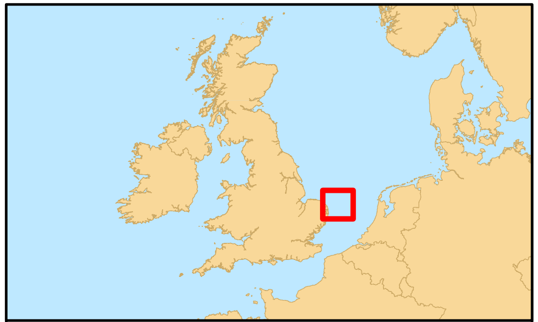
681. Within NV West there are eight sites identified in the ZEA as maritime or aviation sites and 27 additional geophysical anomalies.

682. Within the provisional offshore cable corridor there are five sites identified in the ZEA as maritime or aviation sites and 8 additional geophysical anomalies. Beyond the boundary of the former Zone area (and hence the ZEA baseline data coverage) there are 19 wrecks and one further obstruction recorded in the OceanWise data set.

683. 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.

684. To determine the total archaeological resource with NV East, NV West and along the cable corridor, geophysical data from site specific geophysical surveys and geotechnical site investigations will be reviewed alongside previously collected and other pertinent data sets.





Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- Wessex Archaeology Wrecks (ZEA)[1]
- Wessex Archaeology Additional Geophysical Anomalies (ZEA)[1]
- OceanWise Wrecks and Obstructions[2]

[1] Wessex Archaeology, 2013. [2] Oceanwise, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Known Wrecks and Additional Geophysical Anomalies

Figure: 2.27 | Drawing No: PB4476-002-2-033

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	JE	GK	A4	1:600,000

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

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2.12.2 Potential impacts

685. 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 will be permanent and there will be no way to replace the resource, as such the impact would be of major significance.

686. Therefore for this topic, impacts will largely be prevented through appropriate layout of the wind farm infrastructure. Wherever possible, infrastructure will 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

687. **Direct physical disturbance:** The installation of the foundations for the wind turbines, 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, 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. 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 Exclusions Zones (AEZs) within the development area.

688. 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 standard mitigation measures should reduce impacts so that they are not significant.

689. **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 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.

690. **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.

691. As set out in the Section 4.2 the proposed project is located an approximate distance of 47km from the coast, 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 be scoped out. There would be potential 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.

692. It is also proposed that the potential impacts of construction of the wind farm upon the setting of offshore heritage assets should be scoped out. As set out in Section 4.2, 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 of the nearby gas rigs and their service vessels. Any impact upon the setting of offshore heritage assets is therefore unlikely to be considered significant.

2.12.2.2 Potential impacts during operation

693. **Direct physical disturbance:** Direct impacts during operation could occur as a result of routine maintenance activities if these disturb the seabed, however as areas will already have been disturbed during construction there will be limited scope for impact and 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 will have been avoided in the original layout, there will be limited potential for impacts from this source.

694. **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.

695. **Indirect disturbance of setting:** It is proposed that the potential impacts of the offshore wind farm on the setting of onshore and offshore heritage assets should be scoped out. The distance from the shore to the offshore wind farm precludes visibility from coastal heritage assets and, as identified in Section 4.2, the setting offshore is already influenced by existing gas rigs and passing shipping vessels in this area, reducing the sensitivity and potential magnitude of change.

2.12.2.3 Potential impacts during decommissioning

696. Impacts arising during the decommissioning are expected to be similar to 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 facilitate the decommissioning works while minimising any impacts upon features of archaeological significance.

2.12.2.4 Potential cumulative impacts

697. Individual known archaeological receptors within NV East, NV West and the provisional offshore cable corridor will not be subject to direct impacts from other known plans or projects as they are discrete and there will be no physical overlap of different infrastructure. Given that indirect impacts (i.e. impacts from scour or sediment transport changes) are likely to be highly localised and small scale (based upon physical process modelling 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.

698. There is potential though 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.

699. 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.

2.12.2.5 Transboundary impact assessment

700. Transboundary impacts may be relevant to archaeology and cultural heritage where wrecks of non-British, European nationality are subject to impact from development

and may therefore fall within the jurisdiction of another country. This will be considered further in the EIA as appropriate.

2.12.2.6 Summary of potential impacts

Table 2.26 Summary of 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)	✓	×	×
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓

scoped in (✓) and scoped out (×)

2.12.3 Mitigation

701. Impacts to both known and potential archaeological receptors are addressed through the application of embedded mitigation. Known archaeology will be avoided through the application of AEZs and subsequent micro-siting of infrastructure on the seabed.

702. Unavoidable impacts to potential receptors will be addressed through a series of agreed mitigation measures to deal with the discoveries once impacts have occurred and been identified. These measures will be set out in the project WSI which will 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).

703. The WSI will be revised, as and when required, throughout the life of the Norfolk Vanguard project, as new data become available and as aspects of the development evolve post consent.

2.12.4 Approach to assessment and data gathering

704. During summer/autumn 2016 the Applicant is undertaking geophysical survey within NV West and the provisional offshore cable corridor (data within NV East having been acquired previously for EA FOUR) and geotechnical site investigations across the offshore project area. In order to ensure that the data produced as a result of this campaign would be capable of supporting archaeological interpretation, the Applicant consulted on, and agreed the approach with Historic England.

705. 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 Norfolk Vanguard. 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.

706. Geotechnical site investigations comprise cone penetrometer tests (CPTs) and vibrocores within NV East, NV West and the provisional offshore cable corridor. Following the 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).

707. In addition to these site specific site investigations, the archaeological desk-based assessment 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.

708. 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 development or activity results in change to the historic character.

709. Norfolk Vanguard 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 Vanguard.

710. The potential impacts from Norfolk Vanguard 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

711. 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 Ministry of Defence (MOD) operations.

712. 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 will be applied in undertaking the EIA.

2.13.1 Baseline

713. The airspace within and above Norfolk Vanguard is used both by civil and military aircraft.

2.13.1.1 Airports

714. The nearest UK airport to Norfolk Vanguard is Norwich Airport, approximately 100km from the nearest point of NV East and 75km from NV West. Amsterdam Schiphol Airport is approximately 120km from the eastern boundary of NV East.

2.13.1.2 International Air Traffic Services

715. The world is divided into Flight Information Regions (FIR) for the responsibility of the provision of Air Traffic Services (ATS) to aircraft. The boundary between London FIR (under the regulation of the UK Civil Aviation Authority (CAA)) and Amsterdam FIR (under the regulation of the Dutch Aviation Authority (IVW)) crosses through the eastern edge of NV East. NV West is wholly within the UK FIR.

2.13.1.3 En-route services

716. National Air Traffic Services En Route Ltd (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.

717. Norfolk Vanguard lies beneath a volume of airspace delegated to LVNL. In this delegated airspace (Flight Level 175 (17500ft) to Flight Level 245 (24500ft)), LVNL is responsible for providing ATS. Below and above the delegated airspace, NERL is responsible for providing ATS.

718. A National Air Traffic Services (NATS) Technical and Operational Assessment (TOPA) was completed by NATS during June 2015 (NATS 2015). The results of the TOPA indicated that no impact is anticipated on NATS navigational aids or radio communication infrastructure. NV East will not be detectable by the NERL Primary Surveillance Radar (PSR) at Cromer which provides radar data for the provision of an en-route service to civil and military aircraft. NV West will be detectable by the Cromer PSR and cause false radar plots (clutter) to be produced, causing unacceptable interference to the PSR. A solution/mitigation has been identified and parties are working closely together to ensure it is implemented prior to construction.

719. Norfolk Vanguard lies beneath a volume of delegated airspace where en-route air traffic services are provided by LVNL. (EAOW, 2012a). During the Zone Appraisal Process, LNVL confirmed that none of the PSR systems used by LVNL have radar line of sight to Norfolk Vanguard, nor will its North Sea Wide Area Multilateration (WAM) and Automatic Dependent Surveillance–Broadcast (ADS-B) systems be affected.

2.13.1.4 Military airfields

720. 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 (AAC) base known as AAC Wattisham. Although all of these military bases are located more than 120km away from Norfolk Vanguard, aircraft operating from any of these bases may transit through or within the airspace above Norfolk Vanguard (EAOW, 2012a).

2.13.1.5 Air Defence Radar

721. The nearest Air Defence Radar (ADR) to Norfolk Vanguard is the TPS77 type radar located at RAF Trimingham, North Norfolk. The majority of Norfolk Vanguard will be within radar coverage and detectable by the TPS77 ADR. The TPS77 ADR has an inherent resilience to WTG 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 (NAIZ). A technical solution/mitigation will be agreed with the UK Ministry of Defence (MOD) prior to construction (as has been completed for the Greater Wash wind farms).

722. During the Zone Appraisal Process, the Dutch Armed Forces confirmed that it has no radar issues with development in the Norfolk Vanguard area (EAOW, 2012a).

2.13.1.6 Military training areas

723. Norfolk Vanguard does not lie within any military training area. (EAOW, 2012a)

2.13.1.7 Air to Air Refuelling Areas (AARA)

724. Norfolk Vanguard does not lie within any AARA. (EAOW, 2012a).

2.13.1.8 Helicopter Main Routes (HMR)

725. There are a number of Helicopter Main Routes (HMRs) in the vicinity of Norfolk Vanguard. This includes one Dutch HMR. HMRs have no defined lateral dimensions, although 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, helicopters may route direct to their destination point.

726. As Norfolk Vanguard lies in the vicinity of a UK and Dutch HMR (EAOW, 2012a), these will be a primary consideration of the EIA.

2.13.1.9 Search and Rescue (SAR) operations

727. 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 (AOC), which allows them total flexibility to manoeuvre using pilot's best judgement.

728. An Emergency Response Co-operation Plan (ERCoP) will be compiled in conjunction with the MCA (see Section 2.11.3).

2.13.1.10 Meteorological office radar

729. 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 rain (or snow) fall and wind. Even partial interruption of the radar beam has the potential to result in errors in the estimated precipitation.

730. 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 turbines indicates that the deployment of turbines within 5km of weather radar be prohibited. In addition, an impact study should be completed on turbines planned between 5km and 20km from UK Meteorological (Met) Office radar.

731. The closest Met Office radar system is Old Buckenham located 20km southwest of Norwich. It is located a significant distance away from Norfolk Vanguard and is highly unlikely to be affected and as such weather radar will not be considered further in completing the EIA.

2.13.2 Potential impacts

2.13.2.1 Potential impacts during construction

732. **Impacts on radar systems:** There will be no specific impact on radar as a result of construction activities, potential impacts arise from the presence of WTGs which are considered in more detail under operational impacts.

733. **Increased collision risk:** During the construction phase, the presence and movement of certain construction vessels (e.g. tall cranes) may present a potential collision risk to aircraft and helicopter flight operations.

734. **Impact on helicopter main routes:** The helicopter operators may have concerns with the potential physical presence of the WTGs as they are constructed.

2.13.2.2 Potential impacts during operation

735. **Impacts on radar systems:** The NERL PSR at Cromer will detect NV West and create WTG induced clutter to be presented on radar displays utilising the Cromer PSR. The MoD ADR at RAF Trimingham will have line of sight to the majority of the Norfolk Vanguard WTGs creating an unacceptable operational effect to the ADR.

736. **Impact on helicopter main routes:** The helicopter operators may have concerns with the potential physical presence of the WTGs. Mitigation may take the form of re-routing helicopters around the Wind farm.

737. **Impact on Military Training Areas:** The MoD may have concerns relating to the partial coverage of an area of military training (RAF Lakenheath North Aerial Tactics Area). However, it is noted that this training area has a base height well above the WTG height, restricting any potential effects to those relating to radar rather than physical obstruction effects.

738. **Increased collision risk:** WTGs can be difficult to see from the air, particularly in poor meteorological conditions and at night, and can increase the collision risk to aircraft and helicopter flight operations.

2.13.2.3 Potential impacts during decommissioning

739. The infrastructure required in the process of WTG decommissioning, in particular large crane structures, may present a physical obstruction and effect operations of Low Flying aircraft, Helicopter Support to Oil and Gas (O&G) Operations and SAR Operations.

740. Any WTG within line of sight to current radar infrastructure will have an impact on the system, unless a form of technical mitigation is utilised for its effect, until the sites are decommissioned.

741. Any impacts from the operation of Norfolk Vanguard will be incrementally reduced to zero with the decommissioning of the wind farm.

2.13.2.4 Potential cumulative impacts

742. Cumulative impacts, especially to radar, are anticipated between Norfolk Vanguard and other offshore wind farms and activities in the North Sea and will be further considered within the EIA.

2.13.2.5 Transboundary impacts

743. The Netherlands authorities have advised that they have no radar coverage (civil or military) over Norfolk Vanguard, the potential transboundary impacts are therefore limited to an en-route obstruction associated with WTGs being erected within the Amsterdam FIR (EAOW, 2012a).

2.13.2.6 Summary of potential impacts

Table 2.27 Summary of impacts relating to aviation and radar

Potential impacts	Construction	Operation	Decommissioning
Impact on radar systems	x	✓	x
Impact on helicopter routes	✓	✓	✓
Impact on military training area	x	x	x
Increased collision risk	✓	✓	✓
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	X	x

scoped in (✓) and scoped out (×)

2.13.3 Mitigation

2.13.3.1 Aviation radar

744. Mitigation of the effects created to the NERL Cromer PSR will be achieved through technical and airspace management solutions around NV West.

745. Mitigation of ADR impacts will be achieved by implementation of technical solutions within the TPS77 (as has been completed for the Greater Wash Wind farms) (EAOW, 2012a).

2.13.3.2 Helicopter main routes

746. Mitigation may take the form of re-routing helicopters around the wind farm.

2.13.3.3 Search and rescue

747. An Emergency Response Co-operation Plan (ERCoP) will be compiled in conjunction with the MCA and would be in place for the construction, operation and decommissioning phases of the Project. The ERCoP will detail specific marking and lighting of the WTGs. The SAR helicopter bases will be supplied with an accurate Project GPS position and Development parameters.

2.13.3.4 Aviation lighting and marking

748. There will be a requirement for Aviation Obstruction Lighting on all or individual WTGs. Consultation with the CAA, MCA (SAR input to the ERCoP) and MOD would be required to establish acceptable aviation lighting to meet requirements, in particular to ensure aviation lighting is clearly distinguishable from maritime lighting.

749. 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 will be required to provide details of the development to the Defence Geographic Centre (DGC).

2.13.4 Approach to assessment and data gathering

750. The EIA process is likely to be supported by further desk-based studies that will identify and examine in greater detail, sensitive aviation and MOD receptors. Studies will be undertaken in parallel with consultation and meetings with specific stakeholders in order to provide a detailed understanding of potential impacts.

751. 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, will be considered during the EIA process:

- CAA, CAP 670, Air Traffic Services Safety Requirements 2014;
- CAA, CAP 393, Air Navigation: The Order and the Regulations (known as the Air Navigation Order (ANO) 2016;
- MOD Obstruction Lighting Guidance (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.

752. Other data sources and guidance considered as part of the desktop review of the baseline situation include the following:

- CAA, Visual Flight Rules Chart 2016;
- 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 2016;
- CAA, CAP 168, Licensing of Aerodromes 2014;
- Military Aeronautical Information Publication (Mil AIP) 2016; and
- MOD UK Low-Flying System (UKLFS) Priority Area Map 2011.

753. 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 operators).

754. It is expected that consultation will be an iterative process, allowing for any concerns that are raised to be considered in the WTG layout and optimisation process of wind farm design.

755. 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. The MOD Trimingham ADR will detect the majority of the WTGs of Norfolk Vanguard and a technical solution has been provided to the MOD for acceptance.

2.14 Infrastructure and Other Users

2.14.1 Baseline

2.14.1.1 Offshore wind farm developments

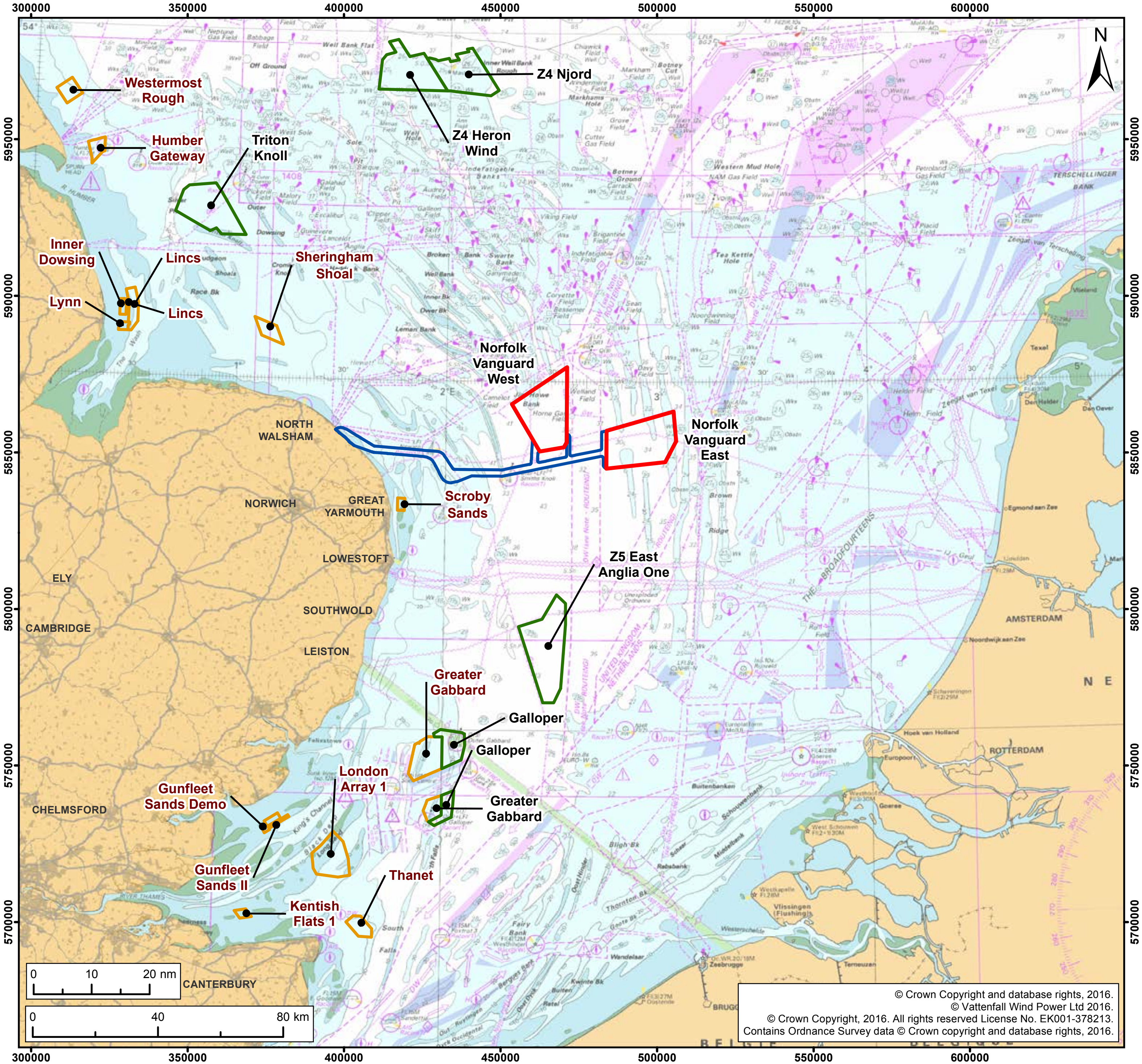
756. Figure 2.28 shows other offshore wind farms developments in the vicinity of Norfolk Vanguard in the southern North Sea. Within the former East Anglia Zone, East Anglia THREE is adjacent to the south of NV East and the proposed future Norfolk Boreas project will be to the north of NV East. Further south within the former Zone is the consented East Anglia ONE project and proposed future developments of East Anglia ONE North and East Anglia TWO.

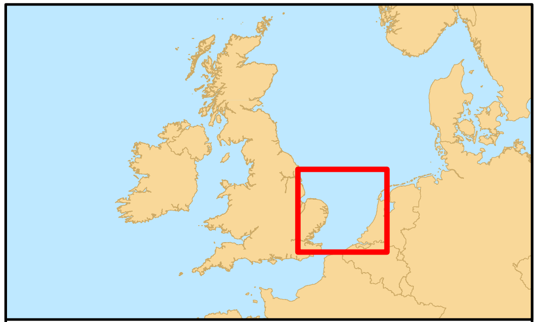
757. Aside from the other developments within the former East Anglia Zone, Norfolk Vanguard is quite distant from other existing UK offshore wind farms, with the nearest being Scroby Sands Offshore Wind Farm, a Round 1 project of 60MW situated more than 65km away from NV East and 44km away from NV West. Sheringham Shoal and Dudgeon are the next closest UK wind farm developments, at over 106km and 97km distance from NV East respectively and 75km and 66km away from NV West.

758. The closest international wind farm developments are the Dutch Ijmuiden Development Zone and the Breeveertien II offshore wind farms which are situated less than 17km and 41km away from NV East respectively, and 47km and 71km away from NV West.

Table 2.28 Nearest existing offshore wind developments to Norfolk Vanguard

Offshore wind farm	Distance from NV East (km)	Distance from NV West (km)
UK - Scroby Sands	65.25	44.75
UK - Sherringham Shoal	106.68	75.37
UK - Dudgeon	97.13	66.34
NL - Ijmuiden Development Zone	16.70	47.20
NL - Breeveertien II	41.17	71.40





Legend:
- Norfolk Vanguard
- Provisional Offshore Cable Corridor

UK Windfarm status
- Consented
- In Operation

Project: Norfolk Vanguard

Report: Environmental Impact Assessment Scoping Report

Title: Other Offshore Wind Farm Developments

Figure: 2.28 Drawing No: PB4476-002-2-034

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	05/09/16	JE	GK	A4	1:1,750,000
01	03/08/16	JE	GK	A4	1:1,750,000

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

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2.14.1.2 Oil and Gas pipelines and platforms

759. There is no surface or subsurface infrastructure within the NV West or NV East redline boundaries, however, there are three active oil and gas well situated at the northern, eastern and western edges of NV West, as shown in Figure 2.29.

760. There are two pipelines crossing the potential 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 eat to west adjacent to the southern boundary of NV West and the northern boundary of NV East.

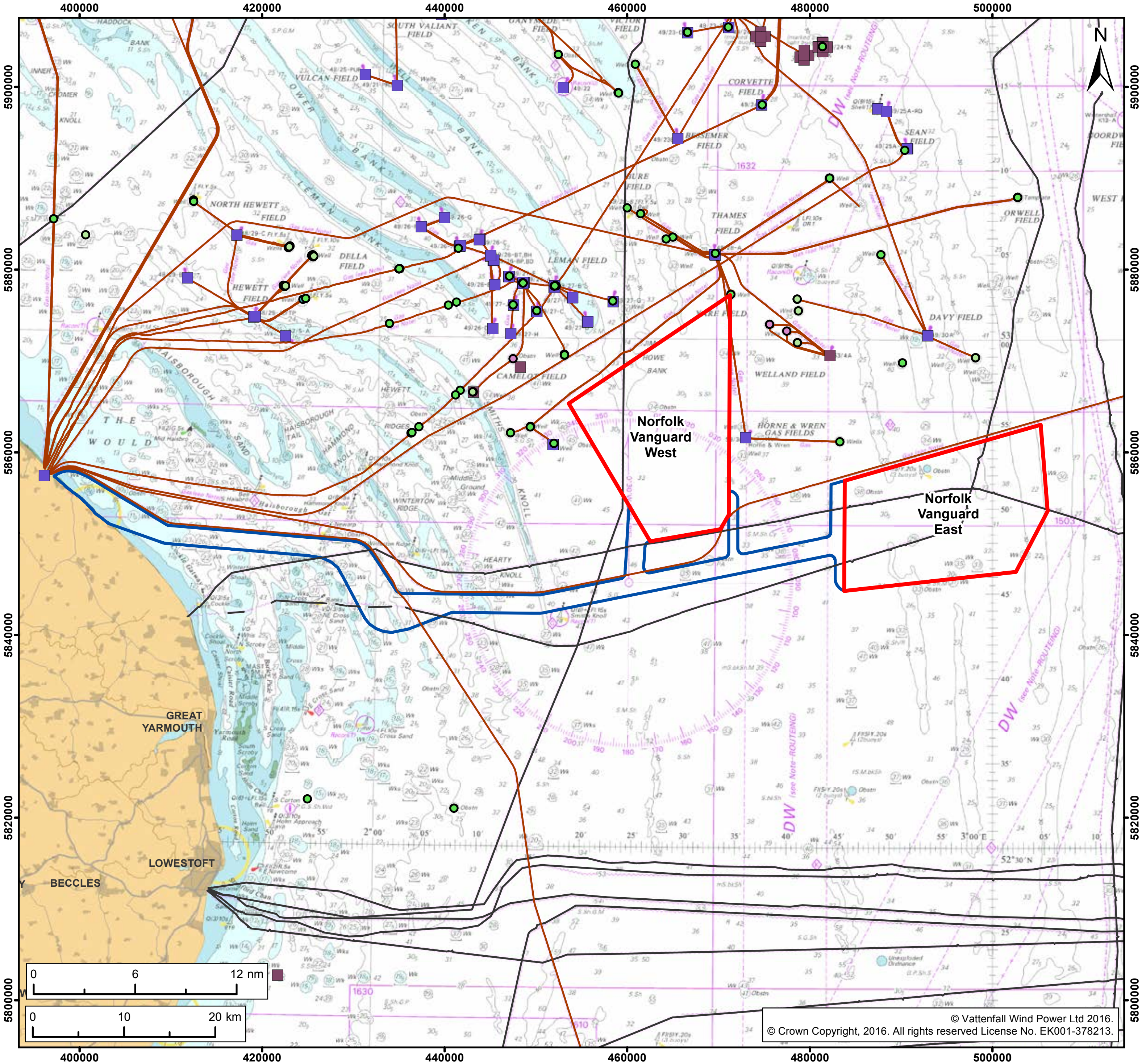
761. Additional infrastructure including operational platforms, wells and pipelines, are located just outside the northern boundary of NV West. The red line boundaries for Norfolk Vanguard have been developed with the aim of avoiding this infrastructure.

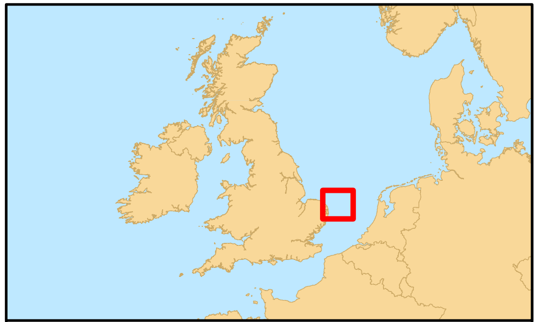
762. There is one active subsurface structure near the provisional offshore cable corridor. There are other subsurface and surface structures surrounding the red line boundary which are active, abandoned or removed (Figure 2.29).

763. The shipping and the aviation traffic associated with the oil and gas industry is discussed in sections 2.3.3 and 2.3.4 respectively.

2.14.1.3 Oil and Gas licensing and exploration

764. There are a number of licensed blocks which are yet to be developed which overlap with NV East. Discussions with the owners of these licensed blocks are ongoing 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.





Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- Pipelines[1]
- Subsea Cables[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 Vanguard	Environmental Impact Assessment Scoping Report

Title:

Other Offshore Infrastructure

Figure: 2.29 Drawing No: PB4476-002-2-014

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	JE	GK	A4	1:600,000

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

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2.14.1.4 Sub-sea cables

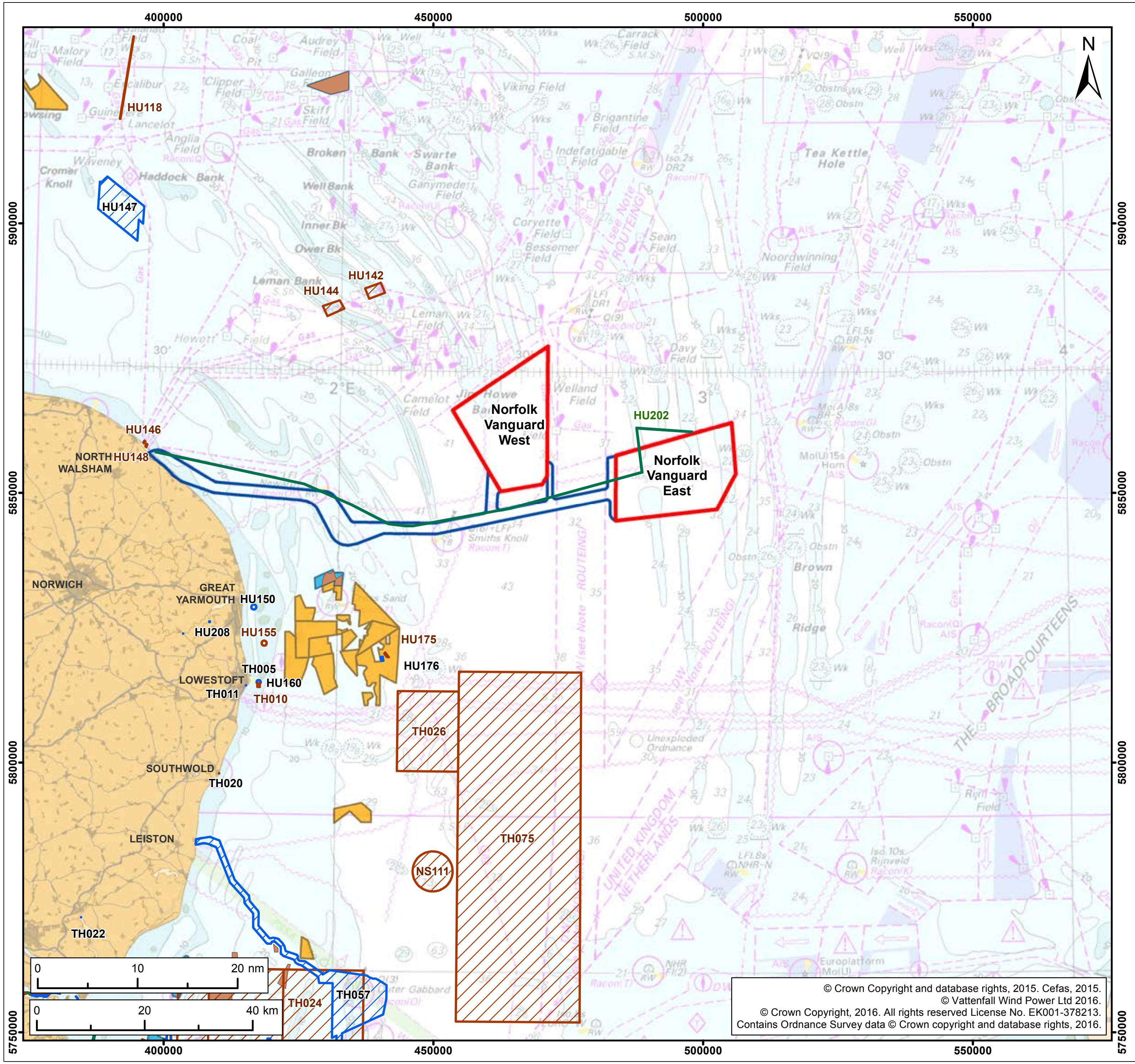
765. The southern North Sea has a significant number of cables; primarily telecommunication connections between the UK and continental Europe (see Figure 2.29). The UK-Netherlands 14 telecommunications cable runs from Winterton-on-Sea to Egmond in the Netherlands and intersects NV East and the provisional offshore cable corridor. The North Sea Com 1 fibre optic cable runs from Lowestoft north through the provisional offshore cable corridor and NV West. All other cables intersecting the Norfolk Vanguard offshore project area are inactive.

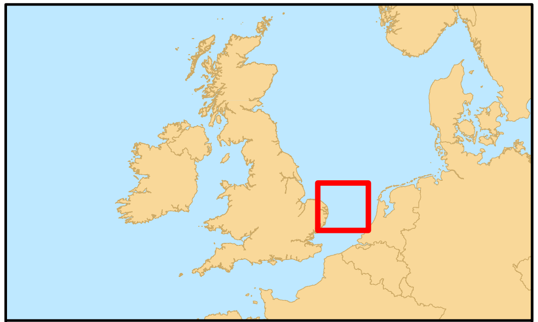
766. In addition, there are disused cables that that date from over 100 years ago, many of which are now lost and represent a risk to seabed activity. Modern charts only display cables decommissioned since 1987.

2.14.1.5 Aggregate dredging

767. There are currently no aggregate dredging areas within Norfolk Vanguard or the provisional offshore cable corridor. There are a number of aggregate dredging licences approximately 30km south west of NV West and 45km south west of NV East; these are shown in Figure 2.30.

768. 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 (Royal HaskoningDHV, 2016).





Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- Aggregate Application
- Aggregate Option Area
- Aggregate Licence Area

Marine Disposal Site

- Closed
- Disused
- Open

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Aggregate Dredging and Marine Disposal Activity

Figure: 2.30 | Drawing No: PB4476-002-2-014

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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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

769. There is one disused marine disposal site HU202 that runs through NV East and the provisional offshore cable corridor. There are two closed marine disposal sites, HU146 and HU148 at the Norfolk Vanguard landfall site and two closed marine disposal sites approximately 25km north of NV West, as shown in Figure 2.30. The largest marine disposal site in the area is TH075. This is closed, located south of the Norfolk Vanguard offshore project area. The closest open marine disposal site from the Norfolk Vanguard wind farm development areas is HU176, found approximately 35km south west of NV West.

2.14.1.7 Unexploded Ordinance (UXO)

770. There are currently two MOD identified explosives dumping grounds to the west and south west of the former East Anglia Zone. There is also potential for wartime unexploded ordinance (UXO) within the southern North Sea (EAOW, 2012a).

2.14.1.8 Ministry of Defence (MOD) Activities

771. No military practice and exercise areas (PEXAs) overlap with Norfolk Vanguard. The closest PEXA is the Southern Military Defence Area (MDA); with the closest distance to Norfolk Vanguard being 49.3km (NV West), and the distance to the closest point on the cable corridor being 70.7km.

2.14.2 Potential impacts

2.14.2.1 Potential impacts during construction

772. **Potential interference with other wind farms:** 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 it is proposed to scope this impact out of the EIA. Crossing of other wind farms cables is discussed below.

773. **Potential interference with oil and gas operations:** Through the process of site selection of Norfolk Vanguard, the Applicant has sought to avoid existing oil and gas infrastructure. Discussions with owners and operators of the infrastructure immediately adjacent to Norfolk Vanguard has advised that these assets will have been decommissioned by 2020, i.e. prior to construction of the wind farm. Discussions will continue 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). Crossing of pipelines is discussed below.

774. 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.

775. **Physical impacts on subsea cables and pipelines:** Existing cables and pipelines within Norfolk Vanguard will be avoided when siting the turbines and infrastructure. However inter-array cables may be required to cross the existing subsea cables and therefore cable crossing agreements with the operators of these will be sought. The provisional offshore cable corridor crosses several existing cables (Figure 2.29); therefore the final cable route will inevitably require cable crossings. Crossing agreements will therefore be prepared with the relevant owners of cables and pipelines and appropriate installation and protection measures developed.

776. **Impacts on aggregate dredging activities:** As there is no overlap of aggregate licence areas with Norfolk Vanguard there are limited pathways for impacts upon aggregate dredging activities. If the project programme for the proposed dredging by the Bacton Gas Terminal changes, such that it overlaps with the Norfolk Vanguard construction this will be considered further, however this is deemed highly unlikely given the current proposal to dredge in 2017 with Norfolk Vanguard construction planned from 2023. Any vessel movement conflicts will be addressed as part of the shipping and navigation assessment (Section 2.11).

777. **Impacts on disposal sites:** Given that there is no overlap between Norfolk Vanguard and disposal sites there is no pathway for impacts and therefore the Applicant propose to scope this out of the EIA. The Warren Springs site (H202) is disused and therefore there is no pathway for impact upon it from export cable installation. Given the lack of contamination there is no likelihood of resuspension of contaminants, this is covered in Section 2.1.3.

778. **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 and this will not be assessed further within the EIA.

779. **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 construction of Norfolk Vanguard and therefore the Applicant proposes to scope this out of the EIA. Impacts on military aviation and radar are discussed in Section 2.13.

2.14.2.2 Potential impacts during operation

780. **Potential interference with other wind farms 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.

781. **Potential interference with oil and gas operations:** Through the process of site selection of Norfolk Vanguard, the Applicant has sought to avoid existing oil and gas infrastructure. Discussions with owners and operators of the infrastructure immediately adjacent to Norfolk Vanguard have advised that these assets will have been decommissioned by 2020, i.e. prior to operation of the wind farm. Discussions will continue 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).

782. 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.

783. **Physical impacts on subsea cables and pipelines:** If cables require maintenance or replacement, standard industry techniques will 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 out of the EIA.

784. **Impacts on aggregate dredging activities:** Based on known active and licensed areas, there is no spatial overlap of aggregate areas with Norfolk Vanguard and therefore there are limited pathways for impacts upon aggregate dredging activities. Any vessel movement conflicts will be addressed as part of the shipping and navigation assessment (Section 2.11).

785. **Impacts on disposal sites:** As there is no spatial overlap with disposal sites, no impacts are anticipated during the operational phase of Norfolk Vanguard and so the Applicant proposes to scope this out of the EIA.

786. **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 Vanguard, therefore the Applicant proposes to scope this out of the EIA. Impacts on military aviation and radar are discussed in Section 2.13.

2.14.2.3 Potential impacts during decommissioning

787. 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 Vanguard will be mitigated by planning and design. This impact is not therefore considered significant.

2.14.2.4 Potential cumulative impacts

788. Given that the impacts of Norfolk Vanguard on infrastructure and other users will be largely dependent upon physical overlap, non-significant or mitigated to no impact; it is unlikely that there will be pathways for cumulative or in-combination impacts.

2.14.2.5 Transboundary impacts

789. Transboundary impacts will not occur separately from the impacts discussed above as impacts are largely dependent upon physical overlap and no pathways exist for impacts beyond Norfolk Vanguard.

2.14.2.6 Summary of potential impacts

Table 2.29 Summary of impacts relating to infrastructure and other users

Potential impacts	Construction	Operation	Decommissioning
Potential interference with other wind farms development	x	x	x
Potential interference with oil and gas operations	x	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 (×)

2.14.3 Mitigation

790. Where conflicts between Norfolk Vanguard and other infrastructure are identified, owners and operators will be consulted and legal agreements will be put in place.

2.14.4 Approach to assessment and data gathering

791. VWPL will undertake consultation with all relevant developers, operators and marine users within the vicinity of Norfolk Vanguard to ascertain any concerns relating to the project. Any areas of concern will be identified and considered within the EIA.

However, it is likely that any impacts will 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

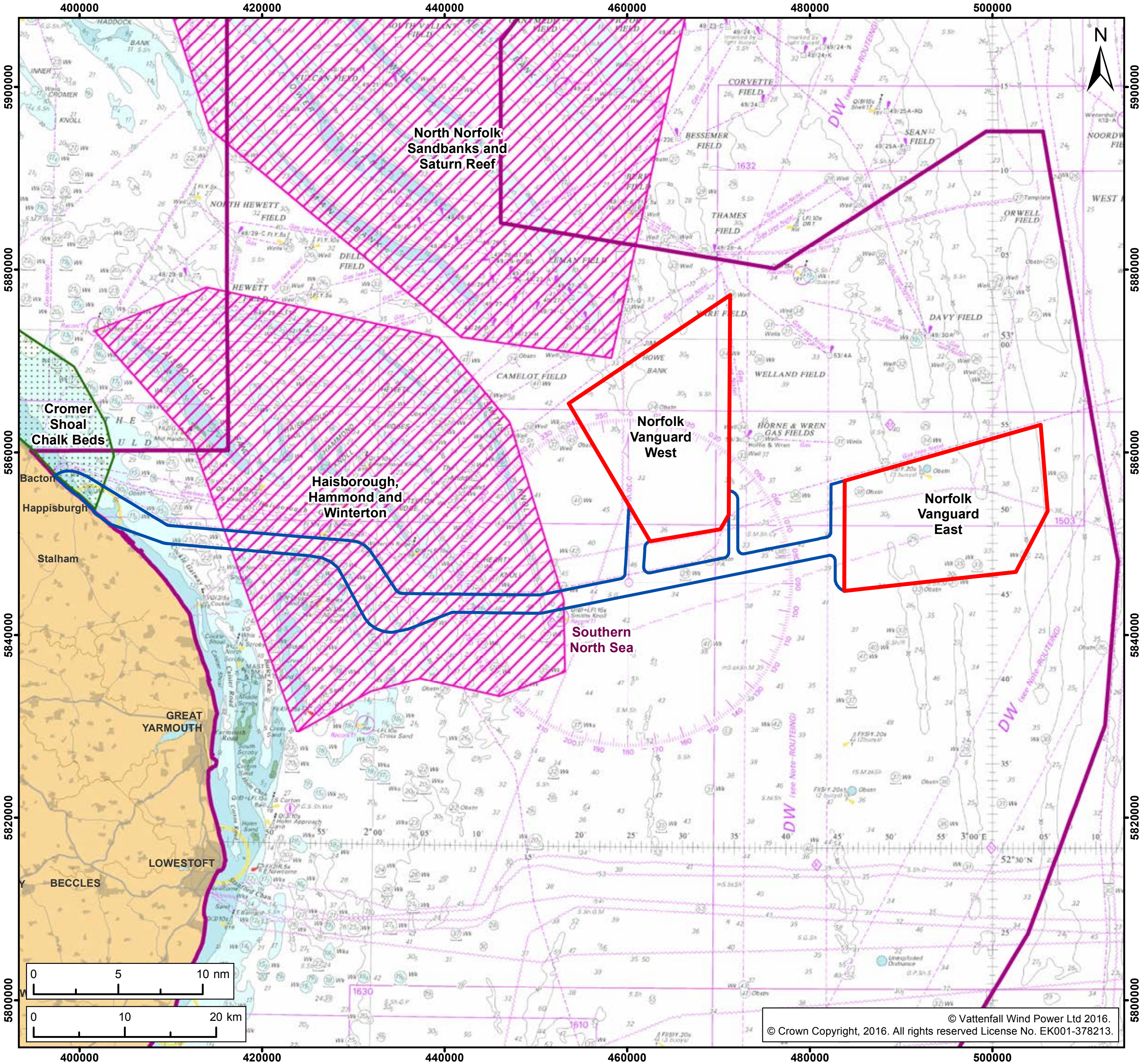
792. As discussed in Section 2.3, the provisional offshore cable corridor runs through the Norfolk East WFD coastal water body (GB650503520003), see Figure 2.4. The North Norfolk WFD bathing waters are approximately 3.1km to the north of the landfall search area around Mundesley and 3.5km south of the landfall search area 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).

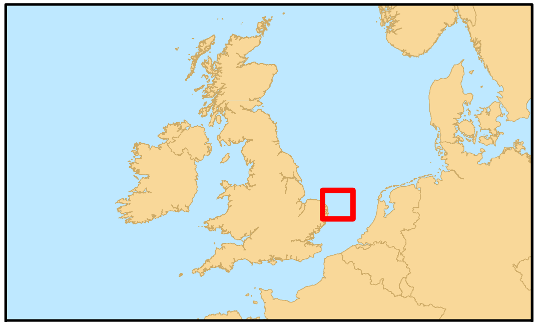
2.15.2 Natura 2000 sites

793. This section provides an overview of Natura 2000 sites designated under the Habitats Directive and Birds Directive (see Section 1.3.3). During the Habitats Regulations Assessment (HRA) Screening for Norfolk Vanguard, 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 Norfolk Vanguard (i.e. those designated for mobile species which may use the offshore project area).

794. Norfolk Vanguard lies within the Southern North Sea pSAC (Figure 2.31). In addition, the offshore cable corridor passes through the Haisborough Hammond and Winterton SCI (Figure 2.31), the Greater Wash Marine pSPA (Figure 2.32) and the Cromer Shoal Chalk Beds MCZ (Figure 2.31).

795. In addition, the potential impacts on EPS (Annex IV of the Habitats Directive) using the project area will be assessed.





Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor

Offshore Designated Sites

- Marine Conservation Zone (MCZ)[1]
- Site of Community Importance (SAC/SCI)[1]
- Possible Special Area of Conservation (pSAC)[1]

[1] Natural England, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Special Areas of Conservation and Marine Conservation Zones in Proximity to Norfolk Vanguard

Figure: 2.31 Drawing No: PB4476-002-2-004

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	JE	GK	A4	1:600,000

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

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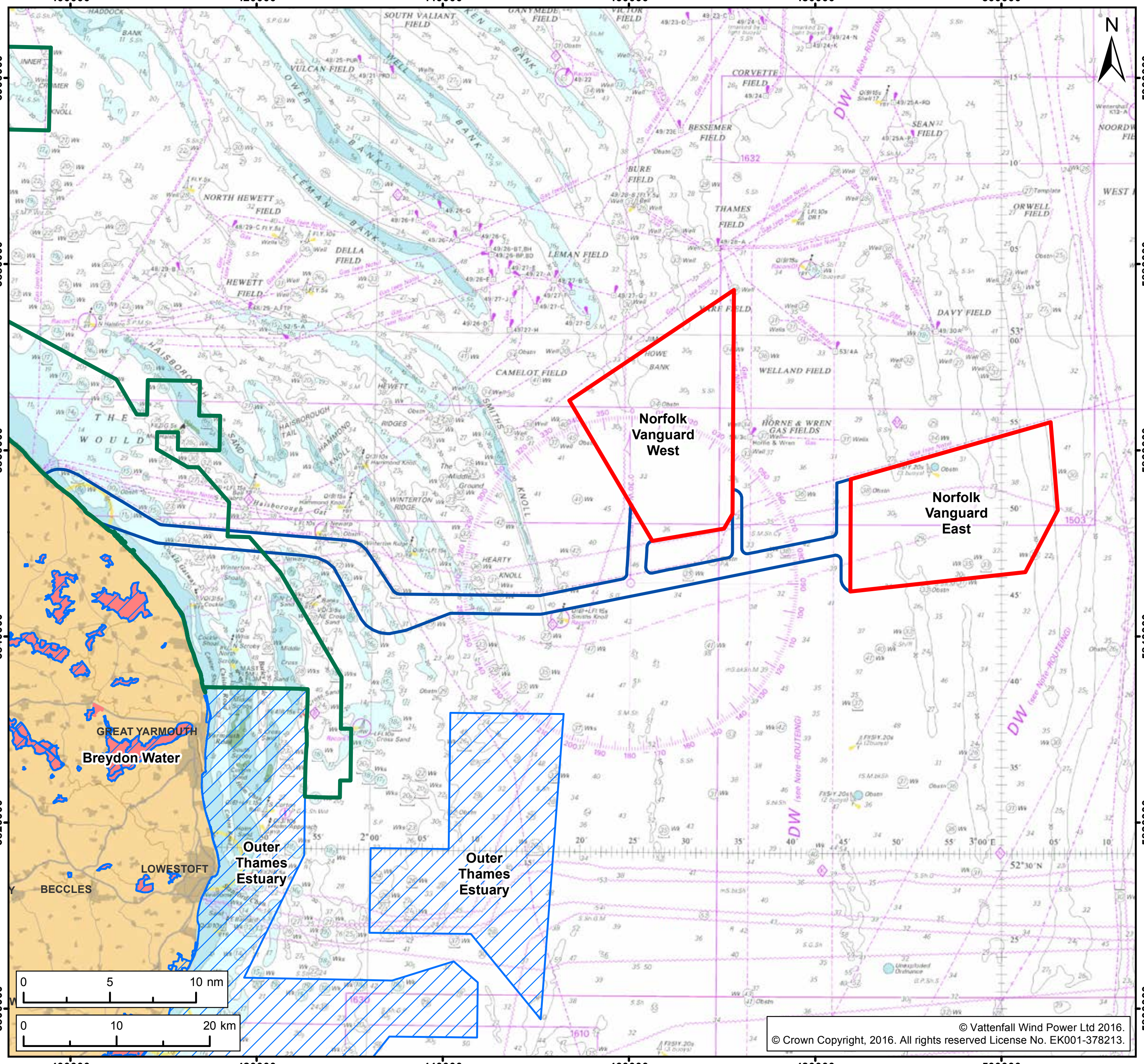

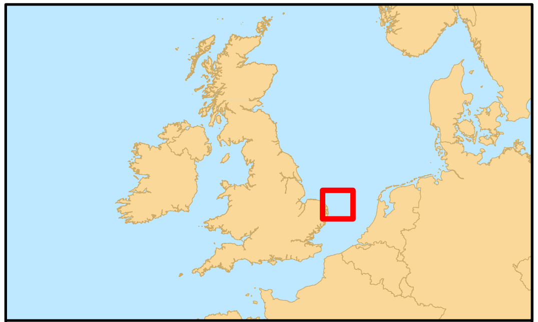

Legend:

- Norfolk Vanguard
- Provisional Offshore Cable Corridor
- Special Protection Areas (SPA)[1]
- Possible Draft Special Protection Area (dSPA)[1]
- Ramsar[1]

[1] Natural England, 2016.

Project: Norfolk Vanguard

Report: Environmental Impact Assessment Scoping Report

Title: Special Protection Areas and Ramsar sites in Proximity to Norfolk Vanguard

Figure: 2.32 | Drawing No: PB4476-002-2-003

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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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

796. 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 SAC 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, 2016).

2.15.2.2 Southern North Sea pSAC

797. The Southern North Sea site is proposed for designation as a pSAC for harbour porpoise. JNCC undertook consultation on the site in 2015, which is has been identified as being within the top 10% of persistently high density areas for harbour porpoise in UK waters (JNCC, 2015b). JNCC (2015b) 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 Vanguard will therefore be based on the harbour porpoise North Sea Management Unit (MU) reference population (IAMMWG, 2015) unless further information becomes available.

2.15.2.3 Greater Wash Marine pSPA

798. 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.

799. 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, 2016b);

- Areas of importance for non-breeding red-throated diver *G. stellata*; and
- Areas of importance for non-breeding little gull *H. minutus*.

2.15.3 Marine Conservation Zones (MCZ)

2.15.3.1 Cromer Shoal Chalk Beds MCZ

800. In January 2016, Cromer Shoal Chalk Beds became a MCZ. 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, 2016) indicates the area of the MCZ which could overlap with the provisional offshore cable corridor may include subtidal chalk as well as subtidal coarse sediment.

2.16 Offshore Inter-relationships

801. The EIA will identify inter-relationships which are likely to result from the construction, operation and decommissioning of Norfolk Vanguard. The inter-relationships relevant to the offshore environment are outlined in Table 2.30.

Table 2.30 Offshore inter-relationships

Offshore Topic	Inter-relationships
Marine Geology, Oceanography and Physical Processes	Will have effects on: • Benthic and Intertidal Ecology • Marine Water and Sediment Quality
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	Is affected by: • Marine Geology, Oceanography and Physical Processes Will have effects on: • Fish Ecology
Fish and Shellfish Ecology	Is affected by: • Marine Water and Sediment Quality • Benthic and Intertidal Ecology Will have effects on: • Commercial Fisheries • Marine mammals
Marine mammals	Is affected by: • Marine Water and Sediment Quality • Fish Ecology • Shipping and Navigation

Offshore Topic	Inter-relationships
Offshore Ornithology	Is affected by: • Fish Ecology
Commercial Fisheries	Is affected by: • Fish ecology • Shipping and Navigation
Shipping and Navigation	Will have effects on: • Marine Mammals • Commercial Fisheries
Offshore Archaeology and Cultural Heritage	Is affected by: • Marine Geology, Oceanography and Physical Processes
Aviation and Radar	N/A
Infrastructure and Other Users	N/A

802. The inter-relationships between receptors (shown in Table 2.30) are incorporated within the impacts identified in Sections 2.2 to 2.14, for example:

- Deterioration in water quality due to increased suspended sediment concentrations (Section 2.3);
- Impacts on benthic ecology as a result of increase suspended sediments (Section 2.6);
- Impacts on fish ecology as a result of increase suspended sediments and smothering (Section 2.7);
- Impacts on marine mammals as a result of impacts on prey species (Section 2.8);
- Impacts on marine mammals as a result of changes to water quality (Section 2.8);
- Vessel Interactions with marine mammals (Section 2.8);
- Impacts on commercially exploited fish and shellfish species (Section 2.10); and
- Increased collision risk for commercial fisheries (Section 2.10).

803. 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 (2012), 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.

804. The approach to offshore inter-relationships will be discussed with relevant stakeholders during the EPP.

2.17 Cumulative and Transboundary Impacts Summary

805. Offshore cumulative and transboundary impacts will be considered as part of the EIA process. The assessment will consider the potential cumulative impacts of Norfolk Vanguard with other proposed wind farms in the former East Anglia Zone which enter the consenting process during the period of the Norfolk Vanguard EIA. At the time of writing these include (Figure 2.33):

- SPR's East Anglia ONE(consented);
- SPR's East Anglia THREE (in determination);
- VWPL's Norfolk Boreas (not yet submitted a request for Scoping Opinion);
- 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).

806. The CIA will also include wider OWFs, 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. Any project with the potential to result in impacts that may act cumulatively with Norfolk Vanguard will be identified during consultation as part of the EPP and following a review of available information.

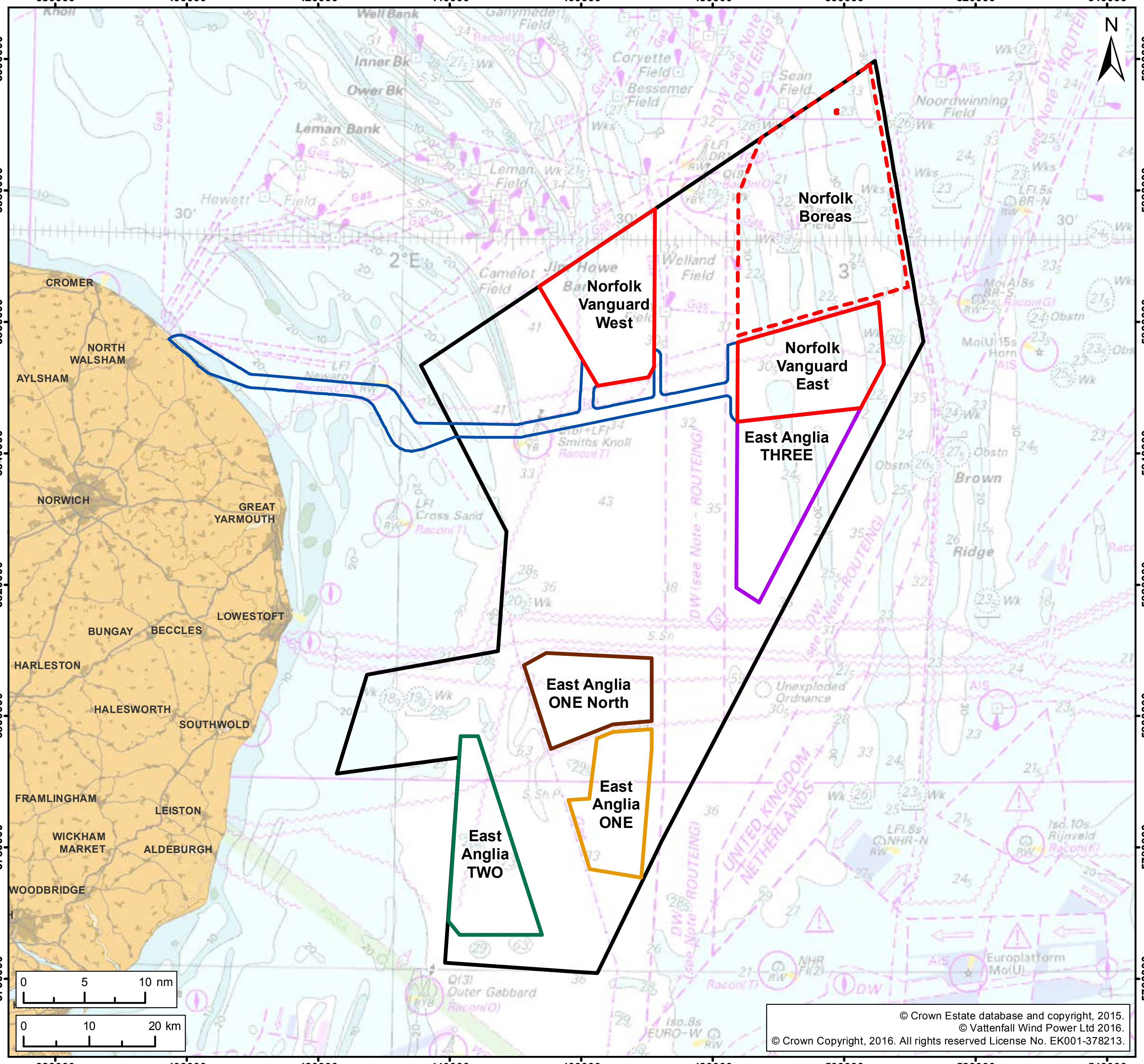
807. The assessment will consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

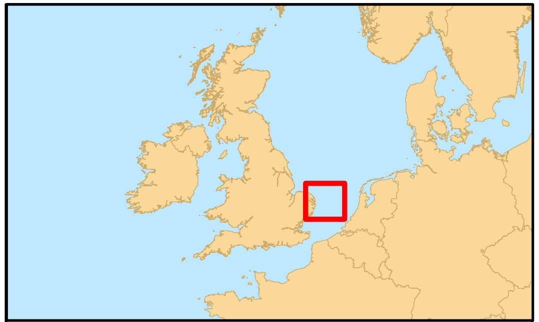
808. Table 2.31 collates the scoping of onshore cumulative impacts discussed in Sections 2.2 to 2.13.3.1.

Table 2.31 Summary of 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

Potential impacts	Construction	Operation	Decommissioning
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





Legend:

- Norfolk Vanguard
- Norfolk Boreas
- Provisional Offshore Cable Corridor
- East Anglia ONE
- East Anglia ONE North
- East Anglia TWO
- East Anglia THREE
- former East Anglia Zone

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Offshore Wind Farms in the former East Anglia Zone

Figure: 2.33 Drawing No: PB4476-002-2-055

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
04	16/09/16	AB	GK	A4	1:850,000
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Co-ordinate System: ETRS 1989 UTM Zone 31N **EPSG:** 25831

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3 PART 3: ONSHORE

3.1 Introduction

809. This section presents the main baseline characteristics of the environment within the onshore scoping area (which includes the landfall search area, cable relay station search area, onshore cable search area and substation search area) as well as the surrounding areas where relevant to each receptor. The potential impacts of Norfolk Vanguard during construction, O&M, and decommissioning are considered. Where there is no pathway for a potential impact, impacts are proposed to be scoped out and not considered further within the EIA process. Where impacts are proposed to be scoped out, these are clearly identified within the relevant section of this Scoping Report. Where impacts are proposed to be scoped in to the EIA, an overview of the approach to the EIA is provided along with potential mitigation measures.

810. The following questions are suggested for consideration while reviewing each onshore section and providing responses for inclusion in the Scoping Opinion:

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

Q6. Is there any further guidance relating to each topic that we should be aware of? If so, please provide details.

Q7. Do you agree with the proposed extent of the study area for the individual topic? If not, please provide details.

Q8. Please tell us your comments for each topic regarding the search areas and sectors for the following project infrastructure:

- ***Landfall search area (Figure 1.3)***
- ***Substation search area (Figure 1.4),***
- ***Cable corridor search area (Figure 1.5); and***
- ***Cable relay station search area (Figure 1.6).***

3.2 Ground Conditions and Contamination

3.2.1 Baseline

3.2.1.1 Data sources

811. The data sources used to inform the ground conditions and contamination baseline are shown in Table 3.1 below.

Table 3.1 Data sources

Source no.	Data	Source	Date
1	Geology	British Geological Survey (BGS) online viewer: www.mapapps.bgs.ac.uk	2016
2	Hydrogeology: groundwater vulnerability, groundwater Source Protection Zones (SPZs), abstractions	Environmental Agency, What's in your back yard website: www.environment-agency.gov.uk	2016
	Landfills and mining		
3	Water Framework Directive (WFD) Classification	Environmental Agency (2016) Catchment Data Explorer: www.environment.data.gov.uk /catchment-planning/	2016

812. Any additional data sets will be identified through feedback from stakeholders following this Scoping Request.

3.2.1.2 Geology

813. The British Geological Survey (BGS) online viewer shows that the solid geology beneath the onshore scoping area (as shown in Figure 1.2 and explained in more detail in Section 1.5) compromises White Chalk and Crag Group deposits which dip gently to the south east. The solid deposits are overlain predominantly by glacial till dating from the Anglian glaciation, interspersed with sheets of glacial sands and gravels.

3.2.1.3 Hydrology

814. Surface water features within the onshore scoping area are described in Section 3.4.

3.2.1.4 Hydrogeology

815. The Crag and the Chalk aquifers are classified as Principal Aquifers by the Environment Agency. The superficial deposits are classified as Secondary A, B and undifferentiated aquifers.

816. The Environment Agency groundwater vulnerability maps indicate the onshore scoping area is located within an area of high groundwater vulnerability (overlying a permeable aquifer). This indicates soils which may be able to transmit a wide range of pollutants into any groundwater stored in the underlying strata.

817. The onshore scoping area is located on the Broadland Rivers Chalk and Crag groundwater body (GB40501G400300). This groundwater body has been classified by the Environment Agency as being of Poor Quantitative status and Poor Chemical status (Water Framework Directive (WFD) water classification status). The Poor Quantitative and Chemical status is attributed to impacts from agriculture.

818. The solid and superficial aquifers support a number of licensed and private water supplies. Furthermore, there are a number of groundwater Source Protection Zones (SPZs) within the onshore scoping area.

3.2.1.5 Land quality

819. The coastal area is developed and notably includes the industrial Bacton Gas Terminal site, however the majority of the onshore scoping area is largely agricultural. There is the potential for both diffuse and point sources of pollution to be present in relation to current agricultural activities.

820. 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 historical contamination to be present in the developed areas e.g. Bacton Gas Terminal, historic and active landfill sites, railways and highways, infilled quarries and sand and brick pits.

3.2.1.6 Designated geological sites

821. Happisburgh Cliffs Site of Special Scientific Interest (SSSI) is designated specifically for its geological interest. It is important both for the cliff exposures which uniquely show three glacial deposits, the Cromer Tills (of Anglian age) with intercalated waterlain sediments, and for the underlying Cromer Forest-bed Formation, exposed in the foreshore, with excellent development of pre-Pastonion and Pastonian sediments.

3.2.2 Potential impacts

3.2.2.1 Potential impacts during construction

822. The excavation of the cable trench and soil/spoil handling procedures, and the excavation and stockpiling of soils has the potential for mobilisation of contaminants which could result in potential human health impacts to construction workers and pollution risks to controlled waters. These potential impacts are discussed in more detail below.

823. It is anticipated that potential risks to human health from ground contamination will be avoided by the use of appropriate Personal Protective Equipment (PPE) and by adopting appropriate working practices. Furthermore, any potential risk to controlled waters will be avoided by adopting appropriate working practices. Other mitigation measures will be adopted if any other impacts are identified on further stages of the assessment.

824. A Code of Construction Practice (CoCP) will be employed during site works to ensure that all appropriate Pollution Prevention Guidelines (PPG)[17] and good practice guidelines are followed.

825. Sensitive locations identified along the route will be avoided by the use of HDD techniques where appropriate and practicable.

3.2.2.2 Potential impacts during operation

826. There are unlikely to be any significant impacts from the operation of the proposed project. O&M activities will follow standard procedures therefore minimising any potential impacts. Non-routine maintenance will be subject to robust and effective planning and risk assessment procedures.

3.2.2.3 Potential impacts during decommissioning

827. 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. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected the onshore cables will be removed from ducts and recycled, with the transition pits and ducts left *in situ*.

[17] Pollution Prevention Guidance (PPG) documents were withdrawn on 17 December 2015 as the Environment Agency does not provide ‘good practice’ guidance. However, the PPG are still relevant and provide examples of best practice measures which will be taken into consideration.

828. 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.

829. It is anticipated that the decommissioning impacts will be similar in nature to those of construction.

3.2.2.4 Potential cumulative impacts

830. 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 Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

831. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

832. Cumulative impacts as a result of the works required by National Grid to connect Norfolk Vanguard to the existing Necton 400kV National Grid Substation will be included as part of this assessment.

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
Ground Conditions and Contamination	✓	×	✓
Human health(construction workers)	✓	×	✓
Human health(residents)	✓	×	✓
Surface water	✓	×	✓
Groundwater	✓	×	✓
WFD groundwater bodies	✓	×	✓
Designated geological sites	✓	×	×
Cumulative impacts	✓	✓	✓

scoped in (✓) and scoped out (×)

3.2.3 Mitigation

833. At this stage, no additional mitigation measures are expected to be needed beyond those embedded in the design of the proposed project.

834. Embedded mitigation is likely 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. HDD at sensitive points); and
- Development and compliance of a CoCP. A draft CoCP will be submitted as part of the DCO.

3.2.4 Approach to assessment and data gathering

835. For the purposes of the assessment, the study area for obtaining relevant information for direct impacts to land quality will be up to a 500m buffer along the cable route and up to a 1km buffer for the substation and cable relay station site.

836. The approach and methodologies to be used within the assessment will be in accordance with the guidance contained within CLR 11: Model Procedures for the Management of Land Contamination (Defra and the Environment Agency, 2004).

837. The assessment will support the ES and will include the following aspects:

- Completion of a contaminated land Phase 1 desk-based study and walkover; and
- Development of Conceptual Site Model (CSM).

838. 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.

3.3 Air Quality

3.3.1 Baseline

3.3.1.1 Data sources

839. The data sources used to inform the air quality baseline are listed below:

- Defra – Interactive Air Quality Management Area Boundaries map (Defra, 2016a)
- Local Air Quality Management (LAQM) reports from North Norfolk, Broadland and Breckland District Councils.

840. Any additional data sets will be identified through feedback from stakeholders following this Scoping Request.

3.3.1.2 Baseline

841. 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 13km from the closest point of the considered onshore scoping area.

842. As the locations of the proposed cable route, landfall, substation and cable relay station are not yet defined, identification of specific sensitive receptors was not conducted as part of this Scoping Request. Depending on the infrastructure layout and proposed HGV haul routes, receptors may include both human and sensitive statutory designated ecological habitats. It is expected that sensitive receptors will include:

- 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; and
- Ecological receptor locations sensitive to dust within 50m of the proposed construction phase activities.

3.3.2 Potential impacts

3.3.2.1 Potential impacts during construction

843. The potential impacts associated with the construction phase of the proposed project 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 $PM_{2.5}$).

844. Dust emitted by construction activities has the potential to cause nuisance at nearby receptors, such as residential properties through:

- Soiling of surfaces; and
- Effects on human health through fine particulate matter.

3.3.2.2 Potential impacts during operation

845. The potential impacts during the operational phase of the development are likely to be negligible. Operation of the proposed built infrastructure (the substation and cable relay station) and maintenance activities will not lead to a significant change in vehicle flows within the study area.

846. 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

847. 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. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected the onshore cables will be removed from ducts and recycled, with the transition pits and ducts left *in situ*.

848. 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.

849. It is anticipated that the decommissioning impacts will be similar in nature to those of construction.

850. The decommissioning phase of Norfolk Vanguard 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

851. 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 Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

852. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

853. Cumulative impacts as a result of the works required by National Grid to connect Norfolk Vanguard to the existing Necton 400kV National Grid Substation will be included as part of this assessment.

3.3.2.5 Summary of potential impacts

Table 3.3 Summary of impacts relating to air quality

Potential impacts	Construction	Operation	Decommissioning
Increase in traffic based air quality pollutant concentrations – human receptor locations	✓	×	✓
Increase in traffic based air quality pollutant concentrations – ecological habitats	✓	×	✓
Construction dust impacts – human receptors	✓	×	✓
Construction dust impacts – ecological habitats	✓	×	✓
Cumulative impacts	✓	×	✓

scoped in (✓) and scoped out (×)

3.3.3 Mitigation

854. Embedded mitigation is likely to include the following:

- Construction and decommissioning works would be undertaken in accordance with best practice measures and proportional to the likely impacts; and
- An Air Quality Management Plan would be developed as part of the CoCP.

855. 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

856. Baseline air quality conditions will be assessed by evaluation of the most recent Local Air Quality Management (LAQM) reports published by North Norfolk, Broadland and Breckland District Councils. The assessment will also consider the air pollution background concentration maps published by Defra.

857. A risk based approach will be used to assess the impacts of construction activities. The assessment will be carried out in accordance with guidance provided by the Institute for Air Quality Management (IAQM) in the 'Guidance on the Assessment of Dusts from Demolition and Construction, February 2014' document. The dust assessment will also define the suitable level of mitigation required based upon the risk of dust impacts.

858. An initial screening assessment will be conducted to determine positions where detailed assessment of road traffic emissions is required. The assessment will use the screening criteria provided in IAQM & Environmental Protection UK (EPUK), Planning for Air Quality (2015) guidance to determine where detailed assessment of road traffic emissions is required. The technical approach to the air quality

assessment will be in accordance with Defra (2016b), Local Air Quality Management Technical Guidance.

859. 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.

3.4 Water Resources and Flood Risk

3.4.1 Baseline

3.4.1.1 Data sources

860. The data sources used to inform the water resources and flood risk baseline are listed below:

- Environment Agency's Flood Map for Planning;
- Environment Agency's Risk of Flooding from Surface Water;
- Environment Agency's Risk of Flooding from Rivers and Sea; and
- Environment Agency's Catchment Data Explorer for WFD River Basin Districts Management Catchments, Operational Catchments and WFD water bodies.

861. Any additional data sets will be identified through feedback from stakeholders following this Scoping Request.

3.4.1.2 Groundwater

862. Regionally, the principle 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 SPZs are identified within the area, with both inner and outer zones of the SPZs extending across the eastern section of the cable route.

863. There are small sections of the onshore scoping area close to the coast, north of North Walsham that is underlain by the North Norfolk Chalk groundwater body; and to the far west of the onshore scoping area that are underlain by the North Norfolk Chalk and North West Norfolk Chalk groundwater bodies.

3.4.1.3 Surface water

864. The onshore scoping area encompasses river systems with associated canal networks and lakes. Due to their catchment size, width of channel and designations, the principal watercourses of interest are the Rivers Bure and Wensum (the River Wensum is designated as SSSI and SAC).

865. In addition, there are a number of smaller watercourses within the onshore scoping area. These watercourses (and their waterbody IDs) include (but are not limited to):

- East Ruston Stream (GB105034055670);
- North Walsham and Dilham Canal (disused) (GB105034055710);
- King's Beck (GB105034055730);
- Scarrow Beck (GB105034055740);
- River Bure (GB105034055690 & GB105034050932);
- Mermaid Stream (GB105034050900);
- Hevingham Watercourse (GB105034050870);
- River Wensum (GB105034051111 & GB105034055881);
- Swannington Beck (GB105034051070);
- Blackwater Drain (GB105034051120);
- Blackwater (Wendling Drain) (GB105034051050);
- Foulsham Tributary (GB105034055850);
- Little Ryburgh Tributary (GB105034055860);
- Wendling Beck (GB105034051020); and
- Nar Upstream of Abbey Farm (GB105033047791).

866. There are a large number of agricultural drainage channels that are unnamed and due to the number within the onshore scoping area cannot be individually listed here. Agricultural drainage will be considered as part of the impact assessment and are also considered separately within Section 3.5.

867. Environment Agency flood zone maps (Environment Agency, 2012) 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 as having a less than 1 in 1,000 annual probability of river flooding (<0.1%). However, any onshore infrastructure located closer to the main rivers of the River Bure and the River Wensum and their tributaries (as identified above) have a higher risk of flooding (up to Flood zone 3 - high risk of flooding), as identified in Figure 3.1.

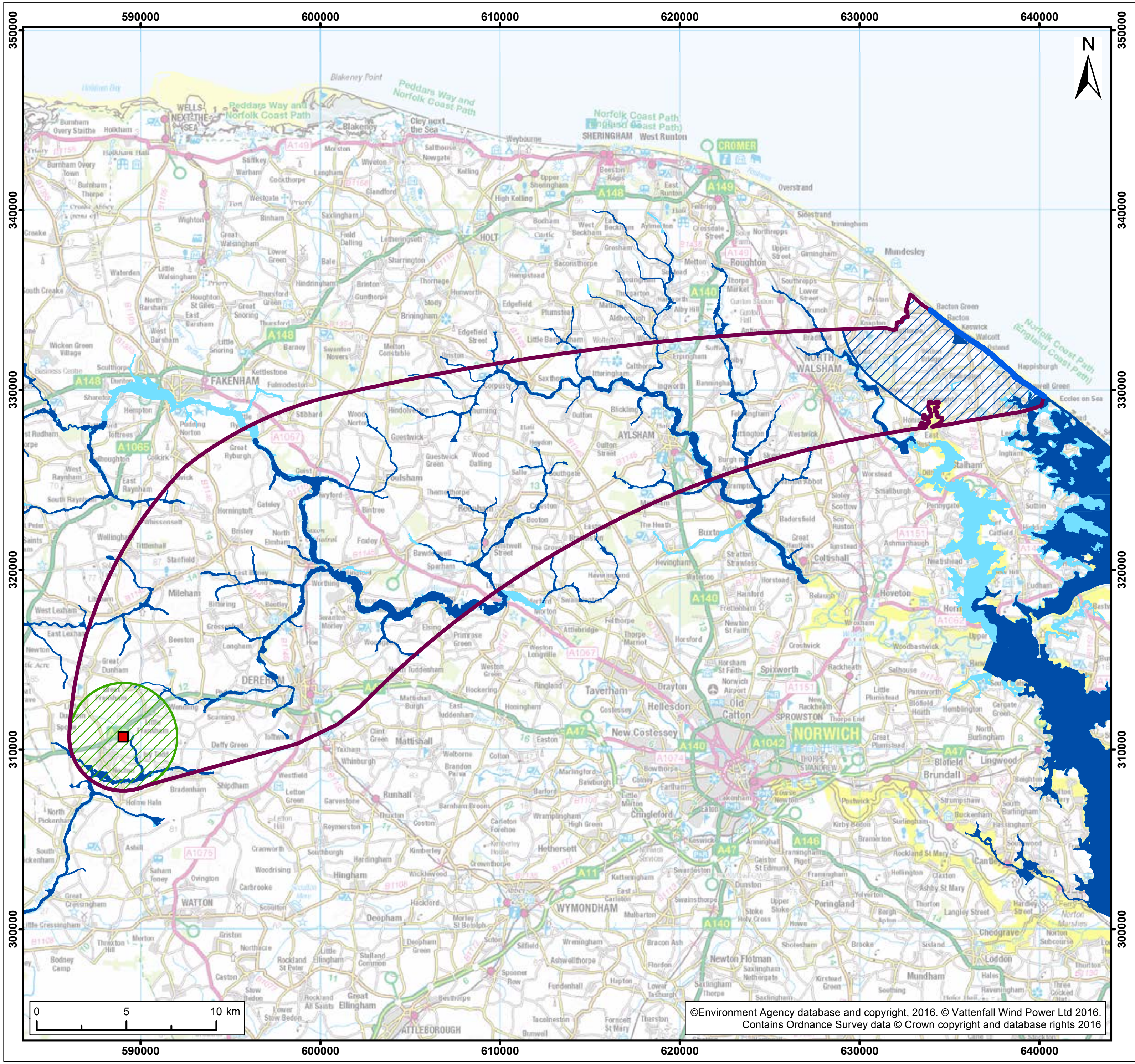
868. Figure 3.2 shows the location of the WFD water bodies within the onshore scoping area. It is necessary to undertake an assessment of the implications of the proposed project on the current and future potential status of water bodies classified under the WFD.

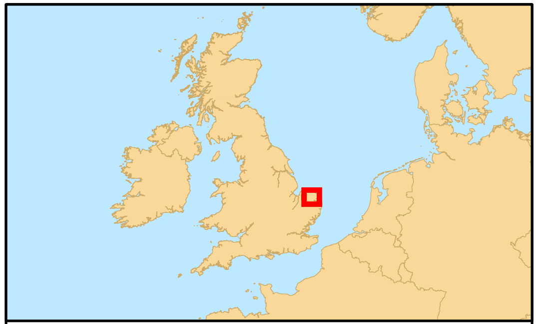
869. Water bodies are selected for inclusion in the initial screening stages of the WFD compliance assessment using the following criteria:

- All surface water bodies that could potentially be directly impacted by the scheme (i.e. those within the project footprint);

- Any surface water bodies further upstream that have direct connectivity and could potentially be affected by the proposed works;
- Any surface water bodies downstream that have direct connectivity and could potentially be affected by the proposed works; and
- Any groundwater bodies that underlie the proposed project.

870. The water bodies listed above are identified in the proposed onshore scoping area and are listed within the River Basin Management Plan Cycle 2, Environment Agency (2016c)).





Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Landfall Search Area
- Cable Relay Station Search Area
- Substation Search Area
- Flood Zone 3
- Flood Zone 2

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Flood Zones

Figure: 3.1 | Drawing No: PB4476-002-2-039

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	26/08/16	JE	RH	A4	1:300,000

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

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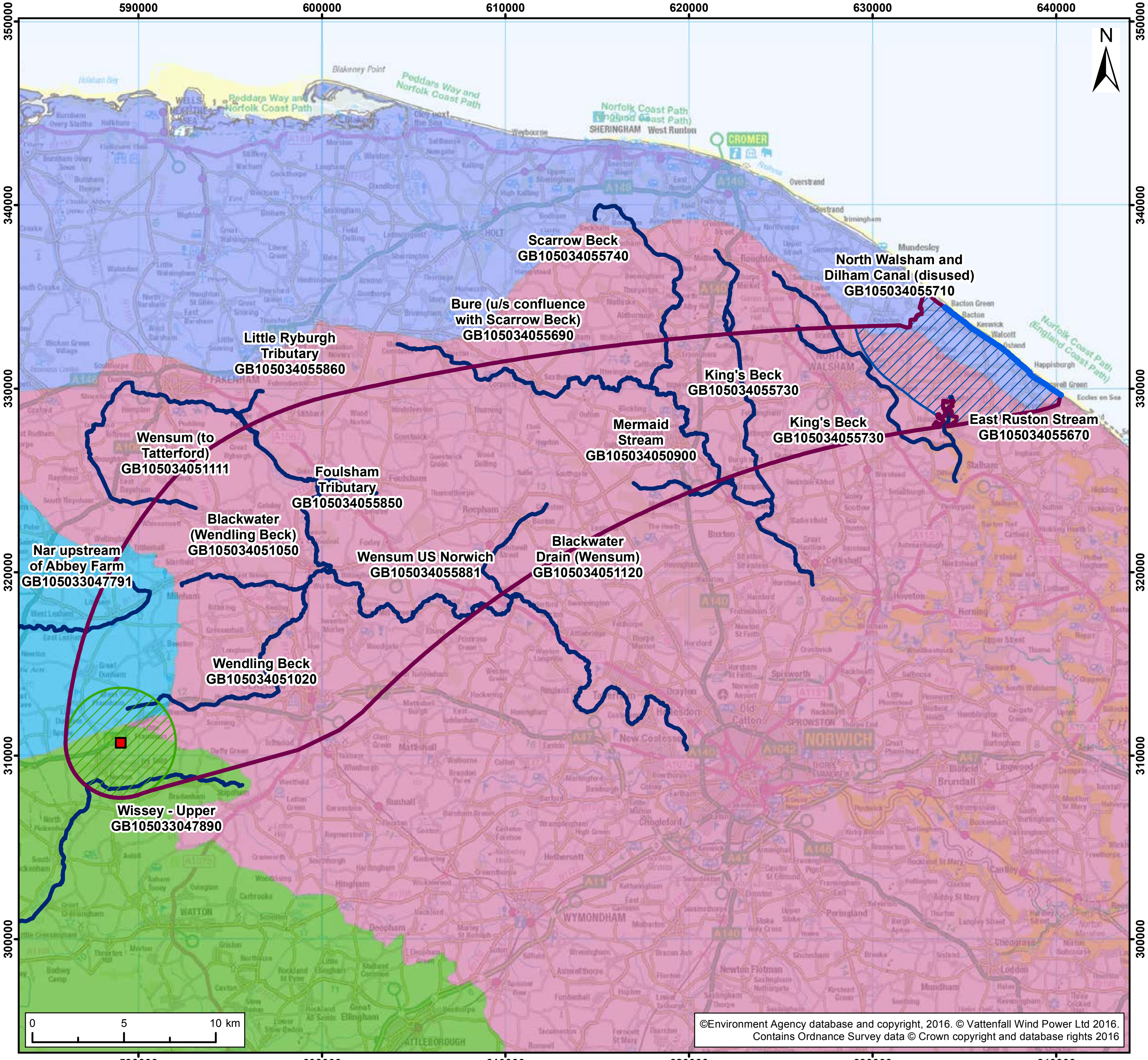

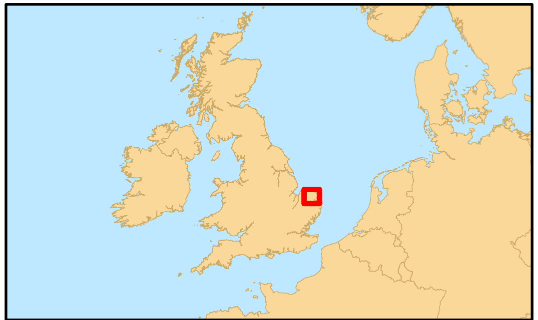

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Landfall Search Area
- Cable Relay Station Search Area
- Substation Search Area
- WFD Fluvial Waterbody

WFD Groundwater body

- Broadland Rivers Chalk & Crag
- Cam and Ely Ouse Chalk
- North Norfolk Chalk
- North West Norfolk Chalk

Project: Norfolk Vanguard

Report: Environmental Impact Assessment Scoping Report

Title: Water Framework Directive Waterbodies

Figure: 3.2 Drawing No: PB4476-002-2-039

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	26/08/16	JE	RH	A4	1:300,000

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

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3.4.2 Potential impacts

3.4.2.1 Potential impacts during construction

Water resources

871. Potential water resource impacts of the project arise from disruptions during construction and O&M which may result in changes in the supply of groundwater and surface water resources. Impacts may also arise as a result of changes in the distribution network (drainage) required in order to facilitate the installation and maintenance of the cable route.

872. Construction activities with the potential to disturb the local water resources are outlined as follows:

- Removal of impermeable superficial deposits and surface cover could increase the potential for erosion of soil particulates discharging to water resources.
- Spills and leaks of contaminants directly into surface waters could adversely affect the water quality and chemical and ecological status of surface water features.
- The requirement may exist to dewater excavations when rainfall or surface water runoff has to be removed or shallow perched groundwater is encountered. There is the risk that dewatering of trenches may lead to the discharge of potentially contaminated water or sediment laden runoff entering nearby surface watercourses or surface water features.
- Soil compaction by construction vehicles and creation of trench and buried concrete jointing pits has the potential to alter or remove surface drainage routes unless formally reinstated or undertaken sensitively.

873. Potential impacts on water bodies will be largely focussed at points where the cable route crosses main rivers and drainage channels. Such impacts on larger water bodies may be mitigated through the use of sensitive construction methodologies for example the use of a trenchless crossing method, such as HDD. This has the potential to reduce the impacts to surface watercourses, the level of reinstatement required and the amount of waste spoil produced. However, there is still the risk that bentonite used as part of the HDD process could pollute surface watercourses.

874. For drainage channels and smaller watercourses an open-cut and fill approach to lay cables underneath the bed level will be used wherever possible. As this will involve working in water, there is the potential for surface waters to be impacted by:

- The input of sediment;
- The crossing of vehicles; and
- Spillages of fuel, oil, chemicals and concrete.

875. Cement based products, such as concrete and grout can be highly alkaline and corrosive and can have a detrimental effect upon water quality and fish. If the material entered the river, there is the risk that aquatic vegetation could be smothered and any contaminants which could be present in river bed sediments potentially mobilised.

876. A CoCP will be employed during site works in line with the relevant CIRIA guidance c649 'Control of water pollution from linear construction projects site guide' to ensure that all appropriate good practice guidelines are followed e.g. regarding silt management, chemicals and solvents and waste materials. Reference will be made to the PPG[18] which contains a mix of regulatory requirements and good practice advice.

Flood risk

877. The construction works may include diversion/over-pumping works and/or use of open-cut techniques. These works may have a temporary impact on watercourses, drainage infrastructure and as a result have an effect on the associated flows and flood risk.

3.4.2.2 Potential impacts during operation

Water resources and flood risk

878. The change in land use as a result of the permanent above ground infrastructure, such as the substation and cable relay station, has the potential to result in increased flood risk during operation.

879. The change in use from existing greenfield agricultural use would create an increase in impermeable area at the substation site and cable relay station site. Whilst permeable surface treatments will 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. The impermeable area is likely to result in increased surface water runoff from developed areas which could cause an increase in flood risk elsewhere. It would be necessary, therefore, to include measures to mitigate this risk. These measures could include use of swales and attenuation basins in order to limit post-development runoff rates to the existing greenfield rates. The drainage strategy for the proposed project should also account for the existing drainage strategy for the wider area, and how the drainage for the substation and cable relay buildings would interface with that wider strategy.

[18] Pollution Prevention Guidance (PPG) documents were withdrawn on 17 December 2015 as the Environment Agency does not provide 'good practice' guidance. However, the PPG are still relevant and provide examples of best practice measures which will be taken into consideration.

880. It is understood that levelling activities may be required in order to create a development platform for the substation and cable relay station. The levelling proposals would need to ensure that the site can be adequately drained and also that the site does not cause an increase in flood risk elsewhere through, for example, blocking existing overland flow routes.

3.4.2.3 Potential impacts during decommissioning

881. 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. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected the onshore cables will be removed from ducts and recycled, with the transition pits and ducts left *in situ*.

882. 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.

883. It is anticipated that the decommissioning impacts will be similar in nature to those of construction.

3.4.2.4 Potential cumulative impacts

884. 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 Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

885. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

886. Cumulative impacts as a result of the works required by National Grid to connect Norfolk Vanguard to the existing Necton 400kV National Grid Substation will be included as part of this assessment.

3.4.2.5 Summary of potential impacts

Table 3.4 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 (×)

3.4.3 Mitigation

887. 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. HDD to directionally drill under water bodies and other sensitive receptors); and
- Development of a CoCP.

888. 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 any of the appropriate Internal Drainage Boards across the proposed cable route.

889. 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

890. 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 and consultation with relevant statutory consultees (Local Authority LLFA, Environment Agency, Natural England and the appropriate Water Authority).

891. 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.

892. A Flood Risk Assessment (FRA) would also be undertaken in accordance with the NPPF to assess the flood risk 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 the proposed development is likely to cause deterioration in the WFD status of any water bodies.

893. 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. Initially the compliance assessment would consist of five steps, in accordance with the Environment Agency's internal guidance on assessing new modifications for compliance with WFD (NEAS Operational Instruction 488_10) (Environment Agency, 2010c):

- Initial screening of impacts: once the water bodies that could potentially be affected have been identified, a preliminary compliance assessment would be undertaken that considers the potential for non-temporary impacts, cumulative impacts or impacts on critical or sensitive habitats. Using Defra's Expert Assessment of Flood Risk Management Impacts guidance (2009) the potential impacts of the proposed project on the biological, hydromorphological and physico-chemical quality elements of each water body would be considered. Whether the scheme is likely to cause deterioration in water body status would then be determined. Water bodies can be screened out of further assessment if it can be satisfactorily demonstrated that there would be no non-temporary impacts resulting in WFD non-compliance. If impacts are predicted, it would be necessary to undertake a detailed compliance assessment.
- Detailed compliance assessment: Based on professional judgement it is likely that impacts on surface water and groundwater bodies can be expected. Therefore it would be necessary to undertake a detailed WFD compliance assessment. This would comprise:
    - An assessment of whether the predicted impacts are considered to have a significant non-temporary effect on the status of one or more WFD quality element.
    - Investigating and designing potential measures to avoid the potential impact or achieve improvement.
    - An assessment to determine whether the cost of any proposed measures is disproportionate, if required.

894. As part of the application the assessment will consider:

- Detailed appraisal of river crossings (as required by the Water Resources Act (1991)); and
- Any works within nine metres of a flood defence will require Flood Defence Consent.

895. 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.

3.5 Land Use

3.5.1 Baseline

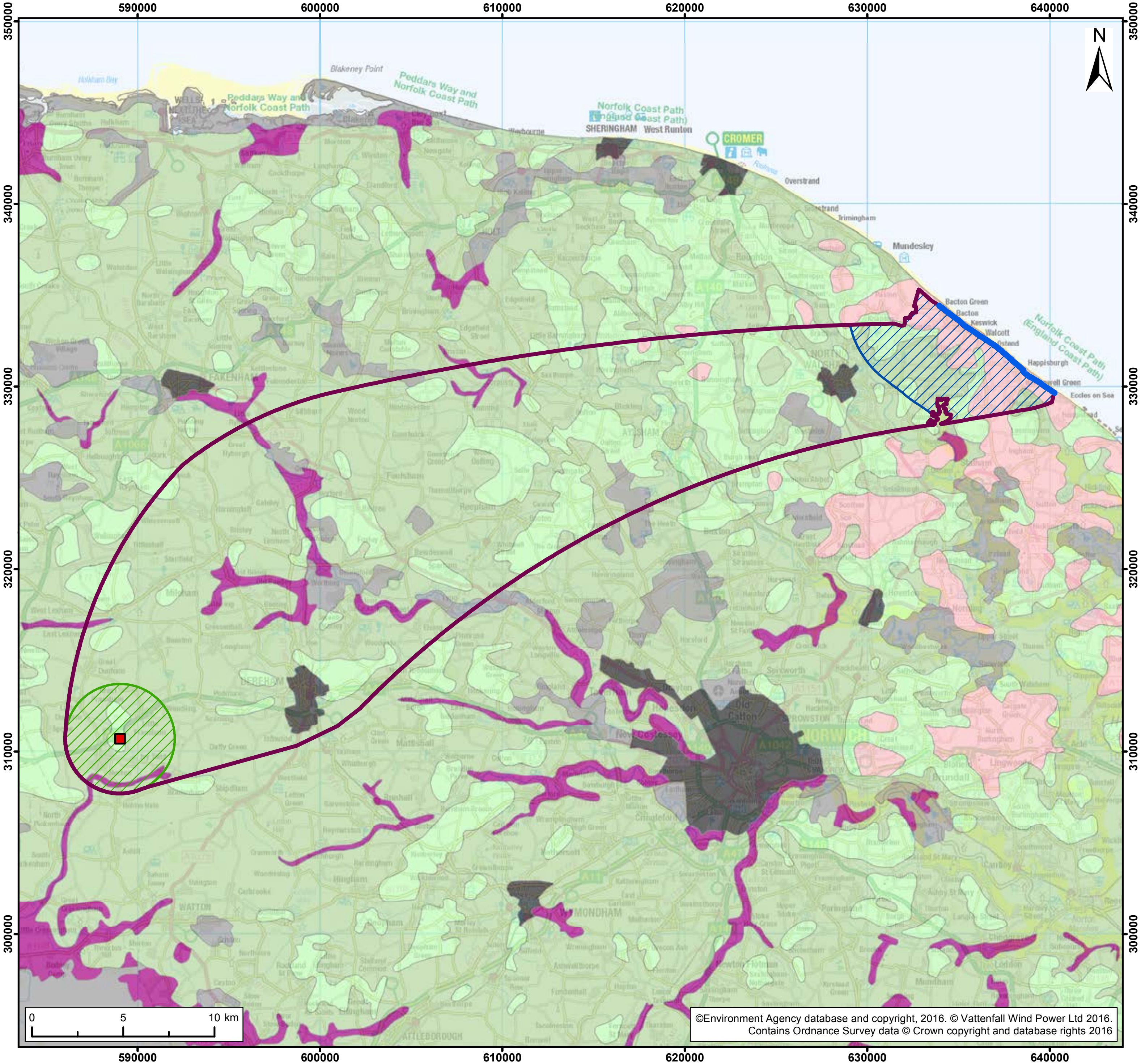
3.5.1.1 Data sources

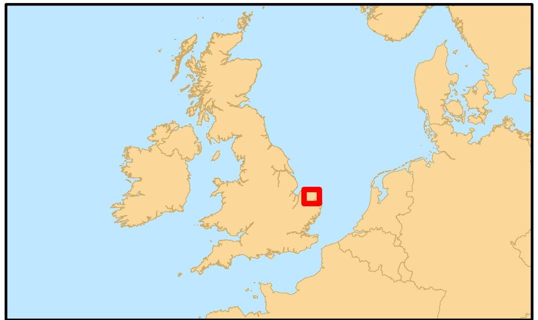
896. The data sources used to inform the land use baseline are listed below:

- Ordnance Survey (2016) ‘A’ Roads, Railway Lines and Urban Areas;
- Natural England (2016) Coastal Paths;
- Natural England (2015) Agriculture Land Classifications;
- Royal HaskoningDHV (2016) Sheringham Shoal and Dudgeon Underground Cables (derived from publically available resources);
- Norfolk County Council (2016) Public Rights of Way (PRoW);
- Sustrans (2015) Regional and National Cycle Routes; and
- National Grid (2015) High Pressure Gas Pipelines.

897. Any additional data sets will be identified through feedback from stakeholders following this Scoping Request.

898. 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. The predominant land use types, including ALC baseline information is shown in Figure 3.3 and networks of PRoW, utilities and roads are illustrated in Figure 3.4 and described for the relevant search areas below.





Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Landfall Search Area
- Cable Relay Station Search Area
- Substation Search Area

Agricultural Land Classification

- Grade 1
- Grade 2
- Grade 3
- Grade 4
- Non-Agricultural
- Urban

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Main Land Use Types

Figure: 3.3 | Drawing No: PB4476-002-2-033

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	05/09/16	AB	RH	A4	1:300,000
01	26/08/16	JE	RH	A4	1:300,000

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

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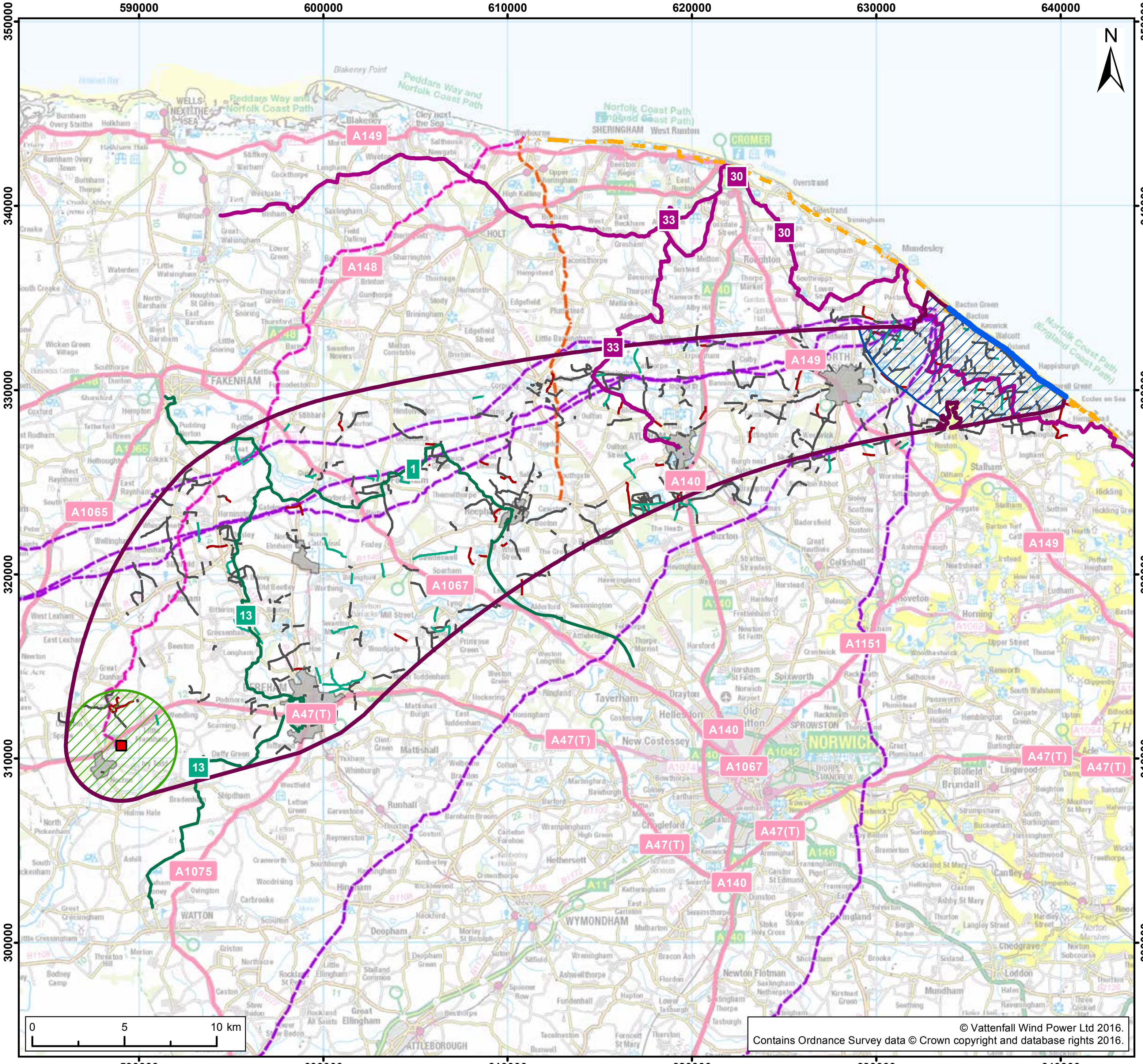

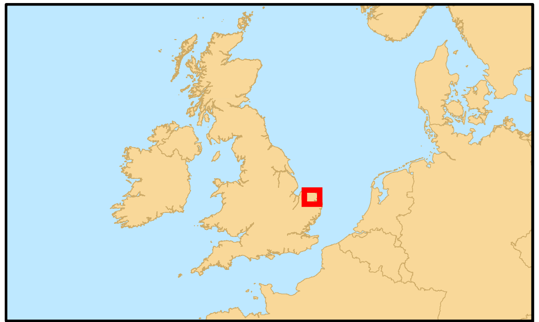

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Landfall Search Area
- Cable Relay Station Search Area
- Substation Search Area
- A Road
- Coastal Path¹

Urban Areas

- Large Urban Area

Cables and Pipelines

- Sheringham Shoal Underground Cable (Indicative)
- Dudgeon Underground Cable (Indicative)
- High Pressure Gas Pipe location²

National Cycle Network³

- Regional Cycle Route selection
- National Cycle Route selection

Norfolk 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: Norfolk Vanguard

Report: Environmental Impact Assessment Scoping Report

Title: PRoWs, Urban Areas, Roads and Utilities

Figure: 3.4 | Drawing No: PB4476-002-2-034

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	05/09/16	AB	RH	A4	1:300,000
01	03/08/16	AB	RH	A4	1:300,000

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

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3.5.1.2 Characterisation of the onshore scoping area

900. The land use in the onshore scoping area is predominantly agricultural with urban areas around the coastal fringe and larger settlements of North Walsham, Aylsham, Reepham and Dereham. There are several patches of ‘non-agricultural’ land, which is comprised of areas of woodland and waterbodies (e.g. rivers, lakes and ponds).

3.5.1.3 Landfall and onshore cable relay station search area

901. The area from Bacton Green to north of Eccles-on-Sea and west towards North Walsham comprises mainly ALC Grade 1 – (excellent quality), and ALC Grade 2 (very good) agricultural land at Happisburgh Common, Ridlington and Knapton. There are some small areas of ALC Grade 3 (good to moderate) at Crostwight, Witton Bridge, Swafield and north and east of North Walsham.

902. The Norfolk Coast Path, other PRoWs and Regional Cycle Route 30 cross the landfall and onshore cable relay station search area.

903. Buried, high pressure gas pipelines run from Bacton Gas Terminal heading overland to the west and south west.

904. There are no large settlements within the landfall and onshore relay substation search area, however there are several villages including Happisburgh, Bacton and Walcott. There are no A-roads in this area, but several local roads, as well as the B1159.

3.5.1.4 Onshore cable corridor search area

905. The onshore cable corridor search area from landfall to the onshore grid connection location at the existing Necton 400kV National Grid Substation crosses all grades of agricultural land, primarily ALC Grade 2 at Sparham, Southgate, Wood Dalling, Oulton Street and Foxley, and ALC Grade 3 in between. There is an area of ALC Grade 1 excellent quality agricultural land south of Erpingham. ALC Grade 4 moderate to poor quality agricultural land is found in corridors along the River Wensum, at Guist, Bittering and Corpusty.

906. There are built up urban areas (North Walsham, Aylsham, Reepham and Dereham), as well as several large waterbodies (River Wensum from Lyng to Great Ryburgh), an army barracks south of Worthing and areas of woodland.

907. The A149, A140 and A1067 cross the onshore cable search area, and there are numerous PRoWs and National Cycle routes 1 and 13.

908. Sheringham Shoal (from Saxthorpe to Cawston) and Dudgeon Offshore Wind Farm underground cables (from Great Ryburgh to Necton) run through the onshore cable search area.

3.5.1.5 Substation search area

909. The substation search area is comprised of ALC Grade 3 – good to moderate quality agricultural land, with some ALC Grade 2 – very good quality agricultural land to the west of Little Fransham and a small area of ALC Grade 4 – moderate to poor quality south of Necton from Bradenham to Necton then running south outside of the onshore scoping area, following the course of the River Wissey.

910. The A47 runs to the North of the substation search area, with National Cycle Route 13 to the east. There are a small number of PRoWs around Great Fransham.

911. There are no large urban areas around the grid connection location at the existing Necton 400kV National Grid Substation, with the closest being Dereham over 10km away. There are several villages and settlements including Necton, Little Dunham and Little Fransham.

912. The Dudgeon Offshore Wind Farm underground cable route comes into the substation search area from the north at Necton.[19]

3.5.1.6 Local planning policies and designations

913. The substation search area falls within Breckland District (approximately from Necton to Lyng), and therefore is within the remit of the Breckland Council (2011) emerging Local Plan 2011-2036. The emerging Local Plan sets out strategic planning policies within Breckland (which replaces the Core Strategy and suit of documents that make up the adopted Local Plan).

914. The onshore scoping area that falls within Broadlands 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).

915. North Norfolk District encompasses part of the cable corridor search area from Banningham to the landfall search area. North Norfolk District Council currently has an Emerging Local Plan 2016-2036, providing the context for development across

[19] At the time of writing, the Dudgeon underground cable is under construction. The cable route construction is due for completion in 2017.

North Norfolk. Within the Local Plan sit the Core Strategy and Site Allocation Plans setting out more detailed, site specific policies.

3.5.2 Potential impacts

3.5.2.1 Potential impacts during construction

Agricultural productivity

916. 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.

Drainage

917. There is potential for an adverse impact to the natural and artificial field drainage systems during construction works.

Disruption to farming practices

918. There is potential for adverse impacts on farming and other land use practices through the temporary loss of land availability, restricted access and disruption caused by working areas and construction traffic.

Temporary closure of PRoWs/cycle paths

919. Closures and alternative routes may be necessary during construction.

Existing utilities

920. During the construction phase, cable installation activity has the potential to impact on water, power and gas infrastructure.

Public health and safety

921. 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

Permanent loss of land

922. The presence of permanent infrastructure at the substation and cable relay station will result in the permanent loss of land including farmland, and therefore also a loss in agricultural productivity of these areas.

Disruption to farming practices

923. There is the potential for farming practices to be restricted due to the presence of cables and access restrictions.

Permanent closure of PRoWs/cycle paths

924. PRoWs or cycle paths in the footprint of the substation have the potential to be permanently closed or redirected, however this will be avoided wherever possible through sensitive siting of onshore infrastructure.

Public health and safety

925. Issues of public concern and health such as EMF arising in relation to buried cables will be considered further in Section 3.11.

Drainage

926. 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 Section 3.4.

Soil heating

927. 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. Any heating effect from the cables is likely to only affect the region immediately adjacent to and directly above the cable system.

3.5.2.3 Potential impacts during decommissioning

928. 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. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected the onshore cables will be removed from ducts and recycled, with the transition pits and ducts left *in situ*.

929. 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.

930. It is anticipated that the decommissioning impacts will be similar in nature to those of construction.

3.5.2.4 Potential cumulative impacts

931. 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 Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

932. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

933. Cumulative impacts as a result of the works required by National Grid to connect Norfolk Vanguard to the existing Necton 400kV National Grid Substation will be included as part of this assessment.

3.5.2.5 Summary of potential impacts

Table 3.5 Summary of impacts relating to land use

Potential impacts	Construction	Operation	Decommissioning
Agricultural productivity	✓	✓	✓
Drainage	✓	✓	✓
Disruption to farming practices	✓	✓	✓
Temporary closure of PRoWs/cycle paths	✓	✓	✓
Existing utilities	✓	×	✓
Public health and safety	✓	✓	✓
Permanent loss of land	×	✓	×
Permanent closure/diversion of PRoWs	×	✓	×
Soil heating	×	✓	×
Cumulative impacts	✓	✓	✓

scoped in (✓) and scoped out (×)

3.5.3 Mitigation

3.5.3.1 Agricultural productivity and drainage

934. Where practical, and consistent with optimal route design, the onshore cable corridor will align with field boundaries. Soils will be handled in accordance with best practice, in order to minimise the risk of 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 the results of pre-construction surveys for the restoration of the potential onshore cable corridor. All drainage systems will be fully reinstated in consultation with landowners and specialist drainage contractors.

3.5.3.2 Disruption to farming practices

935. Embedded mitigation will ensure that where practicable, steps will be taken to avoid creation isolated land parcels, cutting off farm access routes and isolating key assets such as water sources.

936. 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

937. PRoWs will be identified and classified in consultation with the relevant local authorities through the EPP. Any PRoW that may be affected by the proposed project will 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 will be minimised as far as possible.

3.5.3.4 Existing utilities

938. Potential mitigation may be required for the cable route crossings with existing pipelines and cables. Major utilities will 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

939. The cables will be buried to a depth 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 will be managed through the use of construction method statements and management plans.

3.5.3.6 Permanent loss of land

940. Land lost for agricultural use will be extensively consulted on with landowners and the local authorities.

3.5.3.7 Soil heating

941. Detailed design will 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

942. 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.

943. The EIA for land use will identify the likely impacts of Norfolk Vanguard, 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.

944. 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, 2012);
- NE124 – Look after your land with Environmental Stewardship (Natural England, 2012);
- 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.

945. 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.

946. The scope of assessment will also be discussed with the relevant local landowners.

3.6 Onshore Ecology

3.6.1 Baseline

3.6.1.1 Data sources

947. 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.

948. The data sources used to inform this ecological desk-based assessment are shown in Table 3.6.

Table 3.6 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
UK Habitats of Principal Importance	Joint Nature Conservation Committee (JNCC)	2016
Protected species records	Norfolk Biodiversity information Service (NBIS)	2016

949. Any additional data sets will be identified through feedback from stakeholders following this Scoping Request.

3.6.1.2 Baseline

Statutory Designated Sites

950. Table 3.7 lists the 57 statutory designated sites that are located within the onshore scoping area, as shown on Figure 3.5. Table 3.7 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 1.3.

Table 3.7 Designated sites for nature conservation of relevance to onshore ecology

Name	Design-ation	Location (NGR) / size (ha)	Qualifying features/reasons for notification
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*
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** 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

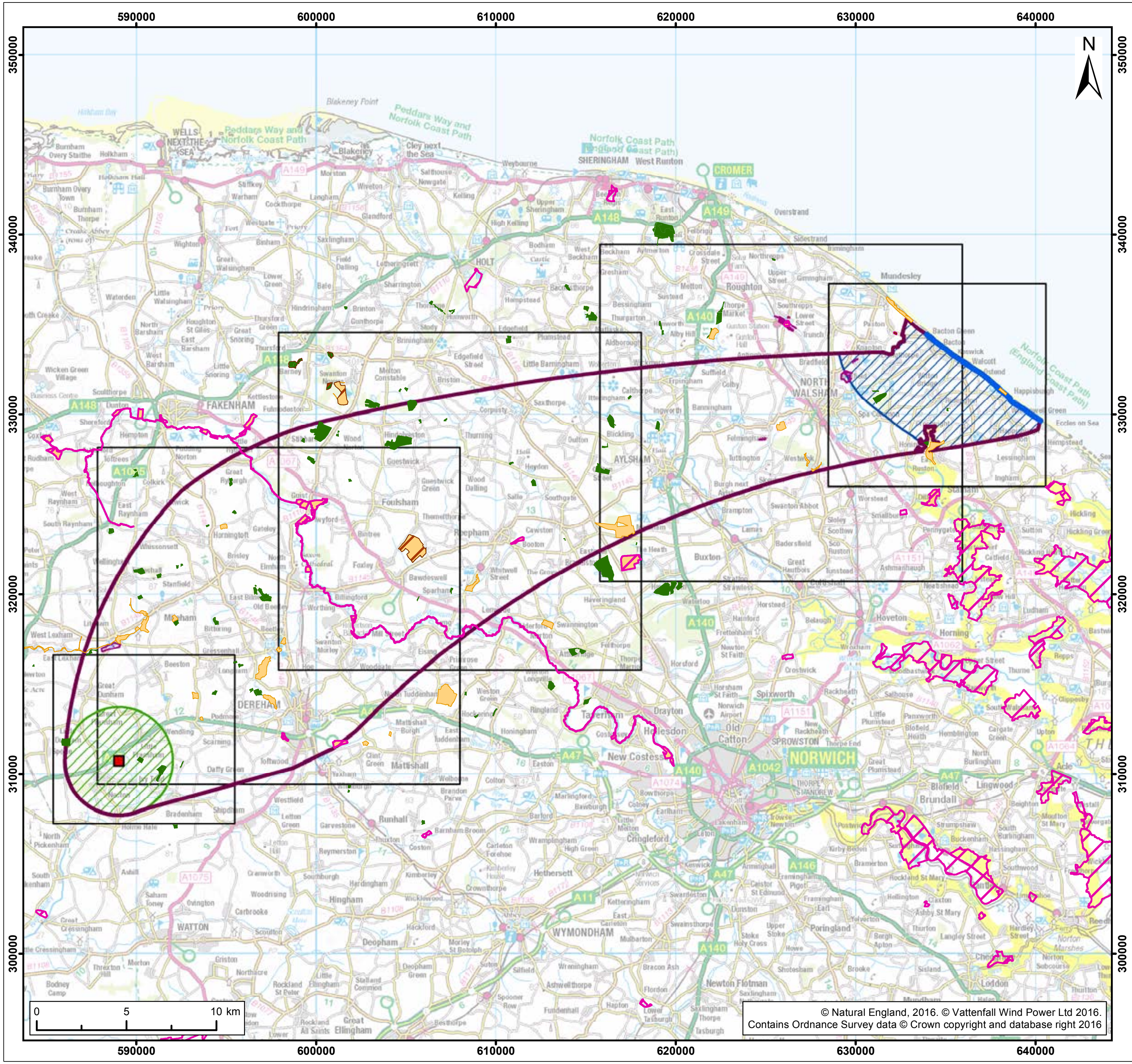
Name	Design-ation	Location (NGR) / size (ha)	Qualifying features/reasons for notification
			corridor, it is probably the best whole river of its type in nature conservation terms, although short stretches of other similar rivers may show a slightly greater diversity of species. ***Key features***: calcareous river habitat, flora, invertebrate assemblage.
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
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
Foxley Wood	SSSI, NNR	TG 056227 122.7	**SSSI** Foxley Wood forms the largest area of ancient woodland now remaining in Norfolk, and includes an unusually 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
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

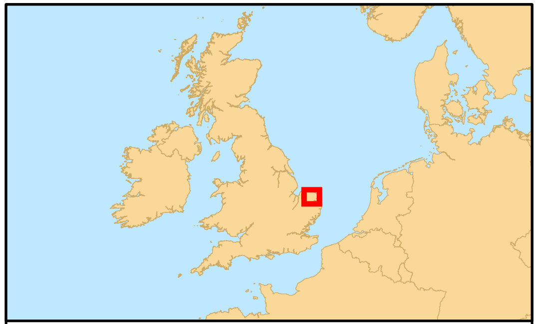
Name	Design-ation	Location (NGR) / size (ha)	Qualifying features/reasons for notification
			the site and an unusual plant community has developed in these conditions, providing a contrast with the majority of the spring-fed fens which are calcareous. There is a very clear zonation of vegetation types 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
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
Horningtoft Wood	SSSI	TF 948238 9.05	Horningtoft Wood is a fragment of a once much larger area of ancient woodland. The wood is situated on a boulder clay plateau and has a structure of coppice-with-standards. A stand-type rare in Norfolk, maple-ash-limewood is present and the ground flora is exceptionally diverse, containing a number of rare and local species. ***Key features***: county-rare maple-ash-limewood woodland habitat
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
River Nar	SSSI	TF 897198 to TF 622184 233.43	The River Nar combines the characteristics of a southern chalk stream and an East Anglian fen river. Together with the adjacent terrestrial habitats, the Nar is an outstanding river system of its type. The River supports extensive areas of inundation community and wetland habitats, including notable flora species and unimproved grassland habitats and alder carr. Breeding bird including snipe, lapwing, redshank, sedge and grasshopper warblers plus kingfisher and sand martin are supported. 12 different species of dragonfly are supported by the habitats of the River Nar. ***Key features***: river habitat, unimproved grassland habitat, alder carr habitat, breeding bird assemblage, dragonfly assemblage
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
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
Cawston and	SSSI	TG 170235	Cawston and Marsham Heaths form the largest area of Heather-dominated heathland now remaining in east Norfolk.

Name	Design-ation	Location (NGR) / size (ha)	Qualifying features/reasons for notification
Marsham Heaths		125.7	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)
Horse Wood, Mileham	SSSI	TF 922186 7.1	Horse Wood is an ancient woodland site on a boulder clay plateau. The wood is probably of primary origin with a structure of coppice-with-standards. The stand types are mainly wet ash-maple wood and the nationally infrequent plateau alder wood. The ground flora is exceptionally diverse and includes a number of rare and uncommon species in great abundance. ***Key features***: ancient woodland habitat; rare flora (wild service tree)
Happisburgh Cliffs	Geological SSSI, no ecological reasons for notification		
Westwick Lakes	SSSI	TG 273274 9.55	Westwick Lakes form a compact group of five secluded, man-made lakes. The Perch Lake group is of a type rarely found in East Anglia and closely resembles nutrient-poor lakes found in the upland areas. The acidic waters support an unusual aquatic flora and plankton fauna which includes one locally uncommon species. The other lakes are more typical with abundant water weeds and provide an interesting contrast to the Perch Lake group. There is considerable ornithological interest with large flocks of wildfowl overwintering in the lakes. ***Key features***: locally very uncommon aquatic flora, wintering ornithology
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
Buxton Heath	SSSI	TG 175218 67.03	Buxton Heath is a diverse heath-with-fen area situated in a basin of glacial sands which, together with Roydon Fen, form the best examples of this rare habitat type in Norfolk. The valley mire is floristically rich and there is a rapid transition from calcareous to acidic plant communities with dry acidic heathland on higher ground. These communities have remained undisturbed for a long period of time and a number of rare relict mosses, liverworts and fungi occur on the site. Several uncommon invertebrates have also been recorded including one species new to Britain. ***Key features***: wet heathland habitat, calcareous fen habitat, nationally rare relict mosses, liverworts and fungi, nationally uncommon invertebrates
Potter & Scarning Fens, East Dereham	SSSI	TF 982120 5.53	Potter and Scarning Fens are small calcareous valley fens on shallow peat and are among the finest of their type in Britain. The site grades from bryophyte-dominated communities on the open, wet parts of the site, through calcareous fen, to heathland on the drier ground. The flora is exceptionally diverse and a number of uncommon mosses and liverworts are present. The site has great entomological interest and supports a rare species of damsel-fly.

Name	Design-ation	Location (NGR) / size (ha)	Qualifying features/reasons for notification
			Key features: wet heathland habitat, calcareous fen habitat, rare flora assemblage, nationally rare invertebrates (small red damsel-fly)
Felmingham Cutting	LNR	TG 248 287 1.04	A butterfly nature reserve, home to 16 different species.
Knapton Cutting	LNR	TG 299 329 0.87	A butterfly nature reserve.
Litcham Common	LNR	TF 855 172 24.9	Litcham Common is a varied heathland site with pockets of wet and dry heath and acid grassland. There are blocks of scrub and attractive well-developed oak/birch woodland. Common reptiles (adder) are present.
Pigney's Wood	LNR	TG295319 20.87	Pigney's Wood is a woodland site with reedbeds, a scrape, and wildflowers, butterflies, trees and birds.
Catchetts Wood	Ancient Woodland	N/A	N/A
Cawston Wood		N/A	N/A
Church Wood		N/A	N/A
Foxley Wood		N/A	N/A
Fring Wood		N/A	N/A
Great Wood		N/A	N/A
Harolds Grove		N/A	N/A
Hindolveston Wood		N/A	N/A
Honeypot Wood		N/A	N/A
Horse Wood		N/A	N/A
Hurdle Wood		N/A	N/A
Jack bells Grove		N/A	N/A
Little Wood		N/A	N/A
Lounds		N/A	N/A

Name	Design-ation	Location (NGR) / size (ha)	Qualifying features/reasons for notification
Wood			
Necton Wood		N/A	N/A
Newhall Grove		N/A	N/A
Normans Wood		N/A	N/A
North Grove		N/A	N/A
Old Carr		N/A	N/A
Old Lane Carr		N/A	N/A
Potters Grove		N/A	N/A
Racknells Covert		N/A	N/A
Rawhall Wood		N/A	N/A
Sandholes Wood		N/A	N/A
Sparham Grove		N/A	N/A
Sparham Wood		N/A	N/A
Sporle Wood		N/A	N/A
The Leaselands		N/A	N/A
The Tollands		N/A	N/A
Thurning Wood		N/A	N/A
West Wood		N/A	N/A





Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Landfall Search
- Cable Relay Station Search
- Substation Search Area
- Special Area of Conservation (SAC)[1]
- Sites of Special Scientific Interest (SSSI)[1]
- National Nature Reserve (NNR)[1]
- Local Nature Reserve (LNR)[1]
- Ancient Woodland[1]

[1] Natural England, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Statutory Designated Sites for Nature Conservation - Key

Figure: 3.5 Drawing No: PB4476-002-2-036

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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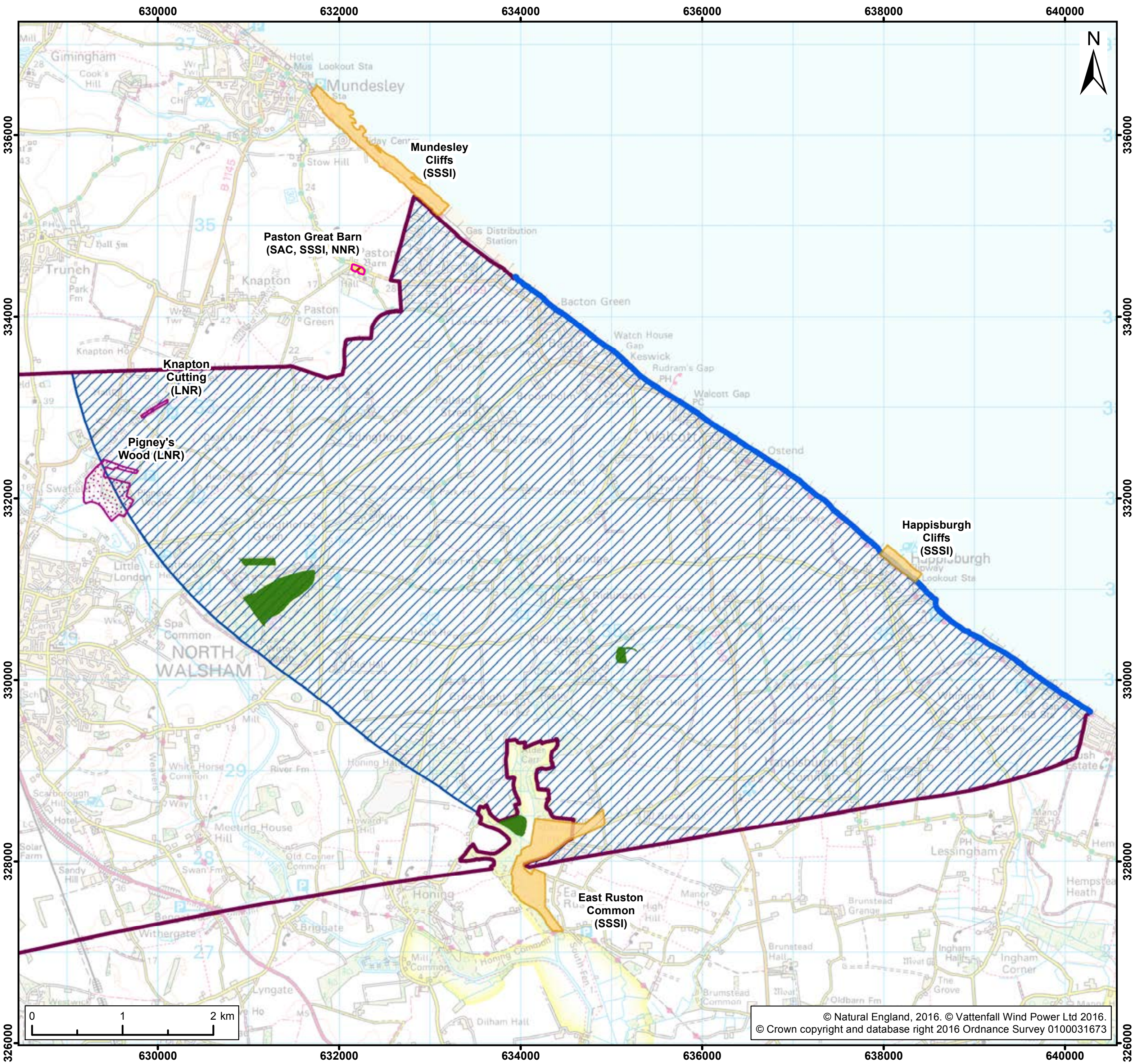

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Landfall Search Area
- Cable Relay Station Search Area
- Special Area of Conservation (SAC)[1]
- Sites of Special Scientific Interest (SSSI)[1]
- National Nature Reserve (NNR)[1]
- Ancient Woodland[1]
- Local Nature Reserve (LNR)[1]

[1] Natural England, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Statutory Designated Sites for Nature Conservation

Figure: 3.5a | Drawing No: PB4476-002-2-036

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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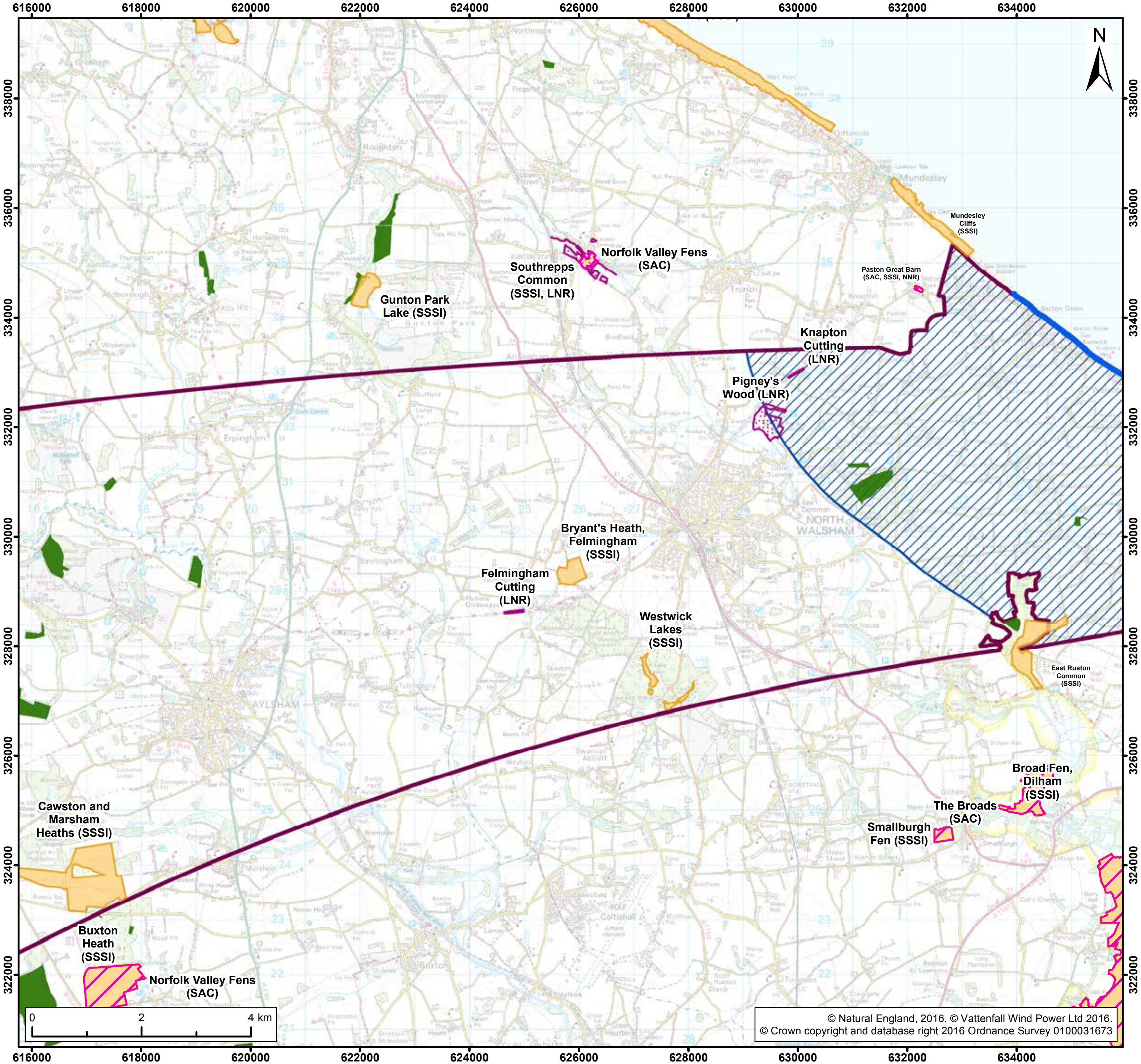

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Landfall Search Area
- Cable Relay Station Search Area
- Special Area of Conservation (SAC)[1]
- Sites of Special Scientific Interest (SSSI)[1]
- National Nature Reserve (NNR)[1]
- Ancient Woodland[1]
- Local Nature Reserve (LNR)[1]

[1] Natural England, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Statutory Designated Sites for Nature Conservation

Figure: 3.5b | Drawing No: PB4476-002-2-036

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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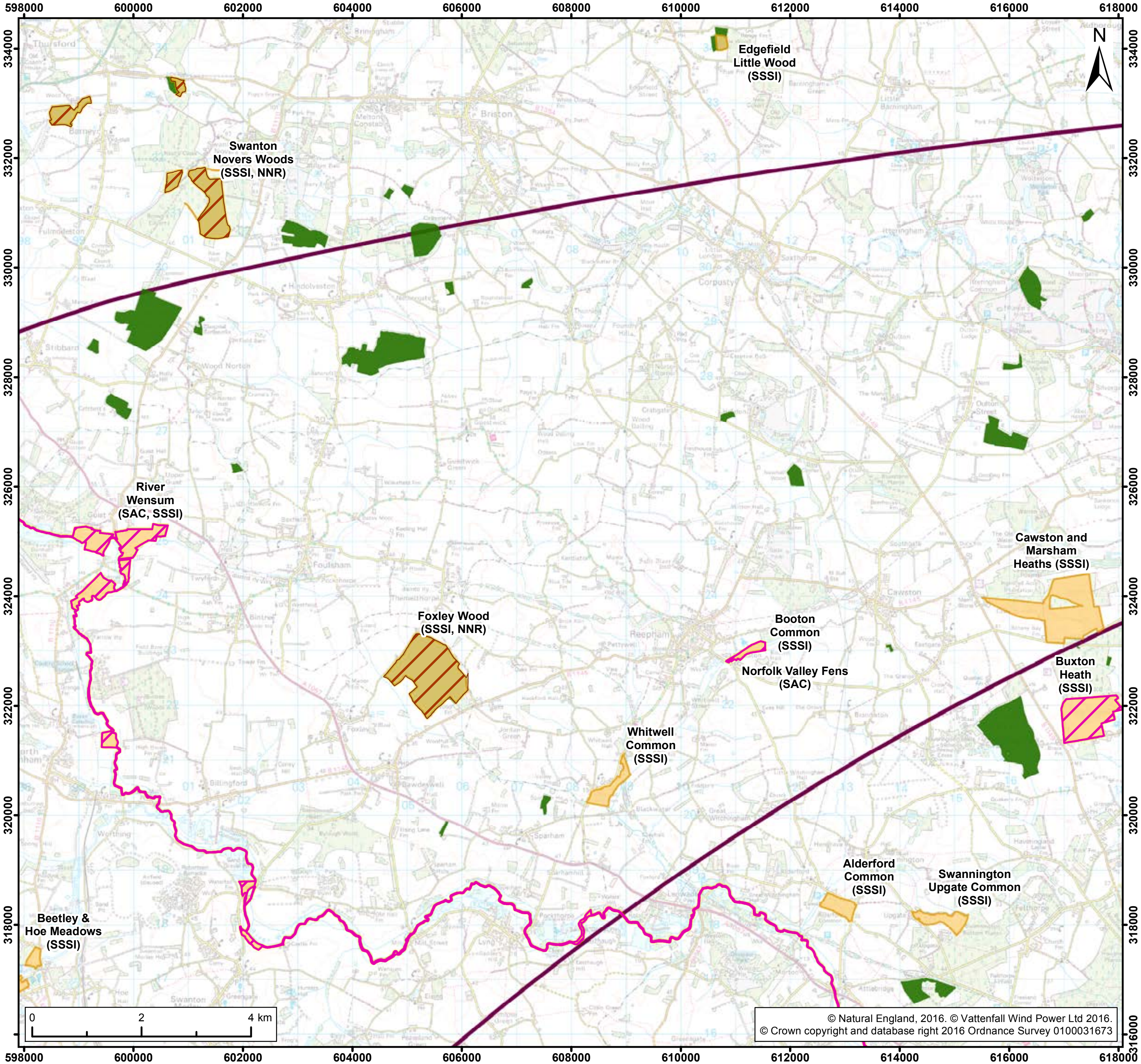

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Special Area of Conservation (SAC)[1]
- Sites of Special Scientific Interest (SSSI)[1]
- National Nature Reserve (NNR)[1]
- Ancient Woodland[1]

[1] Natural England, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Statutory Designated Sites for Nature Conservation

Figure: 3.5c | Drawing No: PB4476-002-2-036

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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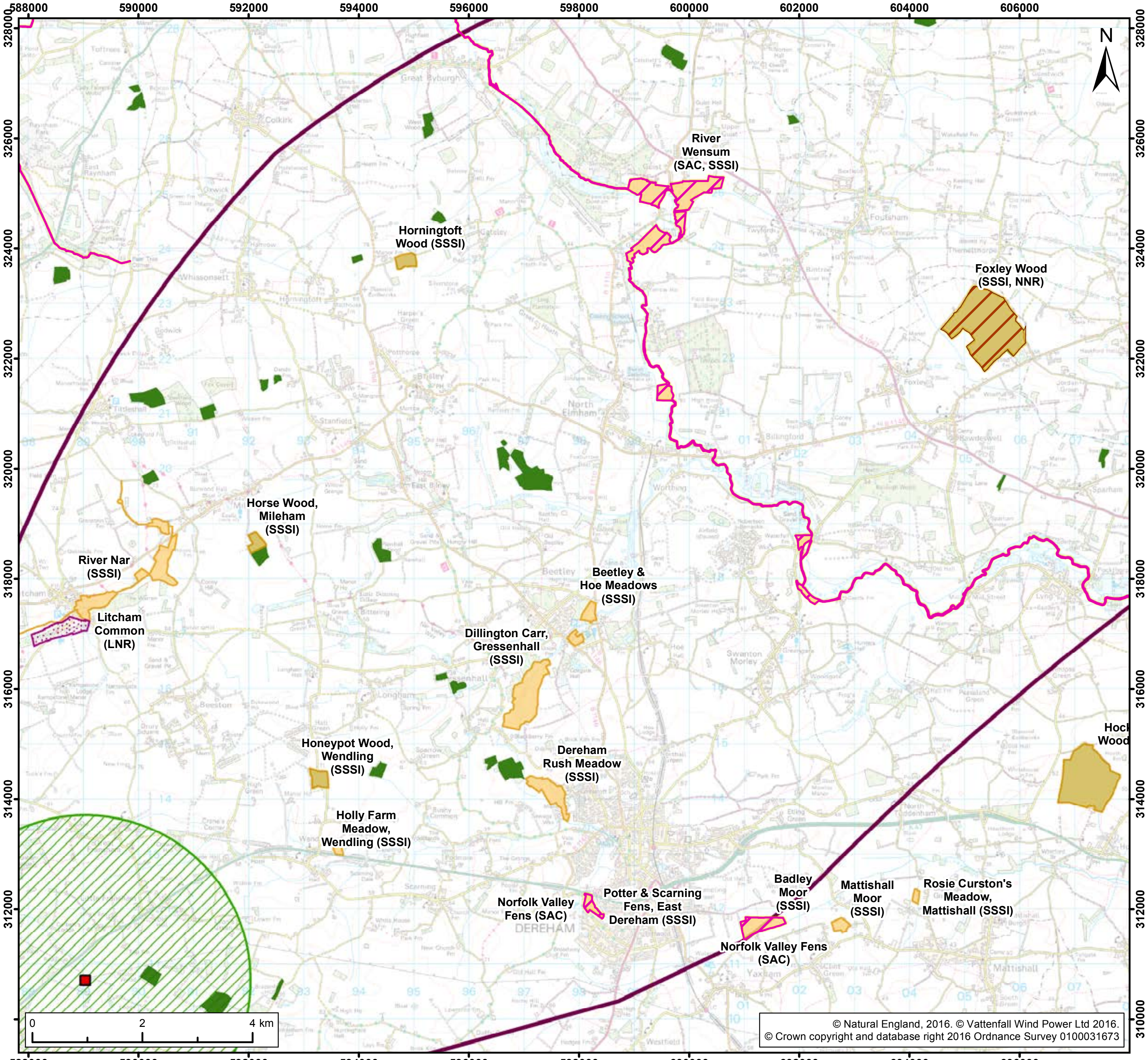

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Substation Search Area
- Special Area of Conservation (SAC)[1]
- Sites of Special Scientific Interest (SSSI)[1]
- National Nature Reserve (NNR)[1]
- Ancient Woodland[1]
- Local Nature Reserve (LNR)[1]

[1] Natural England, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Statutory Designated Sites for Nature Conservation

Figure: 3.5d — Drawing No: PB4476-002-2-036

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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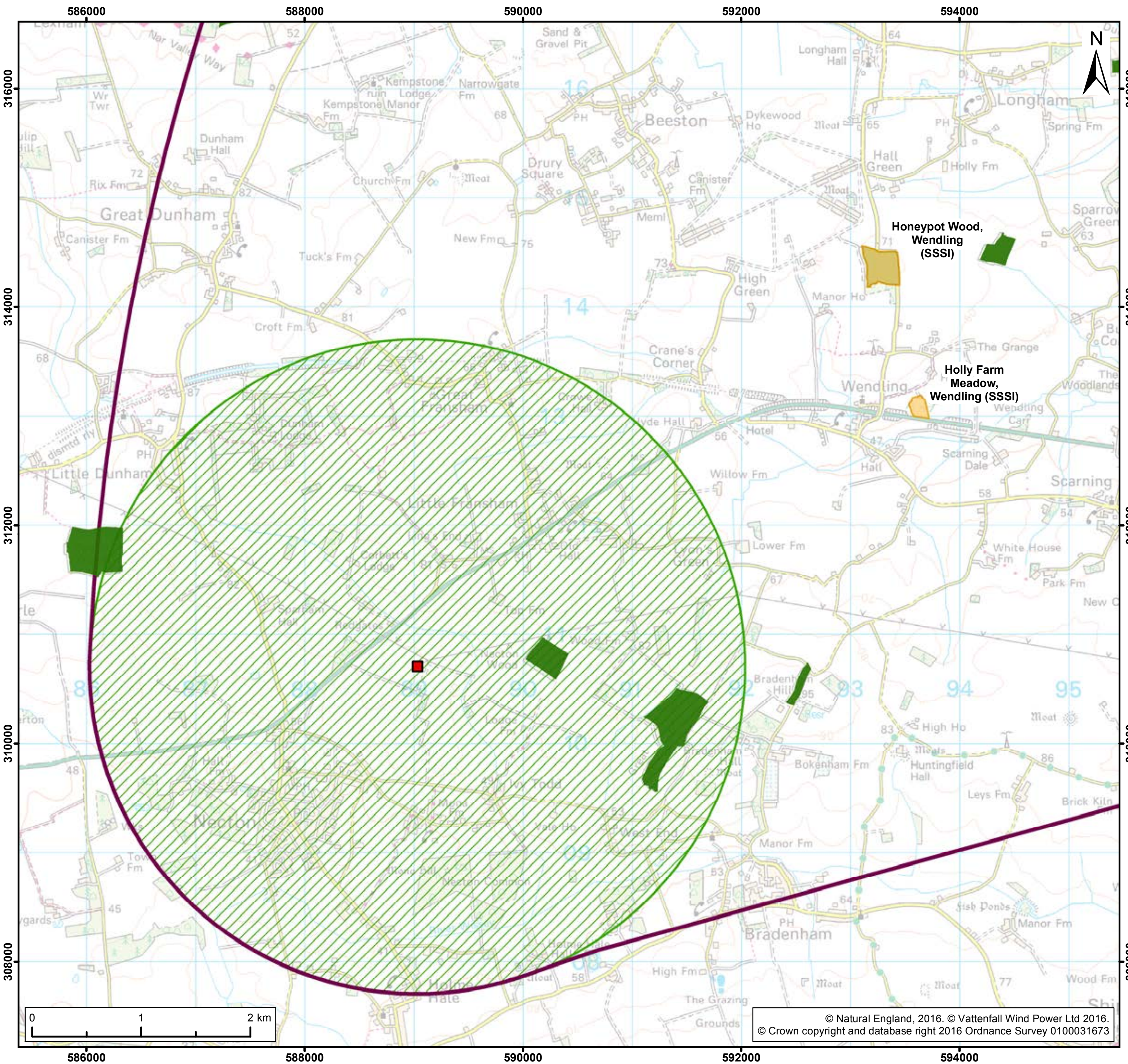

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Substation Search Area
- Sites of Special Scientific Interest (SSSI)[1]
- Ancient Woodland[1]

[1] Natural England, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Statutory Designated Sites for Nature Conservation

Figure: 3.5e | Drawing No: PB4476-002-2-036

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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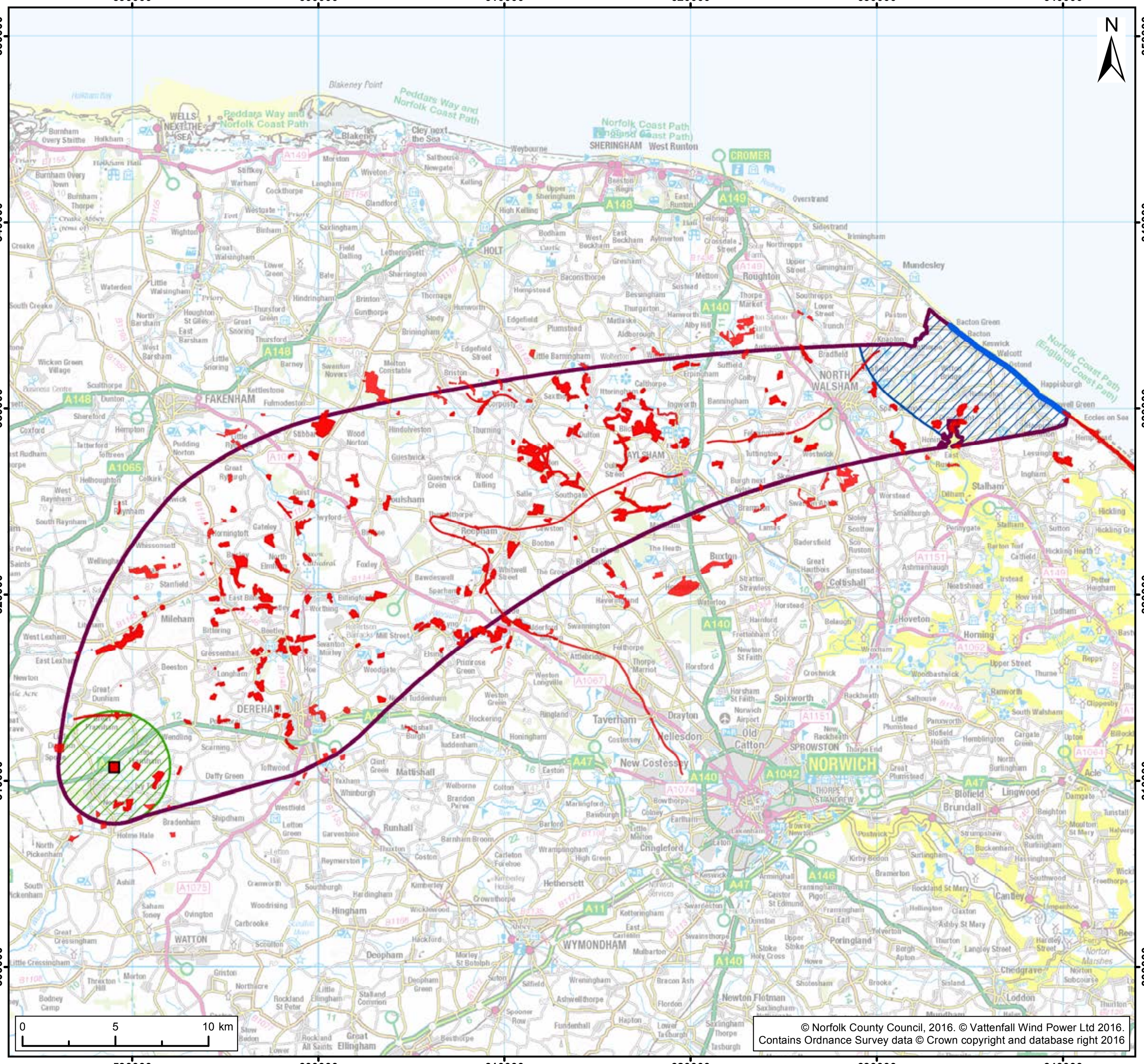

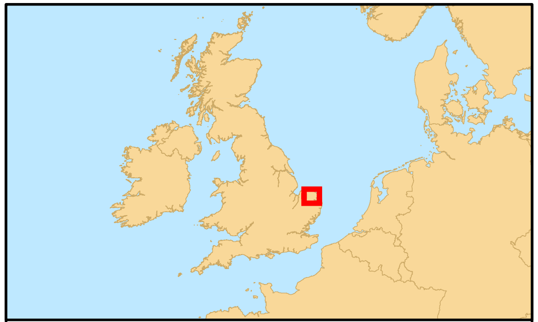

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Landfall Search Area
- Cable Relay Station Search
- Substation Search Area
- County Wildlife Sites

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Non-Statutory Designated Sites for Nature Conservation

Figure: 3.6 Drawing No: PB476-002-2-037

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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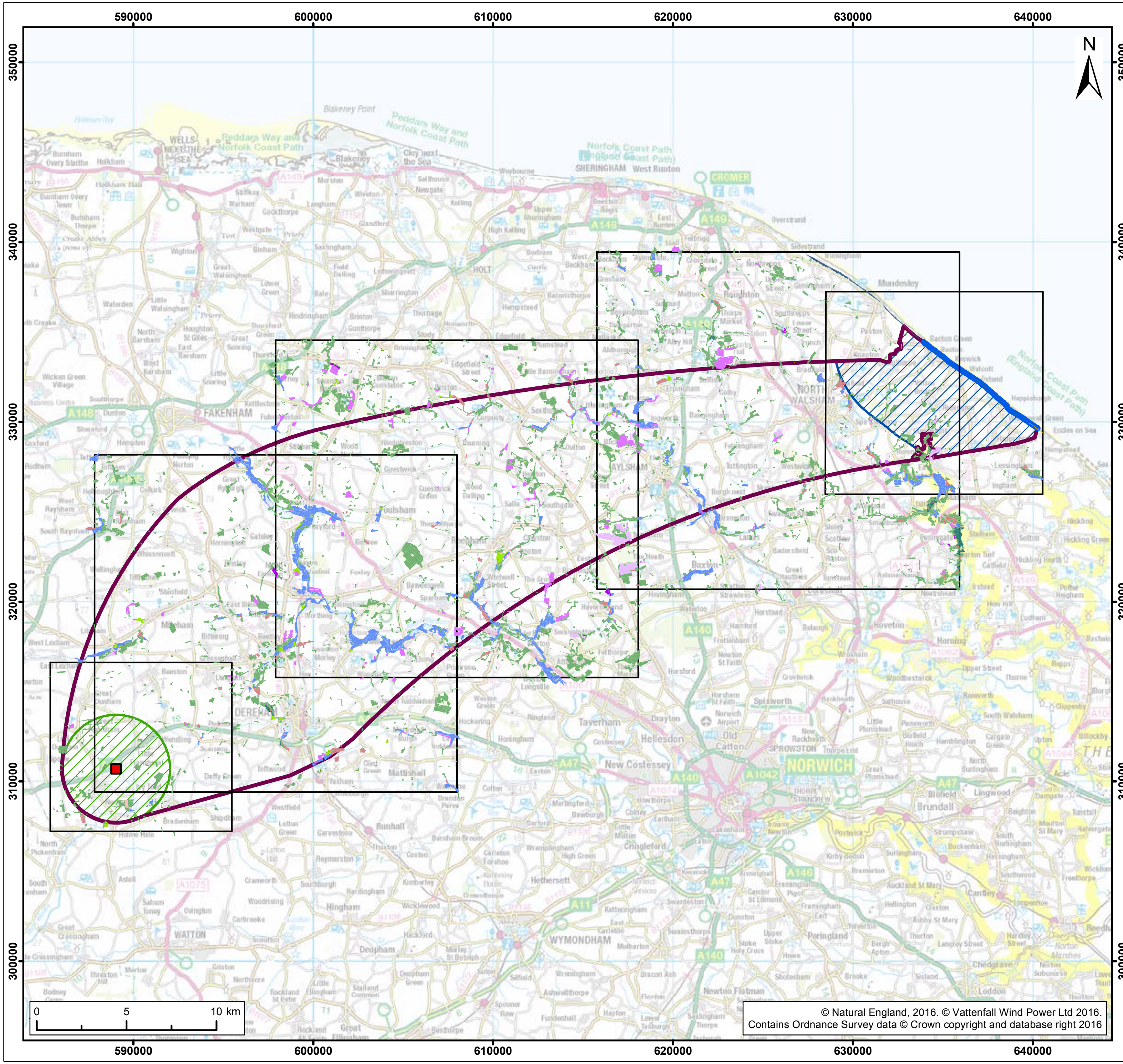

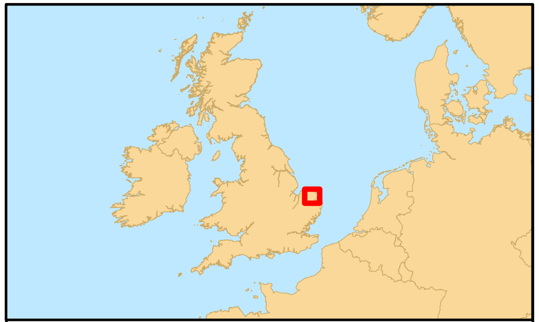

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Landfall Search Area
- Cable Relay Station Search Area
- Substation Search

UK BAP Priority Habitats

- Coastal and floodplain grazing marsh
- Coastal sand dunes
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland calcareous grassland
- Lowland fens
- Lowland heathland
- Lowland meadows
- Maritime cliff and slope
- Purple moor grass and rush pastures
- Reedbeds
- Traditional orchard

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

UK Habitats of Principal Importance - Key

Figure: 3.7 Drawing No: PB4476-002-2-038

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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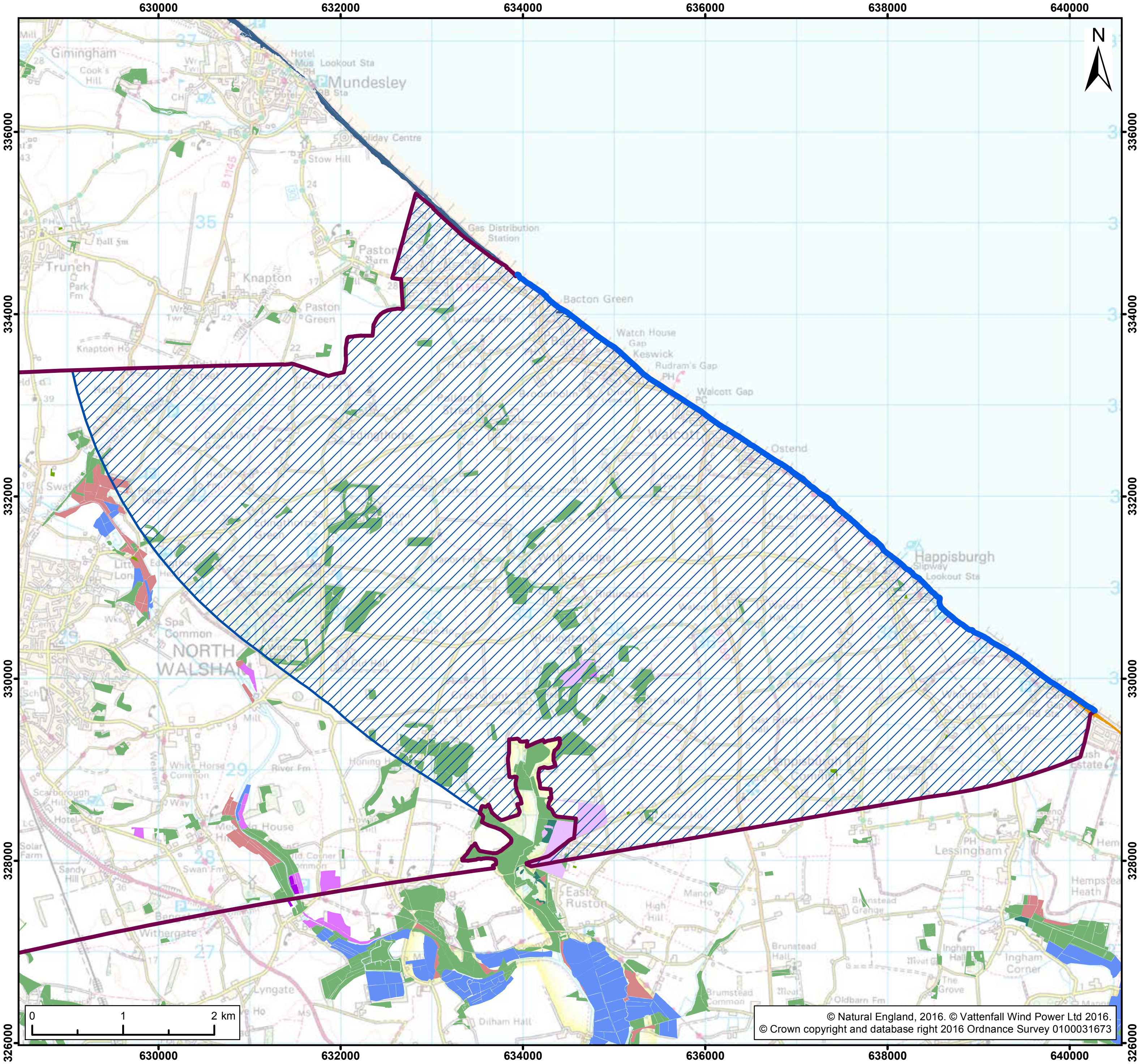

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Landfall Search Area
- Cable Relay Station Search Area

UK BAP Priority Habitats

- Coastal and floodplain grazing marsh
- Coastal sand dunes
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland fens
- Lowland heathland
- Maritime cliff and slope
- Purple moor grass and rush pastures
- Reedbeds
- Traditional orchard

Project: Norfolk Vanguard

Report: Environmental Impact Assessment Scoping Report

Title: UK Habitats of Principal Importance

Figure: 3.7a

Drawing No: PB4476-002-2-038

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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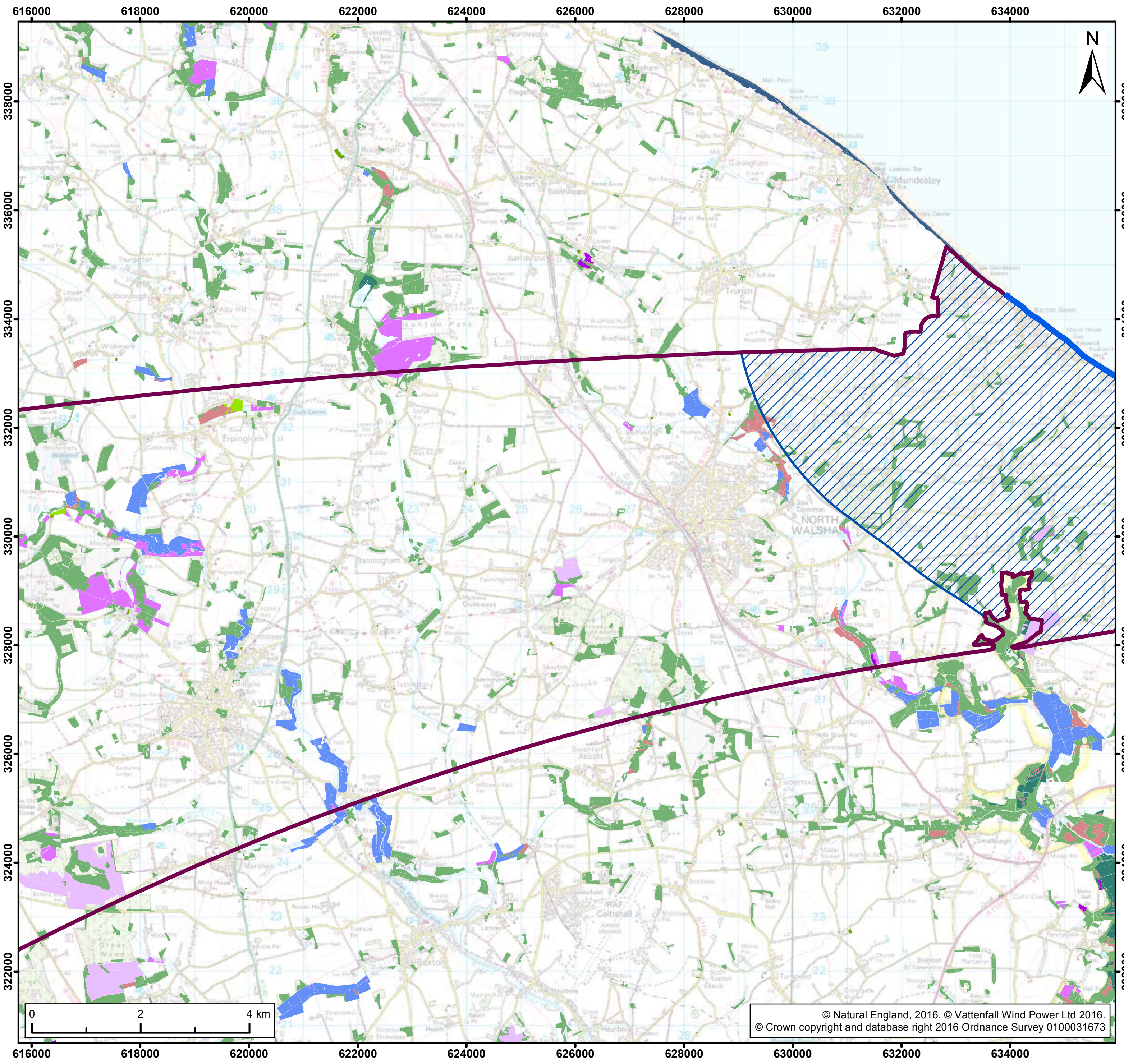

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Landfall Search Area
- Cable Relay Station Search Area

UK BAP Priority Habitats

- Coastal and floodplain grazing marsh
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland fens
- Lowland heathland
- Lowland meadows
- Maritime cliff and slope
- Purple moor grass and rush pastures
- Reedbeds
- Traditional orchard

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

UK Habitats of Principal Importance

Figure: 3.7b   Drawing No: PB4476-002-2-038

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid   **EPSG:** 27700

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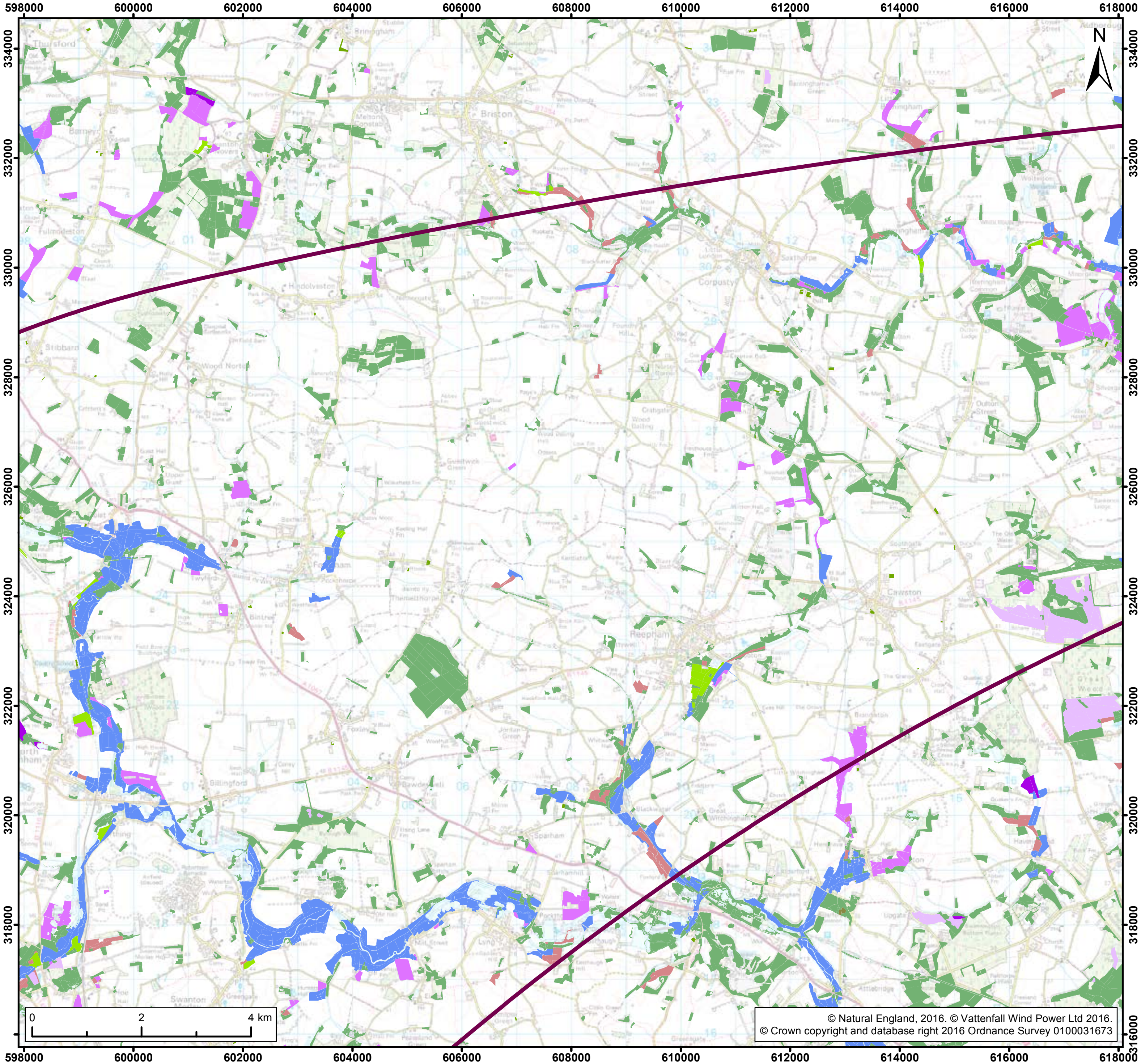

Legend:

- Onshore Scoping Area & Cable Corridor Search Area

UK BAP Priority Habitats

- Coastal and floodplain grazing marsh
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland calcareous grassland
- Lowland fens
- Lowland heathland
- Lowland meadows
- Purple moor grass and rush pastures
- Traditional orchard

Project: Norfolk Vanguard

Report: Environmental Impact Assessment Scoping Report

Title: UK Habitats of Principal Importance

Figure: 3.7c

Drawing No: PB4476-002-2-038

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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01	04/08/16	AB	RH	A4	1:100,000

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

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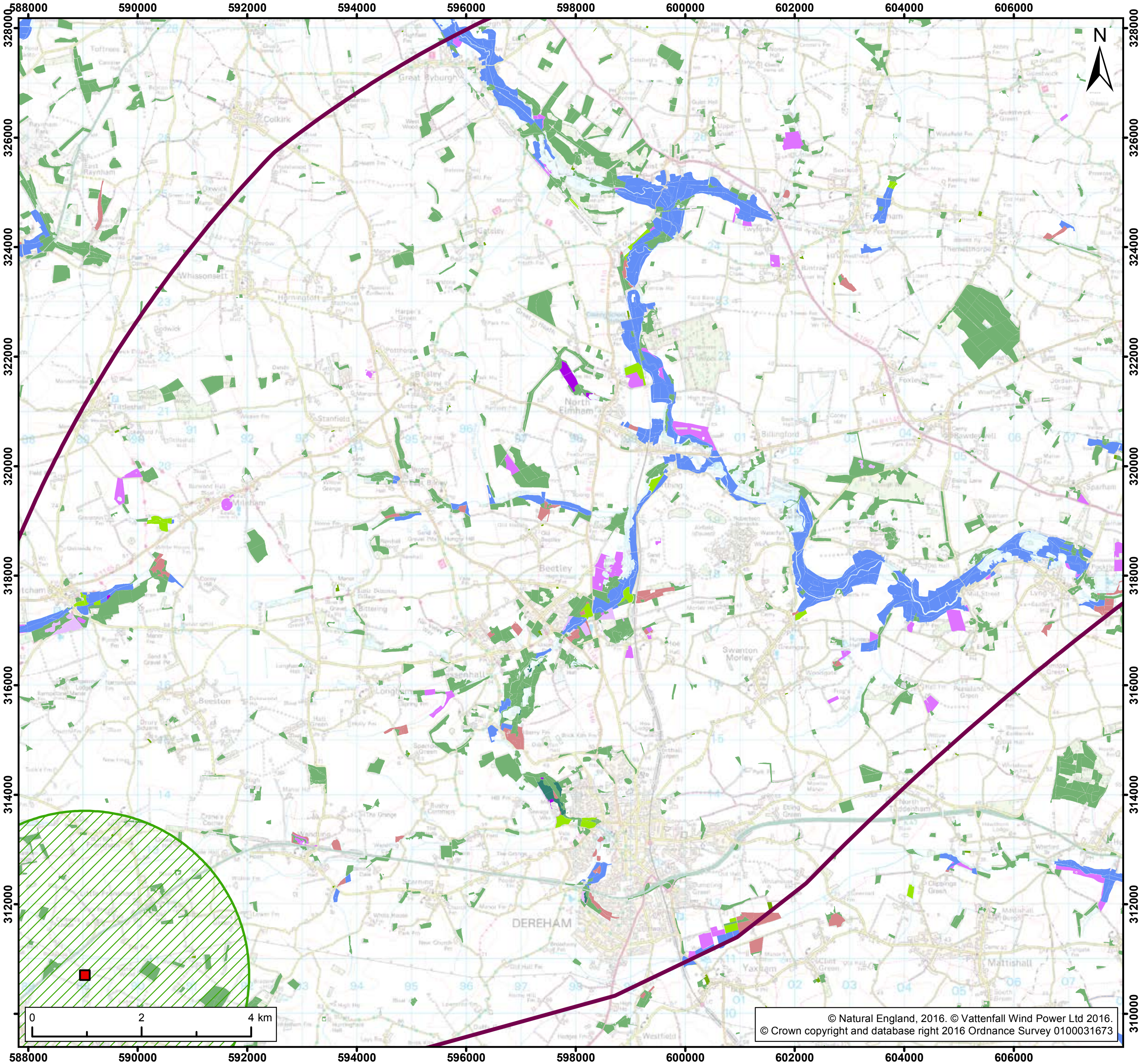

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Substation Search Area

UK BAP Priority Habitats

- Coastal and floodplain grazing marsh
- Deciduous woodland
- Good quality semi-improved grassland
- Lowland fens
- Lowland heathland
- Lowland meadows
- Purple moor grass and rush pastures
- Reedbeds
- Traditional orchard

Project: Norfolk Vanguard

Report: Environmental Impact Assessment Scoping Report

Title: UK Habitats of Principal Importance

Figure: 3.7d

Drawing No: PB4476-002-2-038

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	05/09/16	AB	RH	A4	1:100,000
01	04/08/16	AB	RH	A4	1:100,000

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

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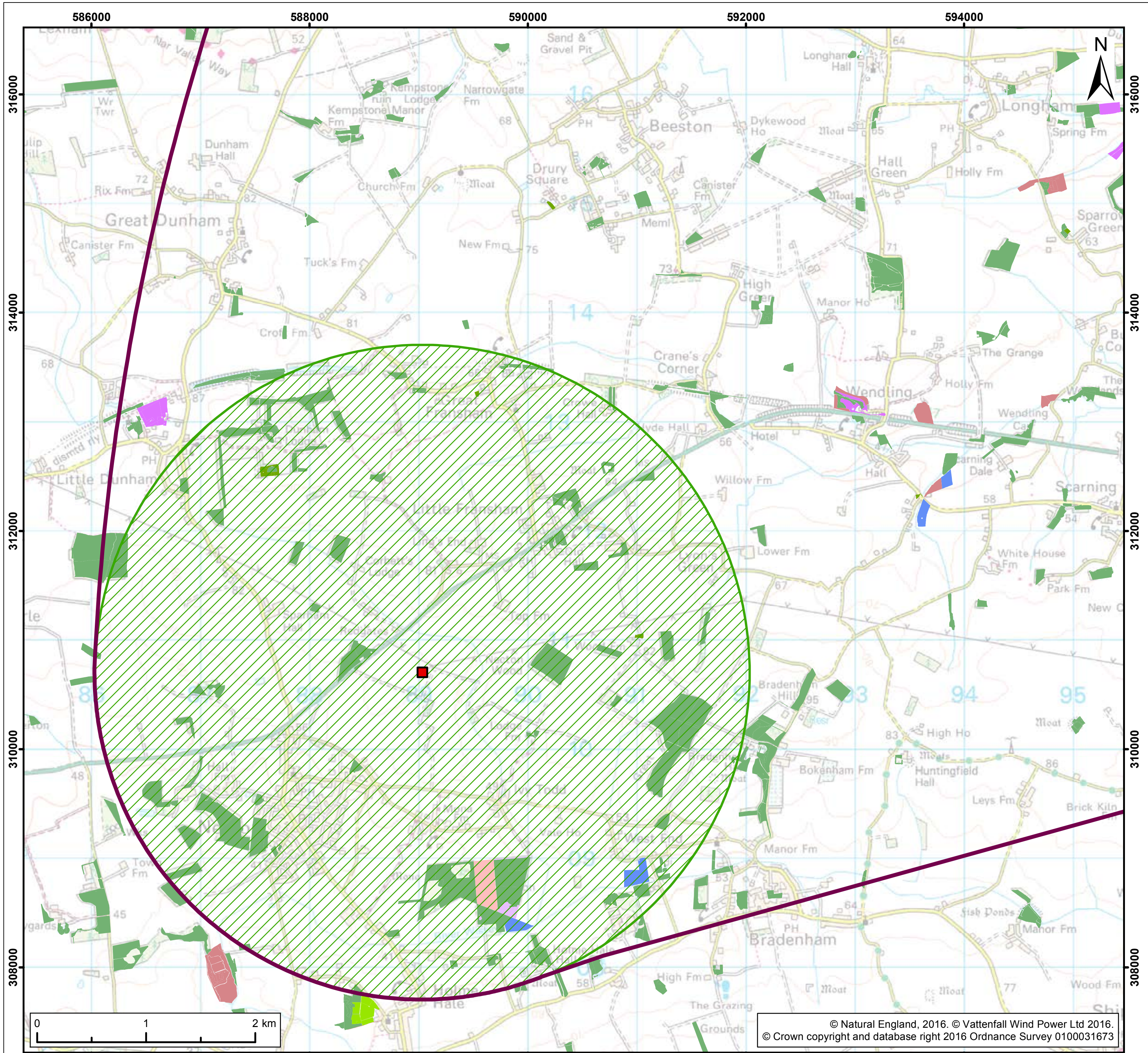

Project: Norfolk Vanguard

Report: Environmental Impact Assessment Scoping Report

Title: UK Habitats of Principal Importance

Figure: 3.7e

Drawing No: PB4476-002-2-038

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Non-statutory Designated Sites

952. A total of 176 non-statutory designated sites (County Wildlife Sites (CWS)) have been identified within the onshore scoping area, as shown on Figure 3.6.

Terrestrial Habitats

953. UK Habitats of Principal Importance recorded within the onshore scoping area, as shown on Figure 3.7 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.

954. The legislation underpinning UK Habitats of Principal Importance is discussed in Section 1.3.

Protected, Notable and Invasive Species

955. 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 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*) (all bats are EPS).

956. There are numerous records of notable terrestrial and aquatic invertebrate species recorded within the onshore scoping area, including a range of moth species.

957. The notable plant species holly-leaved naiad *Najas marina* has been recorded within the onshore scoping area.

958. 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 giant hogweed *Heracleum mantegazzianum*, floating pennywort *Hydrocotyle ranunculoides*, Japanese knotweed *Fallopia japonica*, and signal crayfish *Pacifastacus leniusculus*.

959. The legislation underpinning legally protected species and invasive species is discussed in Section 1.3.

3.6.2 Potential impacts

960. Potential impacts have been identified from the information available at the time of preparing this document and based on the project description as set out in Section 1.4. The key aspects of construction with respect to onshore ecological receptors are the construction of the substation and cable relay station, and the excavation works and supporting activities associated with the onshore cable route and landfall during construction.

961. 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

Impacts to statutory and non-statutory designated sites

962. Statutory and non-statutory designated sites for nature conservation will be avoided wherever possible as part of the site selection process for the cable route. Potential indirect impacts upon statutory and non-statutory designated sites arising from disturbance caused by works at the substation, cable route, landfall and cable relay station may occur 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.

Permanent and temporary loss of habitats

963. At the substation and cable relay station there is potential for the permanent loss of several UK Habitats of Principal Importance due to the construction footprint of

these elements of the project. The construction of the cable relay station will result in permanent habitat loss of approximately 1ha, which may comprise UK Habitats of Principal Importance. Similarly, the construction of the substation will result in permanent habitat loss of approximately 7.5ha, which may comprise UK Habitats of Principal Importance depending on the final location of the infrastructure.

964. Several UK Habitats of Principal Importance will potentially be impacted along the cable route corridor. The majority of impacts would be avoided by careful selection of the route and crossing points and use of HDD where necessary (for example below the coastal floodplain grazing marsh and river habitats of the River Wensum). There is likely to be some temporary loss of Habitats of Principal Importance during trenching activities, including loss of sections of hedgerows. There will also be some permanent habitat loss associated with construction consolidation sites and access. Key considerations are likely to be habitats which support protected and notable species such as bat, water vole, otter, badger, reptiles and great crested newt and potentially invertebrates.

Temporary habitat fragmentation and species isolation

965. There is potential for temporary habitat fragmentation and species isolation as a result of construction, particularly with regard to the cable route. This is particularly relevant for linear habitats such as hedgerows. As part of embedded mitigation habitat removal would be restricted to a minimum working width where possible, and habitats would be reinstated upon completion.

Impacts upon protected species or upon their resting or breeding sites

966. The potential exists for protected species to be impacted by construction activities either physically or from disturbance. Of key concern will be water vole, otter, bats, badger, great crested newt, reptiles and certain invertebrates, however prior to the completion of detailed ecological field surveys all UK legally protected and notable species must be assumed to be potentially affected by the project.

Spread of non-native, invasive species

967. There is potential for the presence of non-native invasive species, which could be spread by construction activities. Control of invasive species, where required, would be incorporated in a project specific Ecological Management Plan (EMP).

3.6.2.2 Potential impacts during operation

968. Planned maintenance at the cable relay station and substation is likely to be highly localised with a minimal likelihood of disturbance expected to the adjacent habitats and species. During operation of the cable relay station and substation there may be

continual operational noise and lighting which have the potential to cause disturbance and illumination on adjacent habitats and species.

969. In the unlikely event of a cable failure, there may be a need to access the buried cables to enable the replacement of a failed cable section. Such reactive repairs are expected to have potential impacts similar to those of construction, however they would be expected to be more localised, of smaller scale and temporary in nature.

970. 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

971. 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. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected the onshore cables will be removed from ducts and recycled, with the transition pits and ducts left *in situ*.

972. 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.

973. It is anticipated that the decommissioning impacts will be similar in nature to those of construction.

3.6.2.4 Potential cumulative impacts

974. 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 Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

975. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

976. Cumulative impacts as a result of the works required by National Grid to connect Norfolk Vanguard to the existing Necton 400kV National Grid Substation will be included as part of this assessment.

3.6.2.5 Summary of potential impacts

Table 3.8 Summary of impacts relating to onshore ecology

Potential impacts	Construction	Operation	Decommissioning
Impacts to statutory and non-statutory designated sites	✓	✓	✓
Permanent and temporary loss of habitats	✓	✓	✓
Temporary habitat fragmentation and species isolation	✓	✓	✓
Impacts upon protected species or upon their resting or breeding sites	✓	✓	✓
Disturbance of bird populations	✓	✓	✓
Cumulative impacts	✓	✓	✓

scoped in (✓) and scoped out (×)

3.6.3 Mitigation

977. Embedded mitigation is likely to include the following:

- Avoidance of impact through cable corridor and route selection (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. HDD 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;
- All habitats removed during construction to be reinstated upon completion of works (where practical);
- Development of a CoCP; and
- Development of an EMP.

978. Additional mitigation measures will be discussed and agreed with stakeholders depending on any potential impacts identified.

3.6.4 Approach to assessment and data gathering

979. This scoping assessment has been undertaken based on a desk-based assessment. 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 of the preferred cable corridor (once it has been identified) followed

by targeted species-specific surveys scoped by the findings of the Extended Phase 1 Habitat Survey. Table 3.9 sets out the ecological surveys required in relation to the project.

980. All surveys listed below will be undertaken in line with best practice guidance for each species concerned.

Table 3.9 Ecological scoping surveys required in relation to for the project

Survey title	Year of survey	Proposed Survey details
Extended Phase 1 Habitat Survey	2017	Will cover the preferred cable route, landfall location, cable relay station and substation 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)	Will cover all habitats which may support wintering birds, as identified during the ornithological desk-based assessment conducted during summer 2016.
GCN Presence/Absence Survey	2017	Will cover all waterbodies identified 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 all badger setts which may be part of more than one territory, and which may be affected by the project.
Bat activity survey	2017	Will cover all suitable commuting/foraging habitats and all potential bat roosts which may be affected by the project.
Water vole	2017	Will cover all suitable aquatic habitats which may be affected by the project.
Reptile surveys	2017	Will cover all suitable habitats may support significant populations of reptiles and which be affected by the project.
Dormice	2017	Will cover all suitable woodland habitats which may be affected by the project.
White-clawed crayfish	2017	Will cover all suitable aquatic habitats which may be affected by the project.
National Vegetation Classification / rare flora surveys, incl. invasive species	2017	Will cover all habitats 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 all habitats 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 all terrestrial and or aquatic habitats which may support rare or notable invertebrates and which may be affected by the project.

981. 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).

982. 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

983. This assessment 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 Baseline

3.7.1.1 Data sources

984. The scoping assessment presented below has been undertaken based on two key data sources:

- An Onshore Winter/Passage Bird Survey Scoping Report which provides detailed information on the passage and wintering ornithological receptors present within the scoping area; and
- A high-level desk-based review of onshore ornithological information related to breeding ornithological receptors conducted in August 2016.

985. The data sources used to inform this high-level desk-based review are shown in Table 3.10.

Table 3.10 Data sources

Data	Source	Date
European designated sites (*SPA, SAC, Ramsar sites*)	JNCC	2016
UK designated sites (*SSSI, NNR, LNR, RSPB Reserves*)	JNCC, Natural England	2016
UK Habitats of Principal Importance	JNCC (JNCC, 2016c)	2016
Bird Atlas 2007-11: The breeding and wintering birds of Britain and Ireland	British Trust for Ornithology (BTO, 2013)	2013

986. Any additional data sets will be identified through feedback from stakeholders following this Scoping Request.

987. This baseline section contains a greater level of detail with respect to passage wintering bird species than to breeding birds. This is because the Onshore Winter/Passage Bird Survey Scoping Report which informs this assessment has been produced primarily to provide the evidence in relation to passage and wintering birds in order to ensure that, if required, passage and wintering bird surveys can be undertaken in Autumn/Winter 2016. The Onshore Winter/Passage Bird Survey Scoping Report does not assess the risk to breeding birds potentially posed by the project. This is because if surveys are required in relation to breeding birds, these will take place during the breeding season 2017, and by this stage further and more detailed information will be available in relation to the project in order to scope these surveys in more detail. Given the additional information gathered in relation to passage wintering birds, it has been presented here to focus the scope with respect to these receptors.

3.7.1.2 Stakeholder consultation

988. Early stakeholder consultation with Natural England and Norfolk County Council has been undertaken with regards to the Onshore Winter/Passage Bird Survey Scoping Report (previously the 'Ornithological Desk-based Assessment') during September 2016. As noted above, this report has informed the baseline of this section.

989. Early stakeholder consultation was conducted on this report to allow the scope for wintering/passage surveys to be refined so that the targeted onshore ornithological surveys, if required to inform the EIA with respect to the onshore scoping area, can commence in winter 2016/2017.

990. In light of the comments raised during this consultation, the following changes have been made to the initial scope of onshore ornithology:

- The title of Onshore Winter/Passage Bird Survey Scoping Report has been changed (previously 'Ornithological Desk-based Assessment');
- Norfolk County Council recommended the removal of Cawston and Marsham Heath SSSI from the ornithological baseline. Wintering hen harrier are a notifiable features of this site, however no sightings of this species have been recorded at the SSSI or in the surrounding area within the last 10 years (Norfolk County Council, pers. comm. 5th September 2016);
- Natural England recommended the inclusion of the Mattishall Moor SSSI within the ornithological baseline due to the presence of wintering snipe;
- Natural England recommended inclusion of the SPA citation data within the ornithological baseline;
- Norfolk County Council and Natural England recommended the inclusion of NERC Act 2006 S41 species and CWS within the ornithological baseline; and

- Natural England recommended commencing wintering bird surveys in October 2016.

3.7.1.3 Designated sites

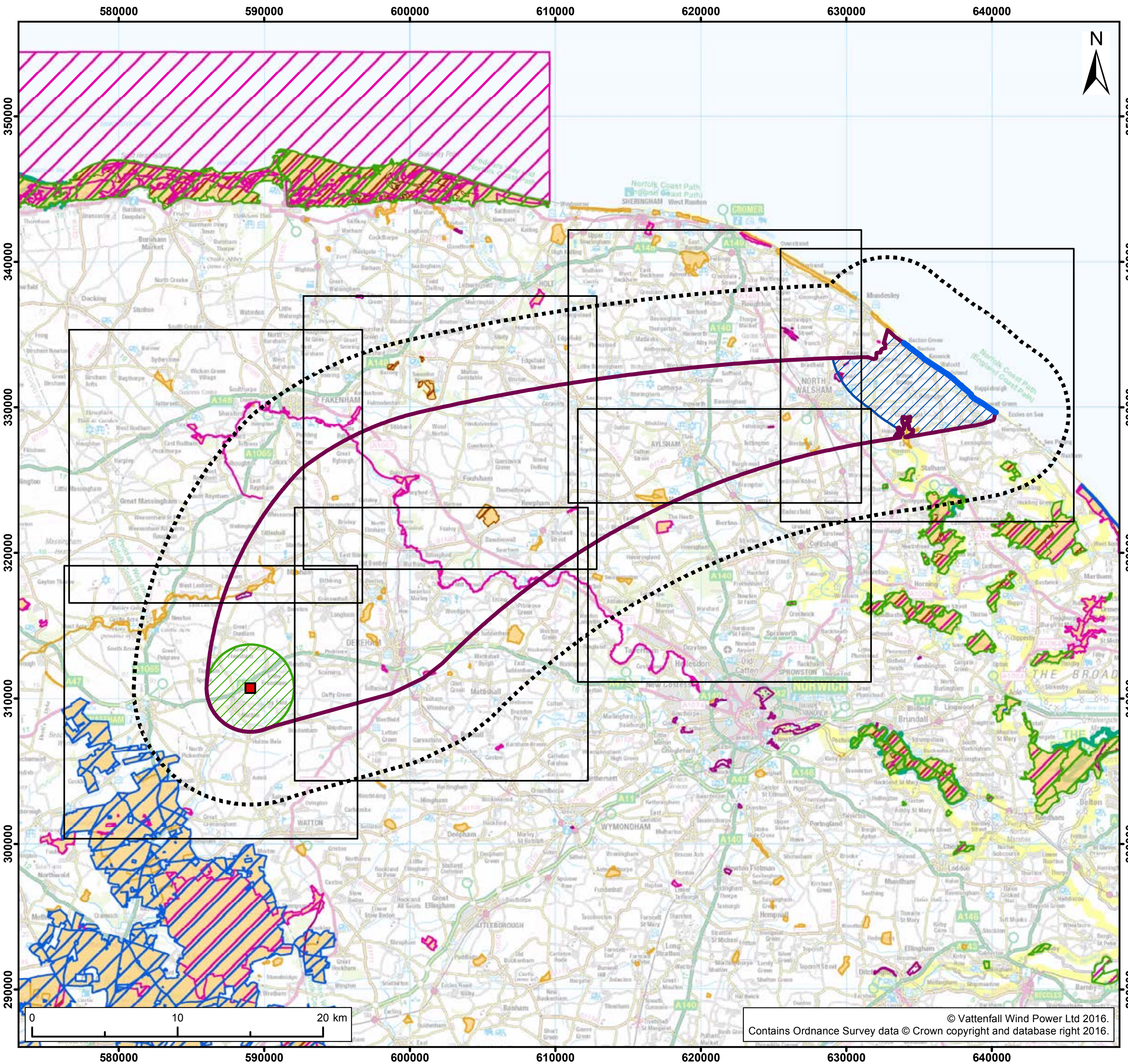
991. Figure 3.8 shows all of the onshore internationally designated sites for nature conservation which are located within 5km of the scoping area, and all other designated sites for nature conservation located within 1km of the scoping area (the 'survey area').

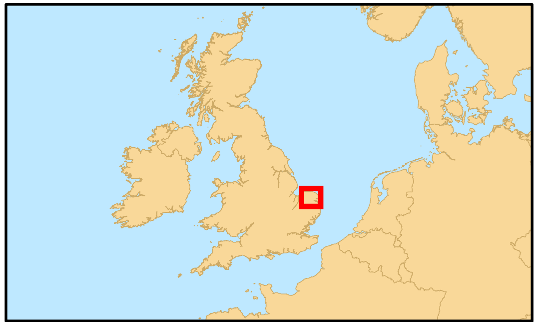
992. Of these sites, not all are designated for their ornithological interest features. Table 3.11 lists all of the designated sites falling within the survey area and details which of those contain ornithological interest features, indicating whether they are for passage or overwinter, or during the breeding season, and hence are relevant to this assessment.

Table 3.11 Designated sites for nature conservation within the survey area

Site name	Designation	Ornithological interest features (Y/N)		Approximate distance to scoping area
		During the breeding season	Passage / over winter	
Norfolk Valley Fens	SAC	N	N	Within onshore scoping area
River Wensum	SAC, SSSI	Y	N	Within onshore scoping area
Beetley & Hoe Meadows	SSSI	N	N	Within onshore scoping area
Dereham Rush Meadow	SSSI	Y	Y	Within onshore scoping area
Foxley Wood	SSSI, NNR	N	N	Within onshore scoping area
Dillington Carr, Gressenhall	SSSI	Y	N	Within onshore scoping area
East Ruston Common	SSSI	N	N	Within onshore scoping area
Holly Farm Meadow, Wendling	SSSI	N	N	Within onshore scoping area
Horningtoft Wood	SSSI	N	N	Within onshore scoping area
Honeypot Wood, Wendling	SSSI	N	N	Within onshore scoping area
River Nar	SSSI	Y	N	Within onshore scoping area
Whitwell Common	SSSI	N	N	Within onshore scoping area
Bryant's Heath, Felmingham	SSSI	N	N	Within onshore scoping area
Cawston and Marsham Heaths	SSSI	Y	N	Within onshore scoping area
Horse Wood, Mileham	SSSI	N	N	Within onshore scoping area
Happisburgh Cliffs	SSSI	N	N	Within onshore scoping area
Westwick Lakes	SSSI	Y	Y	Within onshore scoping area
Booton Common	SSSI	Y	N	Within onshore scoping area
Buxton Heath	SSSI	N	N	Within onshore scoping area
Potter & Scarning Fens, East Dereham	SSSI	N	N	Within onshore scoping area
Felmingham Cutting	LNR	N	N	Within onshore scoping area
Knapton Cutting	LNR	N	N	Within onshore scoping area
Litcham Common	LNR	N	N	Within onshore scoping area
Pigney's Wood	LNR	N	N	Within onshore scoping area
Paston Great Barn	SSSI, NNR	N	N	Within 1km of onshore scoping area
Alderford Common	SSSI	Y	N	Within 1km of onshore scoping area

Site name	Designation	Ornithological interest features (Y/N)		Approximate distance to scoping area
		During the breeding season	Passage / over winter	
Horse Wood - Mileham	SSSI	N	N	Within 1km of onshore scoping area
Badley Moor	SSSI	Y	N	Within 1km of onshore scoping area
Mundesley Cliffs	SSSI	N	N	Within 1km of onshore scoping area
Mattishall Moor	SSSI	Y	Y	Within 1km of onshore scoping area
Broadland	SPA	Y	Y	Within 5km of onshore scoping area
Great Yarmouth North Denes	SPA	Y	N	Within 5km of onshore scoping area
Breckland	SPA	Y	N	Within 5km of onshore scoping area
Sutton Fen	RSPB Reserve	Y	Y	Within 5km of onshore scoping area
Broadland	Ramsar	Y	Y	Within 5km of onshore scoping area
The Broads	SAC	N	N	Within 5km of onshore scoping area
Paston Great Barn	SAC	N	N	Within 5km of onshore scoping area
Overstrand Cliffs	SAC	N	N	Within 5km of onshore scoping area
Breckland	SAC	N	N	Within 5km of onshore scoping area





Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Landfall Search Area
- Cable Relay Station Search Area
- Substation Search Area
- 5km Study Area
- Special Area of Conservation (SAC)[1]
- Special Protection Area (SPA)[1]
- Sites of Special Scientific Interest (SSSI)[1]
- Ramsar[1]
- National Nature Reserve (NNR)[1]
- Local Nature Reserve (LNR)[1]
- RSPB Reserve[2]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area - Key

Figure: 3.8 | Drawing No: PB4476-002-2-045

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	AB	RH	A4	1:375,000

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

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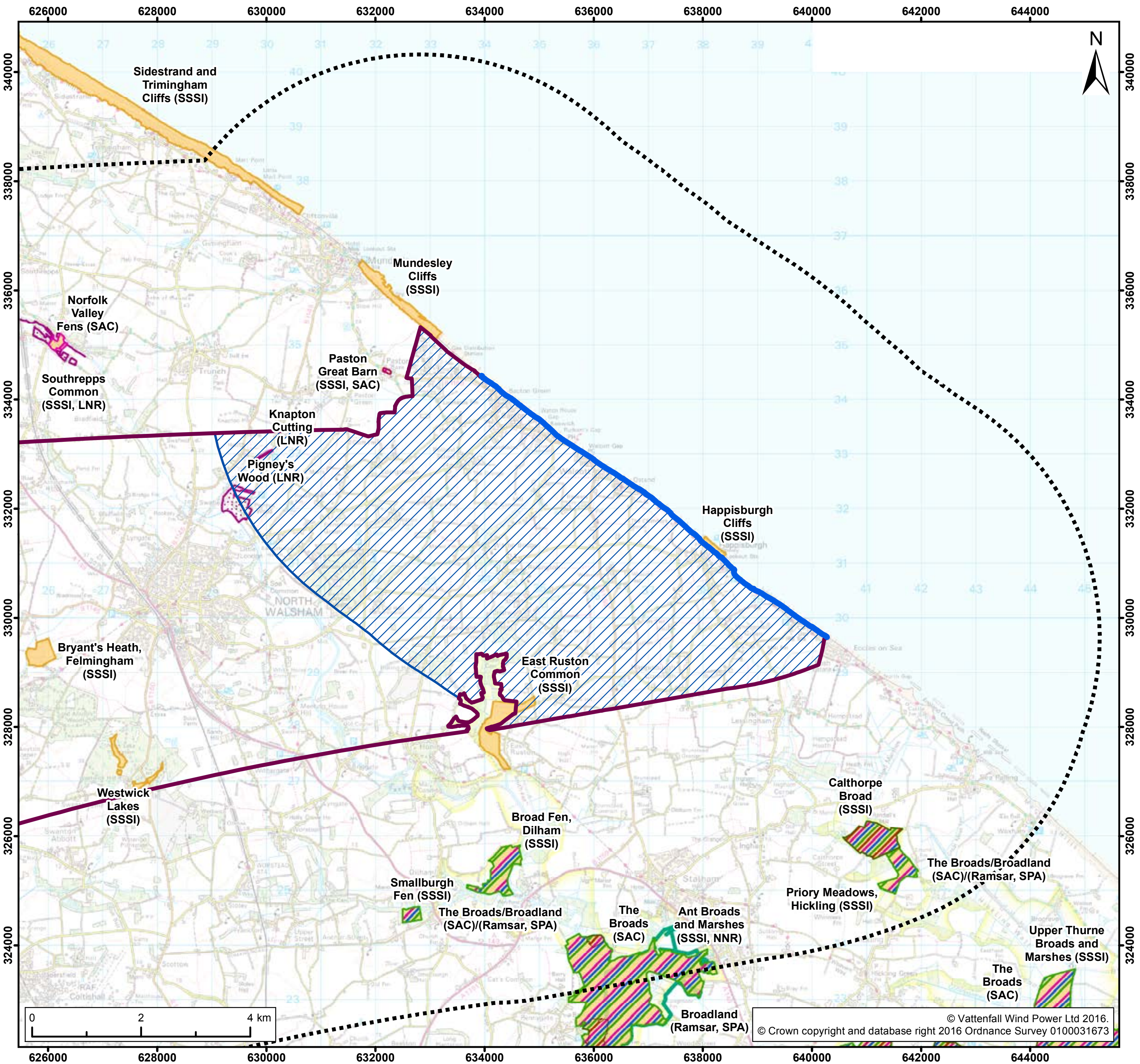

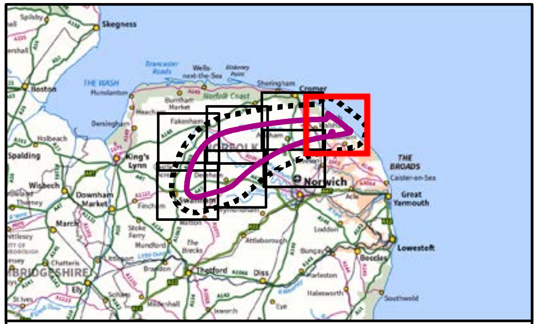

Legend:
- Onshore Scoping Area & Cable Corridor Search Area
- Landfall Search Area
- Cable Relay Station Search Area
- 5km Study Area
- National Nature Reserve (NNR)
- Ramsar[1]
- Special Protection Area (SPA)[1]
- Special Area of Conservation (SAC)[1]
- Sites of Special Scientific Interest (SSSI)[1]
- Local Nature Reserve (LNR)[1]
- RSPB Reserve[2]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:
Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.8a Drawing No: PB4476-002-2-045

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

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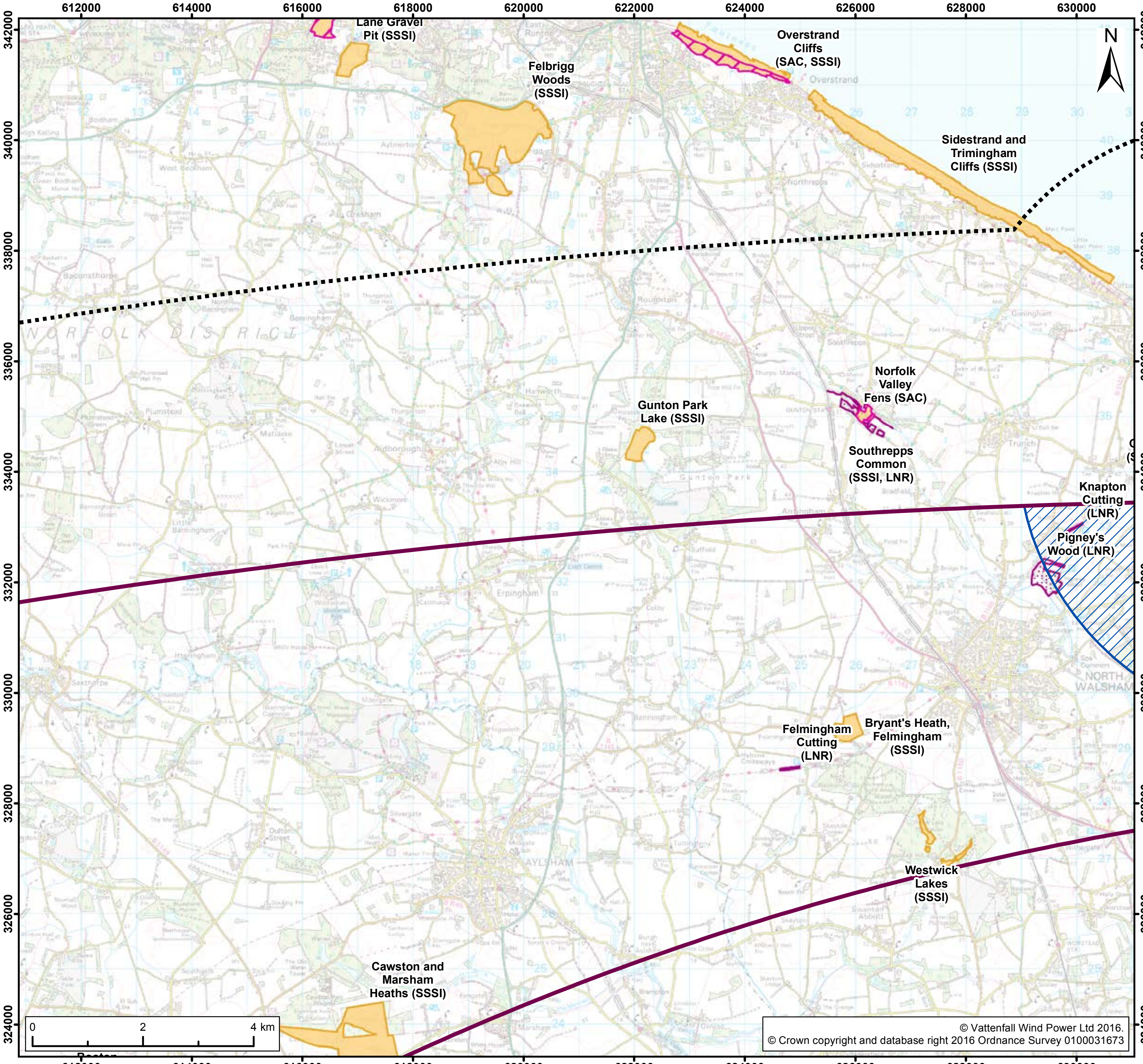

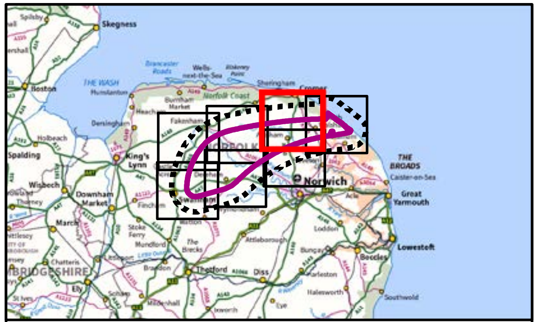

Legend:
- Onshore Scoping Area & Cable Corridor Search Area
- Cable Relay Station Search Area
- 5km Study Area
- Special Area of Conservation (SAC)[1]
- Sites of Special Scientific Interest (SSSI)[1]
- Local Nature Reserve (LNR)[1]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:
Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.8b | Drawing No: PB4476-002-2-045

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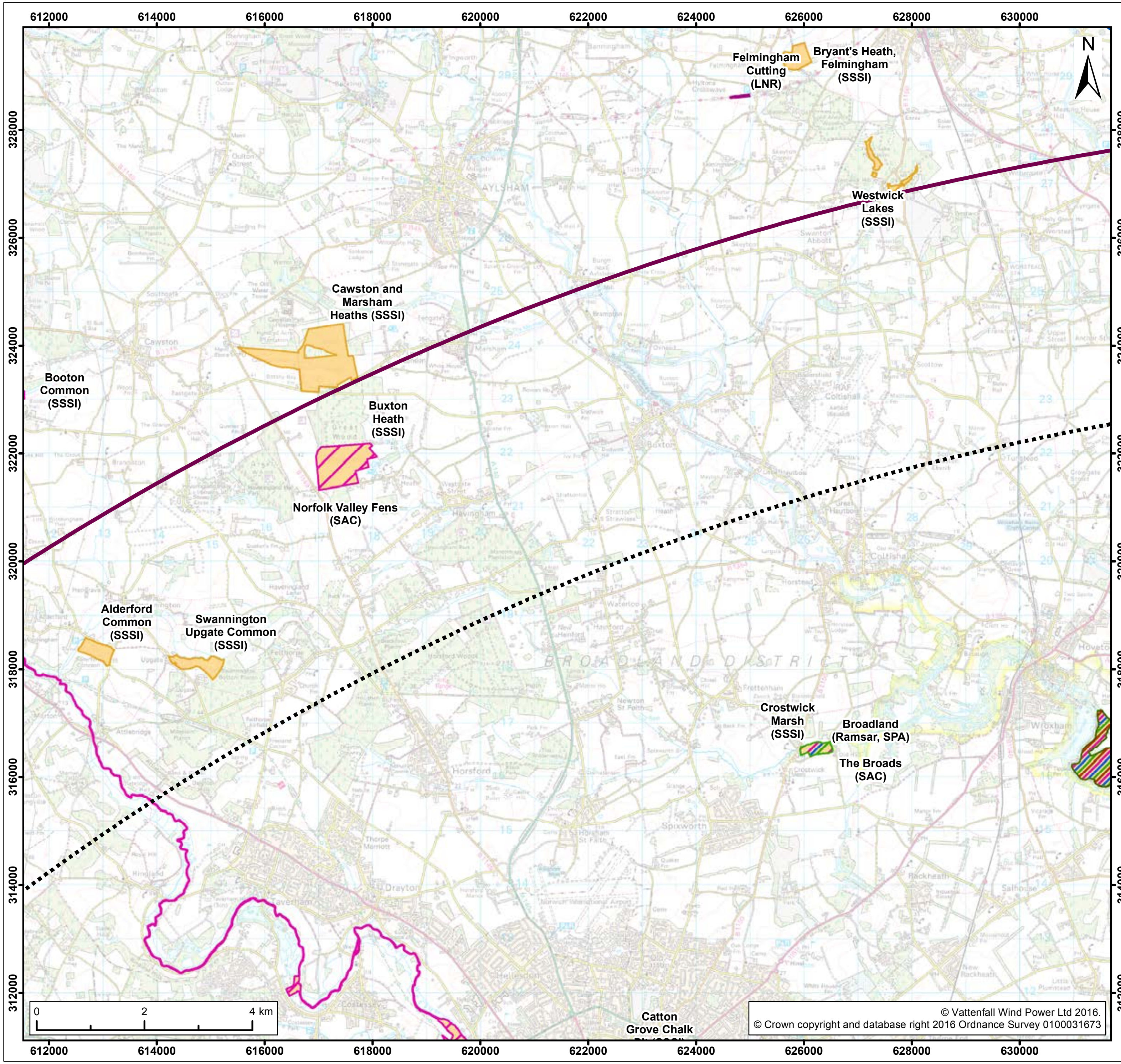

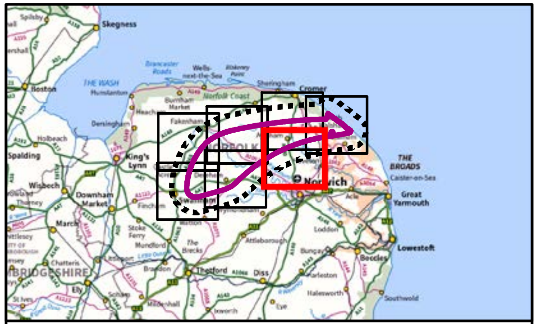

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Cable Relay Station Search Area
- 5km Study Area
- National Nature Reserve (NNR)
- Ramsar[1]
- Special Protection Area (SPA)[1]
- Special Area of Conservation (SAC)[1]
- Sites of Special Scientific Interest (SSSI)[1]
- Local Nature Reserve (LNR)[1]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:
Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.8c   Drawing No: PB4476-002-2-045

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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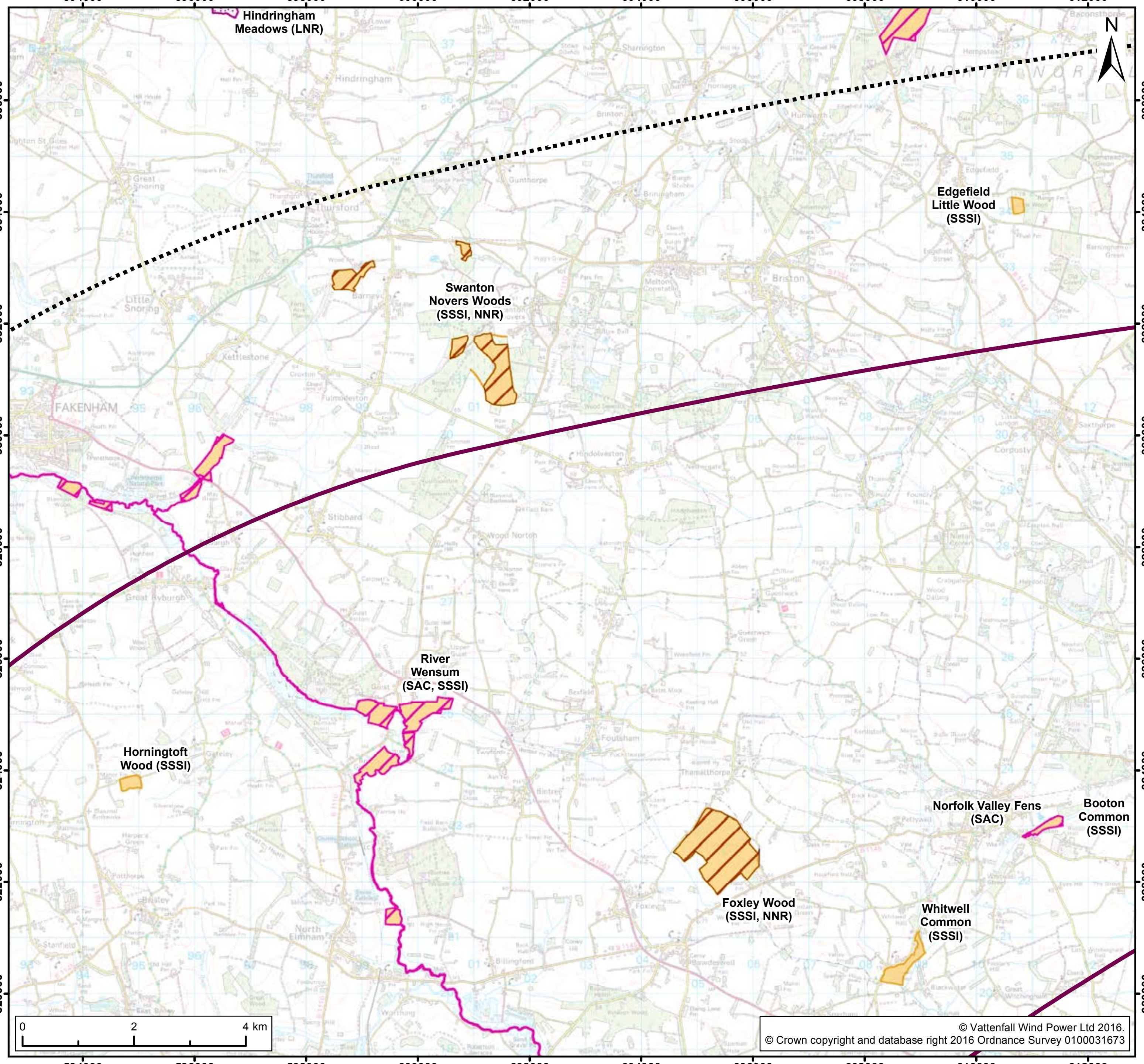

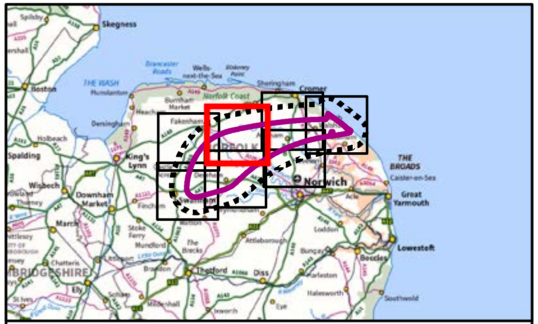

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- 5km Study Area
- National Nature Reserve (NNR)
- Special Area of Conservation (SAC)[1]
- Sites of Special Scientific Interest (SSSI)[1]
- Local Nature Reserve (LNR)[1]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Statistical Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.8d | Drawing No: PB4476-002-2-045

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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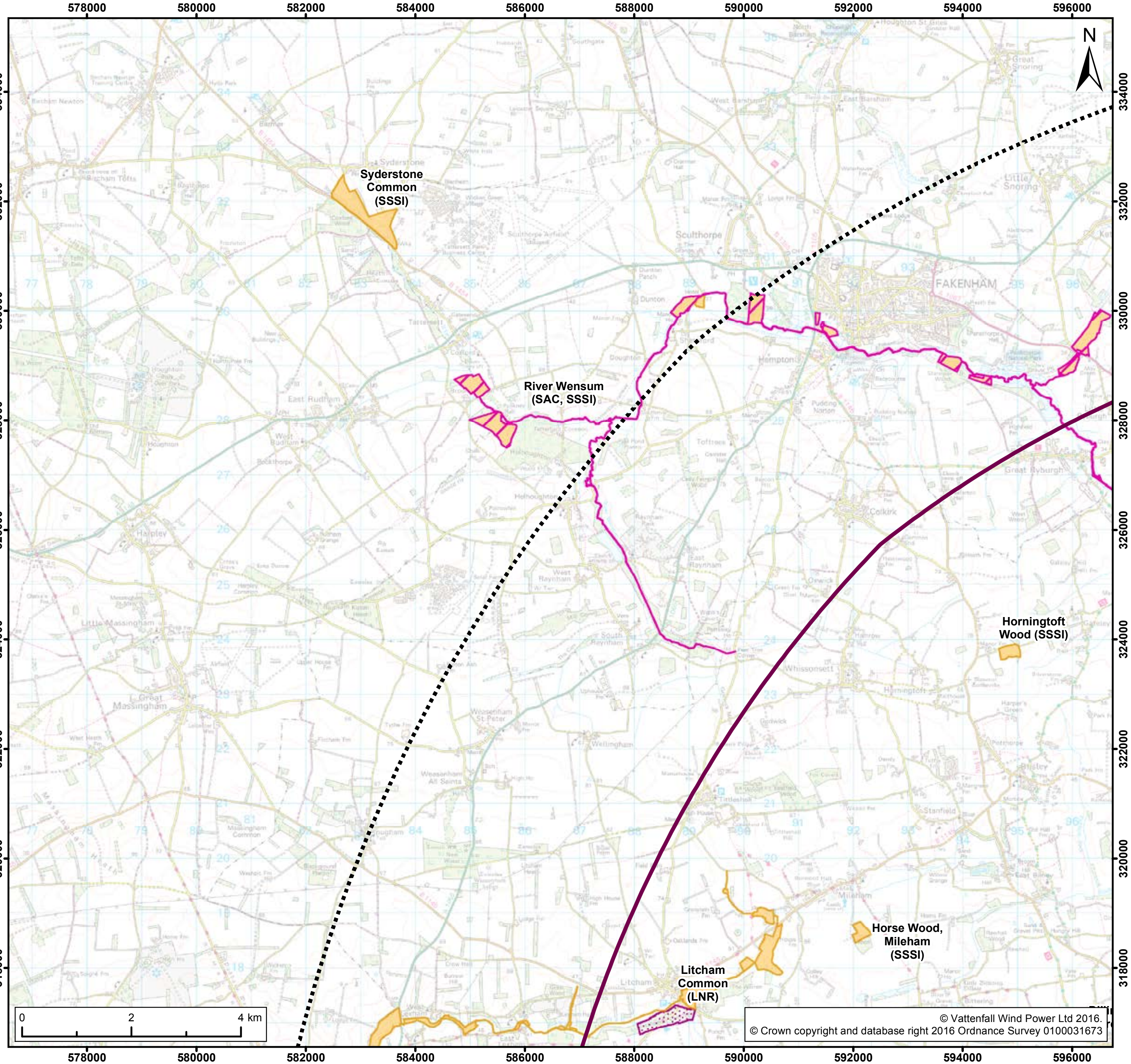

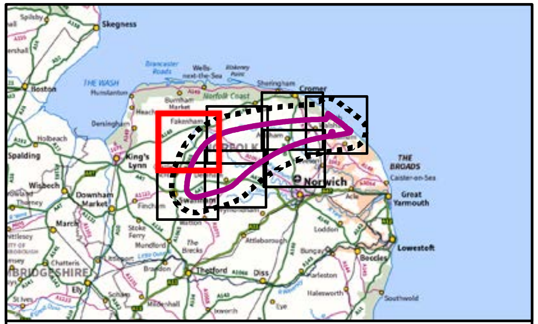

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- 5km Study Area
- Special Area of Conservation (SAC)¹
- Sites of Special Scientific Interest (SSSI)¹
- Local Nature Reserve (LNR)¹

¹ Natural England, 2016.
² RSPB, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:
Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.8f | Drawing No: PB4476-002-2-045

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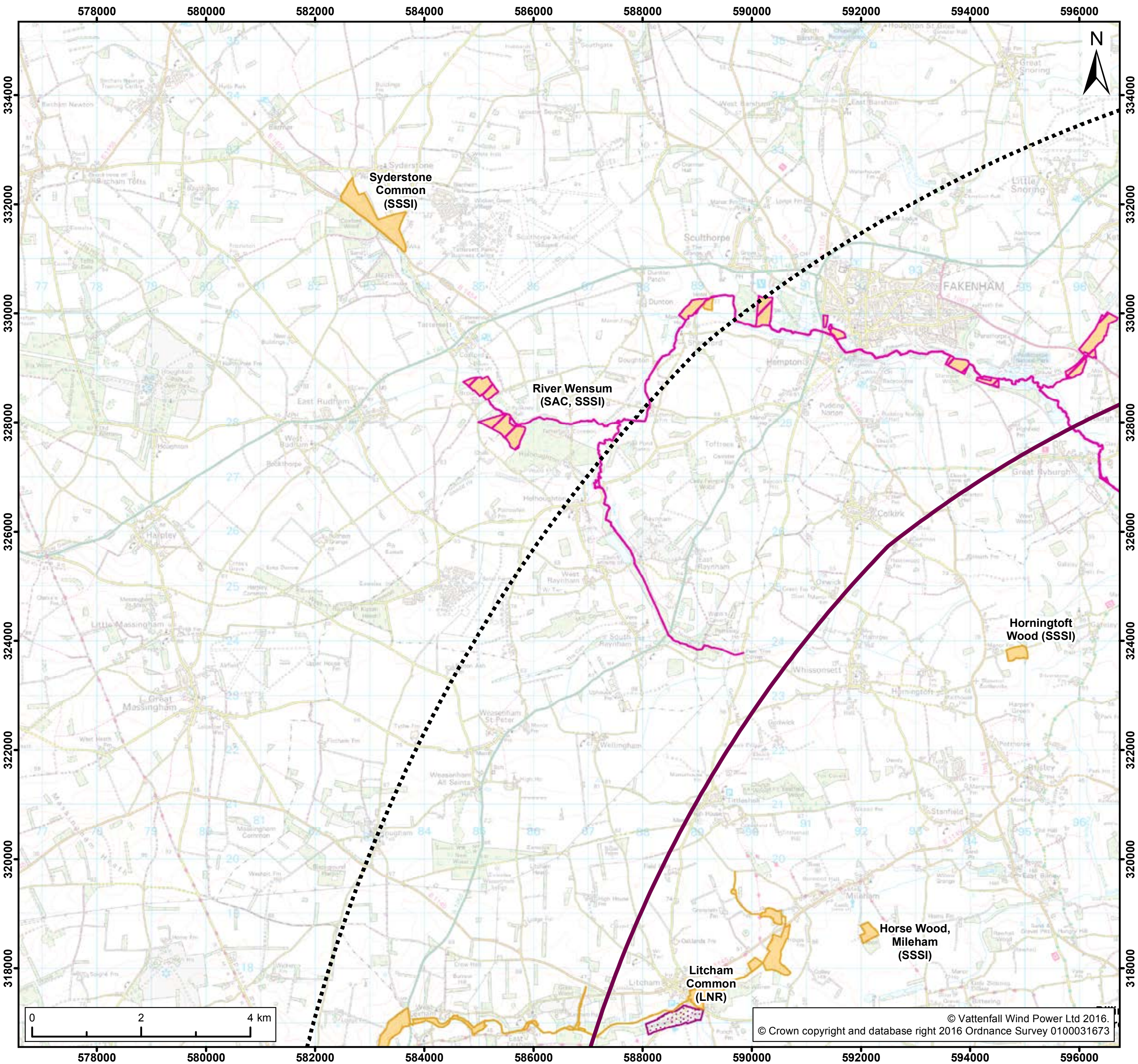

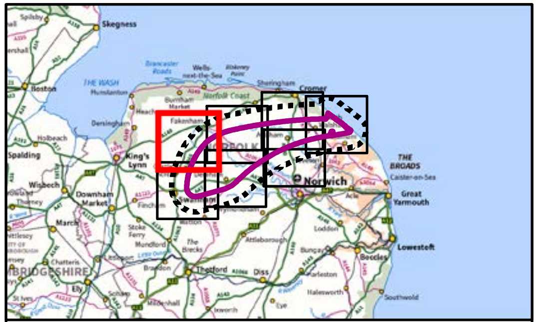

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- 5km Study Area
- Special Area of Conservation (SAC)[1]
- Sites of Special Scientific Interest (SSSI)[1]
- Local Nature Reserve (LNR)[1]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:
Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.8f Drawing No: PB4476-002-2-045

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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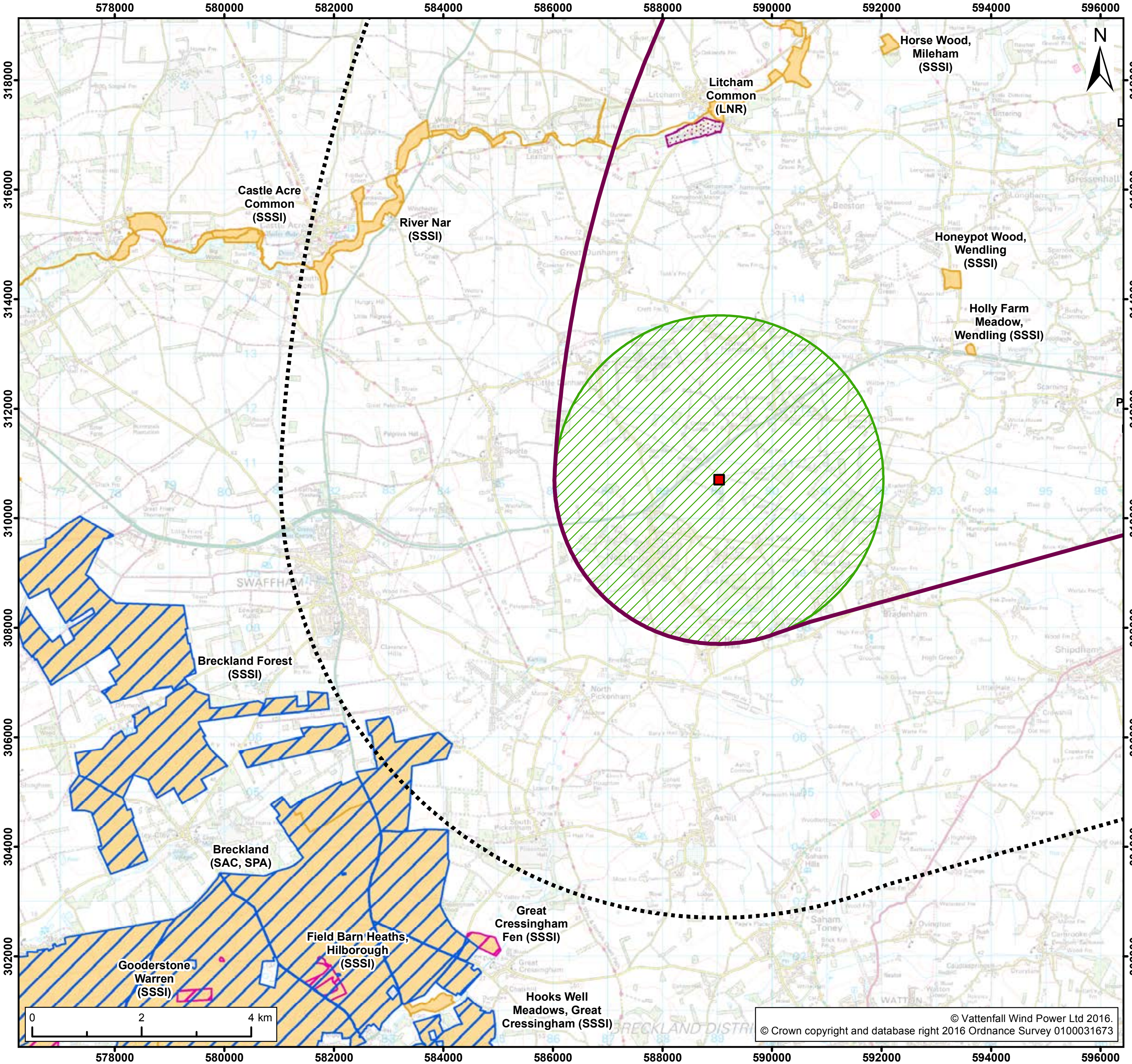

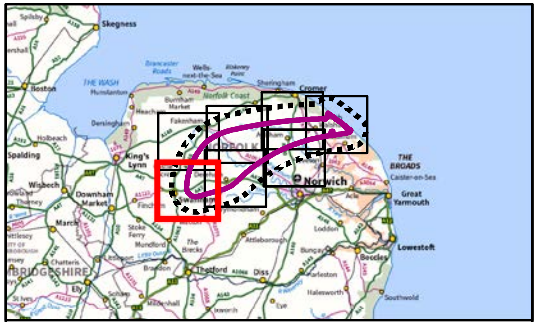

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Substation Search Area
- 5km Study Area
- Special Protection Area (SPA)[1]
- Special Area of Conservation (SAC)[1]
- Sites of Special Scientific Interest (SSSI)[1]
- Local Nature Reserve (LNR)[1]

[1] Natural England, 2016.
[2] RSPB, 2016.

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:
Statutory Designated Sites for Nature Conservation within 5km of the Scoping Area

Figure: 3.8g | Drawing No: PB4476-002-2-045

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	AB	RH	A4	1:100,000

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993. Of the designated sites falling within the survey area, six contain ornithological interest features relating to passage and/or wintering birds. A further eight contain ornithological interest features relating to breeding birds.

994. 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 3.7.1.4 below.

3.7.1.4 Ornithological interest features on passage/over winter

995. There are six sites listed in Table 3.11 above 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

996. Broadland SPA is located approximately 1.6km south of the scoping area boundary. The site is designated for the following features:

Table 3.12 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) Widgeon *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 *columbianus bewickii*, Whooper Swan *Cygnus cygnus*, Ruff *Philomachus pugnax*, Pink-footed Goose *Anser brachyrhynchus*, Gadwall *Anas strepera*, Bittern *Botaurus stellaris*, Great Crested Grebe *Podiceps cristatus*, Coot *Fulica atra*, Bean Goose *Anser fabalis*, White-fronted Goose *Anser albifrons albifrons*, Wigeon *Anas penelope*, Teal *Anas crecca*, Pochard *Aythya ferina*, Tufted Duck *Aythya fuligula*, Shoveler *Anas clypeata*.

Broadland Ramsar site

997. Broadland Ramsar site is located approximately 1.6km south of the scoping area boundary. The site is designated for the following features:

Table 3.13 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: Tundra swan, NW Europe 196 individuals, representing an average of 2.4% of the GB population (5 year peak mean 1998/9- 2002/3) Eurasian wigeon, 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, represeting an average of 3.1% of the GB population (5 year peak mean 1998/9- 2002/3) Northern 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 anser, Iceland/UK, Ireland 1007 individuals, representing an average of 1.1% of the population (Source period not collated)

Sutton Fen RSPB Reserve

998. Sutton Fen RSPB Reserve is located approximately 3.4km south of the scoping area boundary.

999. The Sutton Fen RSPB Reserve is comprised of fen habitat which forms part of the Broadland SPA and Ramsar site. The Reserve is closed to the public to ensure bird disturbance levels are minimised, making it particularly susceptible to anthropogenic disturbance. The site is not designated for specific features, but bittern and marsh harrier are associated with the site.

Dereham Rush Meadow SSSI

1000. Dereham Rush Meadow SSSI is located within the 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. However the site is also of interest as its winter floods are periodically used by waterfowl.

Westwick Lakes SSSI

1001. Westwick Lakes SSSI is located within the scoping area boundary. The site is notified as a SSSI as lakeland habitat which supports a number of interest features, including considerable ornithological interest with large flocks of wildfowl overwintering in the lakes.

1002. One lake (Perch Lake) attracts many species of diving duck in winter including goldeneye *Bucephala clangula* and goosander *Mergus merganser*.

Mattishall Moor SSSI

1003. Mattishall Moor SSSI is located within 1km of the scoping area boundary. The site is notified as a SSSI is an area of species-rich calcareous valley fen and marshy grassland, containing areas of wet alder woodland with scrub and open fen.

1004. The site supports reed bunting *Emberiza schoeniclus* and regularly records wintering snipe *Gallinago gallinago*.

Non-statutory Designated Sites

1005. A total of 176 non-statutory designated sites (CWS) have been identified within the onshore scoping area, as shown on Figure 3.6.

3.7.1.5 Birds of Conservation Concern 4 (BoCC4) 'Red list' Species

1006. Species listed on the Birds of Conservation Concern 4 (BoCC 4) 'Red list' are those identified by the UK's leading bird conservation organisations as being those of greatest 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 studied to identify those species which are present within the scoping area on passage and over winter.

1007. Table 3.14 shows the Red list species which have been recorded within the scoping area and in what abundance (over winter).

Table 3.14 BoCC4 Red List species within the onshore scoping area

Species	Relative abundance within the scoping area
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

Species	Relative abundance within the scoping area
Grey wagtail	Moderate
Hawfinch	Low
Linnet	High
Twite	Low (coast only)
Yellowhammer	High
Corn bunting	Low

3.7.1.6 UK Species of Principal Importance

1008. There are 49 UK bird Species of Principal Importance, all of which may be present within the onshore scoping area. 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 detailed in Table 3.15 below.

Table 3.15 UK bird Species of Principal Importance excluding BoCC 'Red List' species

Species	
Aquatic Warbler	Greater Scaup
Balearic Shearwater	Lesser Redpoll
Bewick's Swan (Tundra 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 Habitats of Principal Importance

1009. UK Habitats of Principal Importance are recorded within the onshore scoping area, as shown on Figure 3.7. Selected habitats provide importance habitat for breeding, passage and wintering birds. The following habitats have been recorded within the scoping area which have suitability to support breeding and passage/wintering bird species:

Breeding birds

- 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; and
* Reedbeds.

Passage/Wintering birds

* Reedbed;
* Lowland fen;
* Rivers and Lakes;
* Lowland heathland; and
* Coastal habitats.

1010. Farmland (pasture and arable), although not a UK Habitats of Principal Importance could also support breeding and passage/wintering bird species.

3.7.2 Potential impacts

3.7.2.1 Potential impacts during construction

1011. The potential impacts associated with construction are discussed below.

Temporary loss of habitat

1012. Temporary loss of habitat suitable for nesting, roosting and foraging birds along the cable corridor route 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.

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, potentially leading to reduced survival rates.

3.7.2.2 Potential impacts during operation

1013. The potential impacts associated with operation may include:

Operational noise and lighting associated with the relay and substations

1014. During operation there would be operational noise and lighting impacts which have the potential to impact on birds through disturbance to adjacent habitats.

Temporary disturbance associated with cable repair/maintenance

1015. In the unlikely event of cable failure access to buried cables may be required. Maintenance and repair will 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

1016. 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. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected the onshore cables will be removed from ducts and recycled, with the transition pits and ducts left *in situ*.

1017. 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.

1018. It is anticipated that the decommissioning impacts will be similar in nature to those of construction.

3.7.2.4 Potential cumulative impacts

1019. 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 Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

1020. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

1021. Cumulative impacts as a result of the works required by National Grid to connect Norfolk Vanguard to the existing Necton 400kV National Grid Substation will be included as part of this assessment.

3.7.2.5 Summary of potential impacts

Table 3.16 Summary of impacts relating to onshore ornithology

Potential impacts	Construction	Operation	Decommissioning
Temporary and permanent loss of habitat suitable for nesting, roosting and foraging birds	✓	✓	×
Noise, vibration and visual disturbance to birds	✓	✓	✓
Cumulative impacts	✓	✓	✓

scoped in (✓) and scoped out (×)

3.7.3 Mitigation

1022. 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; and
- Development of an EMP to include mitigation measures for birds.

3.7.4 Approach to assessment and data gathering

1023. The impact assessment will be undertaken using the CIEEM guidance for EcIA in the UK (CIEEM 2016).

1024. An initial desk assessment of existing ornithological data will be undertaken. 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.

1025. As detailed in Section 3.6, an Extended Phase 1 Habitat Survey will be conducted in 2017. This will cover the cable route, landfall location, cable relay station and substation plus a 50m buffer. Together the desk assessment data and the outcome of this survey will inform the need for any further surveys including dedicated ornithological surveys in relation to breeding birds.

1026. The Onshore Winter/Passage Bird Survey Scoping Report (unpublished) contains information regarding the proposed scope for the wintering bird surveys, and is subject to agreement with Norfolk County Council and Natural England. However, it has identified a need for further wintering bird surveys in relation to the supporting habitats of Broadland SPA and Ramsar site, and in relation to Dereham Rush Meadow, Mattishall Moor and Westwick Lakes SSSIs. These surveys will take the form of systematic walk-over surveys (e.g. using transects) along the supporting habitats identified within the Onshore Winter/Passage Bird Survey Scoping Report. Surveys of these habitats will be undertaken once per month between October 2016 and March 2017.

1027. The Onshore Winter/Passage Bird Survey Scoping Report identified no need for further surveys in relation to passage species.

1028. 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

1029. The daya sources used to inform the onshore archaeology and cultural heritage baseline are listed in the table below.

Table 3.17 List of available online data sources

Source	Data Viewed
Norfolk Heritage Explorer maintained by Norfolk Historic Environment Service	Online map and list of all recorded archaeological sites and find spots within the County.
The National Record for the Historic Environment (NRHE) maintained by Historic England.	A list of all recorded archaeological sites across England.
National Heritage List online maintained by Historic England	A list of all designated heritage assets across England.
North Norfolk District Council Planning website	List of all Conservation Areas within the district.

1030. Any additional data sets will be identified through feedback from stakeholders following this Scoping Request.

1031. This section presents a high level summary of the existing archaeological and cultural heritage baseline conditions recorded within the onshore scoping area in relation to

Norfolk Vanguard. The offshore archaeology and cultural heritage baseline is set out in Section 2.12.

1032. There are no World Heritage Sites within the onshore scoping area.

1033. There are 29 Scheduled Monuments within the onshore scoping area including the ruins of Bromholm Priory at Bacton within the cable relay station search area, and the site of Wendling Abbey towards the substation search area (see Figure 3.9).

1034. Within the onshore scoping area there are 52 Grade I Listed Buildings, 81 Grade II* Listed Buildings and 933 Grade II Listed Buildings. These are mostly clustered around the towns and villages located within the onshore scoping area as shown on Figure 3.9.

1035. There are five Conservation Areas within the onshore scoping area including those at Bacton, Happisburgh, Ingworth, Itteringham and North Walsham.

1036. Within the onshore scoping area there are five Grade II* and four Grade II Registered Parks and Gardens (see Figure 3.9). There are no Registered Battlefields within the onshore scoping area.

1037. There are a large number of non-designated heritage assets recorded on the Norfolk Historic Environment Record (NHER) within the onshore scoping area. These records provide evidence of human activity from the Lower Palaeolithic period through to modern times.

1038. At Happisburgh, within the landfall search area, 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.

1039. Evidence for past human activity is often identified from surviving earthworks and cropmarks recorded from aerial photographs. Examples of this from within the onshore scoping area include the Neolithic long Barrow at Stow Heath (MNF31740), numerous Bronze Age barrows and brunt mounds, Billingford Roman town (MNF56528), multi-period field systems and deserted medieval villages.

1040. Evidence of human activity can also be mapped through the artefacts left behind and later retrieved through metal detecting or by fieldwalking recently ploughed fields. At Salle, for example, a late Bronze Age hoard was discovered during metal detecting which included seven copper alloy socketed axeheads (MNF47592/MNF47358).

1041. Archaeological sites have also been discovered in advance of construction, for example Neolithic, Bronze Age and Iron features were recorded at Bittering Quarry

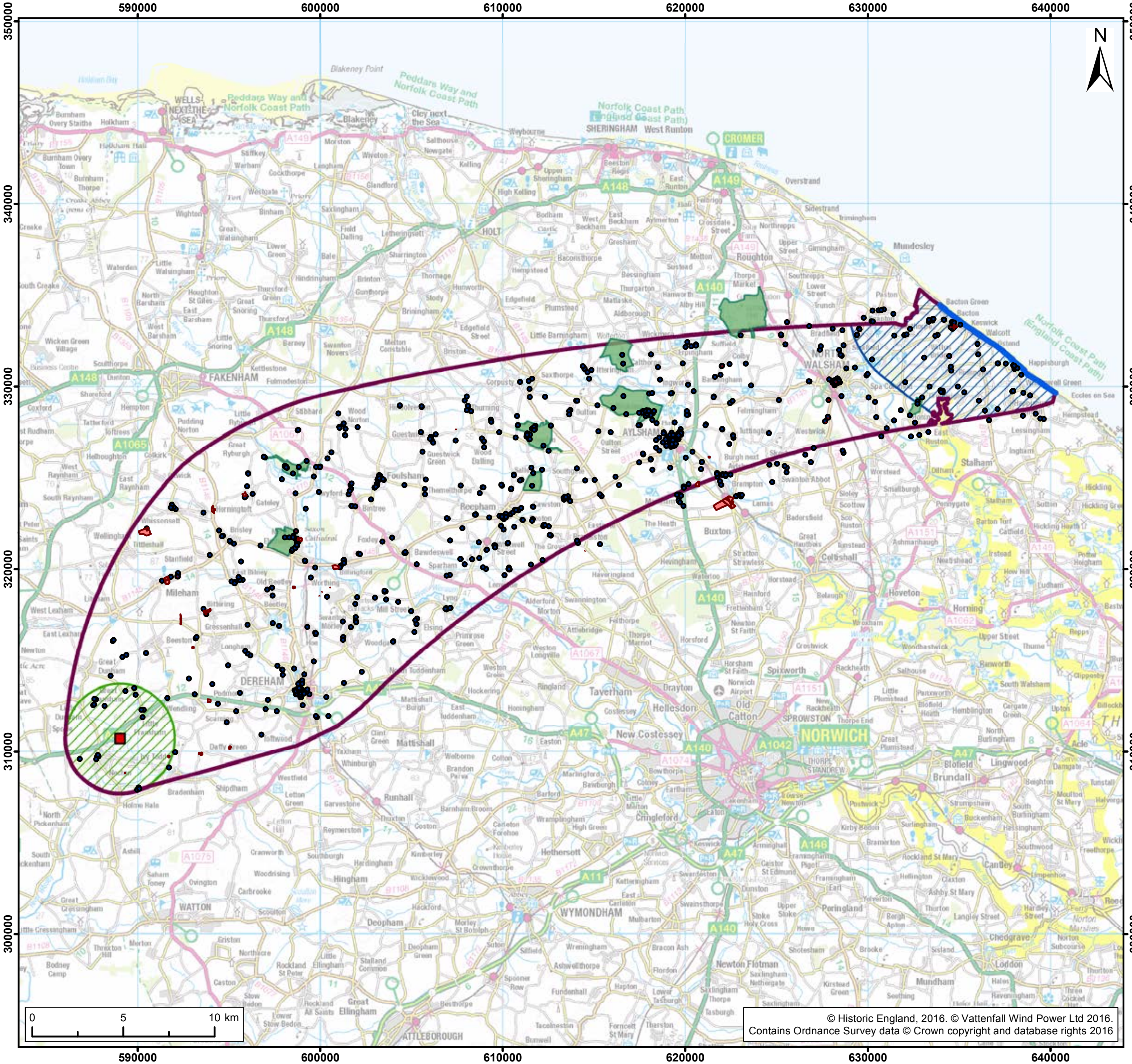
(MNF15995), multi-period activity including an early Saxon cemetery at Beetley Quarry (MNF41404) and prehistoric and Roman features were recorded in advance of a quarry extension at Bittery (MNF46877).

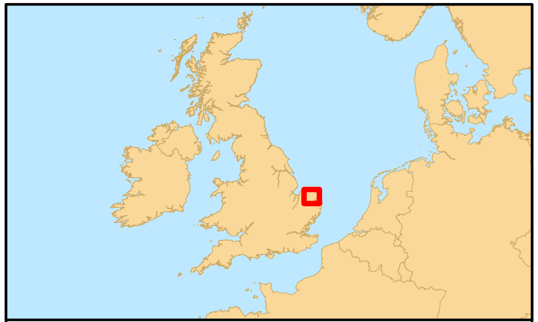
1042. Within the onshore scoping area, there is also a wealth of evidence dating back to the medieval and post-medieval periods in the form of settlements, agriculture and transport and communication links.

1043. 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). Numerous training camps and pillboxes are also recorded within the onshore scoping area, as well as aircraft crash sites.

1044. 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 within and 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 period that were not previously recorded.

1045. 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 enhance our understanding of past human activity and development within Norfolk.





Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Landfall Search Area
- Cable Relay Station Search Area
- Substation Search Area
- Scheduled Monuments
- Registered Parks and Gardens
- Listed Buildings

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Designated Heritage Assets within the Onshore Scoping Area

Figure: 3.9 Drawing No: PB4476-002-2-031

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
02	05/09/16	AB	RH	A4	1:300,000
01	02/08/16	JE	RH	A4	1:300,000

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

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together

3.8.2 Potential impacts

3.8.2.1 Potential impacts during construction

1046. The extent of any impact on buried archaeological remains, including palaeoenvironmental deposits, will depend on the presence, nature and depth of any such remains, in association with the depth of the proposed construction-related groundworks. Any adverse effect would likely be permanent and irreversible in nature.

1047. Potential impacts upon the setting of built heritage assets (both designated and non-designated) and the historic landscape would likely occur through the presence of machinery, construction traffic and general construction activities taking place within the onshore scoping area. The sight, noise and smell as well as any dust and vibration created during the construction phase could have an indirect impact upon built heritage assets and their settings. Where the works are buried any adverse effect would be likely to be temporary and reversible in nature.

3.8.2.2 Potential impacts during operation

1048. There will be no physical impacts to the buried archaeological remains or palaeoenvironmental deposits during the operation phase as any such impacts would have occurred during the construction phase.

1049. The completed development at the substation and the cable relay station could permanently alter the setting of built heritage assets and the historic landscape which could result in an impact upon their heritage significance.

1050. The onshore cable would not impact upon the setting of built heritage assets or the historic landscape as this will be buried.

3.8.2.3 Potential impacts during decommissioning

1051. 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. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected the onshore cables will be removed from ducts and recycled, with the transition pits and ducts left *in situ*.

1052. 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.

1053. There will be no physical impacts to the buried archaeological remains or palaeoenvironmental deposits during the decommissioning phase as any such impacts would have occurred during the construction phase.

1054. The potential impact upon the setting of built heritage assets and the historic landscape would be the same as those identified at the construction phase.

1055. Following the removal of the substation and the cable relay station, there would be an opportunity to restore, and potentially enhance, the setting of the affected built heritage assets and the historic landscape to the appearance and character recorded prior to construction. This could result in a beneficial impact.

3.8.2.4 Potential cumulative impacts

1056. 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 Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

1057. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

1058. Cumulative impacts as a result of the works required by National Grid to connect Norfolk Vanguard to the existing Necton 400kV National Grid Substation will be included as part of this assessment.

1059. For a cumulative impact to arise as a result of impacts during construction to buried archaeological remains, a development would have to share a boundary with the onshore scoping area and could therefore potentially affect the same buried archaeological resource during construction.

1060. Cumulative impacts at the construction, operation and decommissioning phases can arise where another development, when viewed from the onshore scoping area, would interrupt, for example, lines of sight between heritage assets which are related, or would contribute to changes in the key views from heritage assets, for example an increase in massing or height of buildings which are clearly visible in views from an asset, thereby altering their setting.

3.8.2.5 Summary of potential impacts

Table 3.18 Summary of impacts relating to onshore archaeology and cultural heritage

Potential impacts	Construction	Operation	Decommissioning
Direct impacts upon buried archaeological remains, including palaeoenvironmental deposits	✓	×	×
Direct impacts upon above ground heritage assets e.g. historic earthworks	✓	×	×
Indirect impacts through the alteration of the settings of built heritage assets	✓	✓	✓
Indirect impacts through the alteration of the setting of the historic landscape	✓	✓	✓
Cumulative impacts	✓	✓	✓

scoped in (✓) and scoped out (×)

3.8.3 Mitigation

1061. The information obtained from the desk-based study and evaluation stages would inform the EIA process, 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, such as preservation by record (archaeological excavation).

1062. A staged approach to archaeological evaluation and mitigation would be undertaken; this would involve the production of a desk-based assessment which would assess the significance of known heritage assets, and their settings, and the potential to uncover buried archaeological remains which are, at present, unknown.

1063. Depending on the findings of the desk-based assessment, there is the potential to use a combination of non-intrusive and/or intrusive archaeological investigations (as outlined below) in order to evaluate the presence/absence and significance of the buried archaeological remains. However, the archaeological evaluation approach would be discussed and agreed as part of the EPP with the Norfolk County Council Historic Environment Service and Historic England, where required. The methodology for each type of investigation would be set out within a survey specific Written Scheme of Investigation (WSI).

1064. In consultation with the Norfolk County Council Historic Environment Service and Historic England (and where required, including the Historic England Regional Science Advisor) a mitigation strategy would be prepared outlining a programme of further archaeological investigations, including excavation and watching brief (archaeological monitoring) requirements as well as preservation *in situ* where warranted and appropriate, prior to and during the construction phase.

3.8.4 Approach to assessment and data gathering

1065. As part of the EIA process, an onshore Historic Environment (Archaeology, Built Heritage and Historic Landscape) Baseline Assessment will be undertaken, including, but not limited to the following:

- Description of the known and potential past human activities that were undertaken overtime, based on available records which will be obtained from the NHER, Historic England's National Record for the Historic Environment and the National Heritage List online, and the archives contained at the Norfolk Record Office;
- A Settings Assessment of all designated and key non-designated built heritage assets; and
- An assessment of the significance (heritage value) of the assets identified in the baseline assessment.

1066. The assessment will identify the impacts of Norfolk Vanguard, assess the effects and identify appropriate mitigation measures if required. This process will lead to an assessment of residual impact of the project on archaeological resources, built heritage assets and the historic landscape.

1067. The assessment will consider direct impacts, setting impacts and indirect impacts.

1068. The assessment will be undertaken in accordance to relevant standards and guidance provided by the Chartered Institute for Archaeology (CIfA) and Historic England. Specific reference will be made to a range of guidance including, but not limited to, the following:

- 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; and
- English Heritage (2008) Conservation Principles: Policy and Guidance for the Sustainable Management of the Historic Environment.

1069. The scope of archaeological fieldwork could entail a programme of non-intrusive (i.e. field walking, metal detecting, geophysical survey) and intrusive (i.e. trial trenching) archaeological investigations to inform the EIA process or prior to the construction phase. However, the archaeological approach would be discussed and agreed as part of the EPP with the Norfolk County Council Historic Environment Service and Historic England, where required. Any works required would be proportionate to the scale of likely impacts.

1070. An assessment of the setting of heritage assets on the coast from landfall and nearshore construction activities will be considered in conjunction with a settings assessment for onshore archaeology and cultural heritage and cross referenced with the landscapes and visual impact assessment sections of the ES. This will include the assessment of both designated and non-designated heritage assets with a setting that contributes to the significance of that asset and which may be impacted by Norfolk Vanguard.

1071. 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.

3.9 Onshore Noise and Vibration

3.9.1 Baseline

3.9.1.1 Data sources

1072. This desk-based assessment has used existing available geographical information to identify noise sensitive receptors and noise sources present within the scoping area.

1073. The data sources used to inform this desk-based assessment are shown in Table 3.19.

Table 3.19 Data sources

Data	Source	Date
Location of noise sources and sensitive receptors within the scoping area	Google Maps Aerial Photography	2016

1074. Any additional data sets will be identified through feedback from stakeholders following this Scoping Request.

1075. The cable relay station search area is located on the North Norfolk Coast within 5km of Bacton Green and Eccles-on-Sea, and is predominantly a rural area 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 to the north at Paston. The northern tip of the Norfolk Broads National Park has been excluded from the search area.

1076. The substation search area is located around 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. The area is generally rural in nature with the village of Necton containing the largest concentration of residential properties. Smaller villages and isolated residential properties are also located within the search area.

1077. The onshore scoping area, which runs from the cable relay station search area on the coast to the substation search area around the existing Necton 400kV National Grid Substation, is again predominantly rural in nature. The largest settlements within the area are at North Walsham, Aylsham and Dereham, the Robertson Barracks at Swanton Morley and smaller villages and isolated residential properties 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

1078. 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

1079. The potential temporary impacts of construction noise may arise from:

- Activities carried out on the surface along the proposed cable corridor (mainly earth moving and excavation);
- Construction activities at the substation and cable relay station sites including any potential landscaping;
- Directional drilling activities;
- Heavy goods vehicles servicing the proposed cable corridors, cable relay station and 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.

3.9.2.2 Potential impacts during operation

1080. The potential permanent impacts of operational noise from the substation and cable relay station may arise from:

- The inherent operational noise from the proposed development, and its characteristics;
- The proximity of the proposed development to noise sensitive premises (including residential properties) and noise sensitive areas (including PRoW and the Norfolk Broads National Park);

- The proximity of the proposed development to quiet places and other areas that are particularly valued for their acoustic environment or landscape quality; and
- The proximity of the proposed development to designated sites where noise may have an adverse impact on protected species or other wildlife.

1081. There are unlikely to be any noise and vibration impacts relating to operational or maintenance vehicular traffic but operational noise impacts may arise from the operation of equipment within the 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.

1082. There are considered to be no significant sources of vibration associated with the operational scheme and operational vibration impacts have therefore been scoped out of further assessment.

3.9.2.3 Potential impacts during decommissioning

1083. 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. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected the onshore cables will be removed from ducts and recycled, with the transition pits and ducts left *in situ*.

1084. 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.

1085. It is anticipated that the decommissioning impacts will be similar in nature to those of construction, but will be more limited in geographical extent and timescale.

3.9.2.4 Potential cumulative impacts

1086. 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 Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

1087. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

1088. Cumulative impacts as a result of the works required by National Grid to connect Norfolk Vanguard to the existing Necton 400kV National Grid Substation will be included as part of this assessment.

1089. 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.

1090. 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 will not be significant.

1091. Operational noise impacts, particularly of the substation, will be considered in conjunction with the consented Dudgeon Offshore Wind Farm substation and other potential proposed developments, subject to the location of the onshore infrastructure.

3.9.2.5 Summary of potential impacts

Table 3.20 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	✓	×	✓
Cumulative impacts	✓	✓	✓

scoped in (✓) and scoped out (×)

3.9.3 Mitigation

1092. The construction works would use BPM to limit the impacts of noise at sensitive receptors. Those measures will be set out in the CoCP.

1093. Operational mitigation measures likely to be considered as part of this scheme will involve:

- Locating the 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; and
- Locating equipment to take advantage of screening inherent in the design, i.e. from the substation hall(s) or control room buildings.

3.9.4 Approach to assessment and data gathering

1094. Noise and vibration issues associated with the onshore elements of the Norfolk Vanguard construction works including cable installation, substation, cable relay station 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.

1095. 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.

1096. The spatial scope of the construction noise assessment would include the following geographic coverage:

- 400m from the cable corridor routes where significant activities could affect noise sensitive receptors; and
- Traffic routes and routes subject to significant changes in traffic flows (and/or percentage HGV) associated with the construction of the project.

1097. Operational impacts would include noise impacts associated with the substation and cable relay station. The guidance and methodology contained in BS 4142:2014 would be used to assess noise impacts arising from the substation and cable relay station.

1098. The tasks required to progress the assessment will include:

- Initial liaison with the local authorities to agree approach, methodology and criteria to be used for the noise assessment;
- Shorter term (daily), baseline noise surveys along the route of the 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 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 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 cable corridor, the cable relay station and the substation;
- Assess construction traffic noise impacts; and
- Assess operational noise impacts of the substation.

1099. 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.

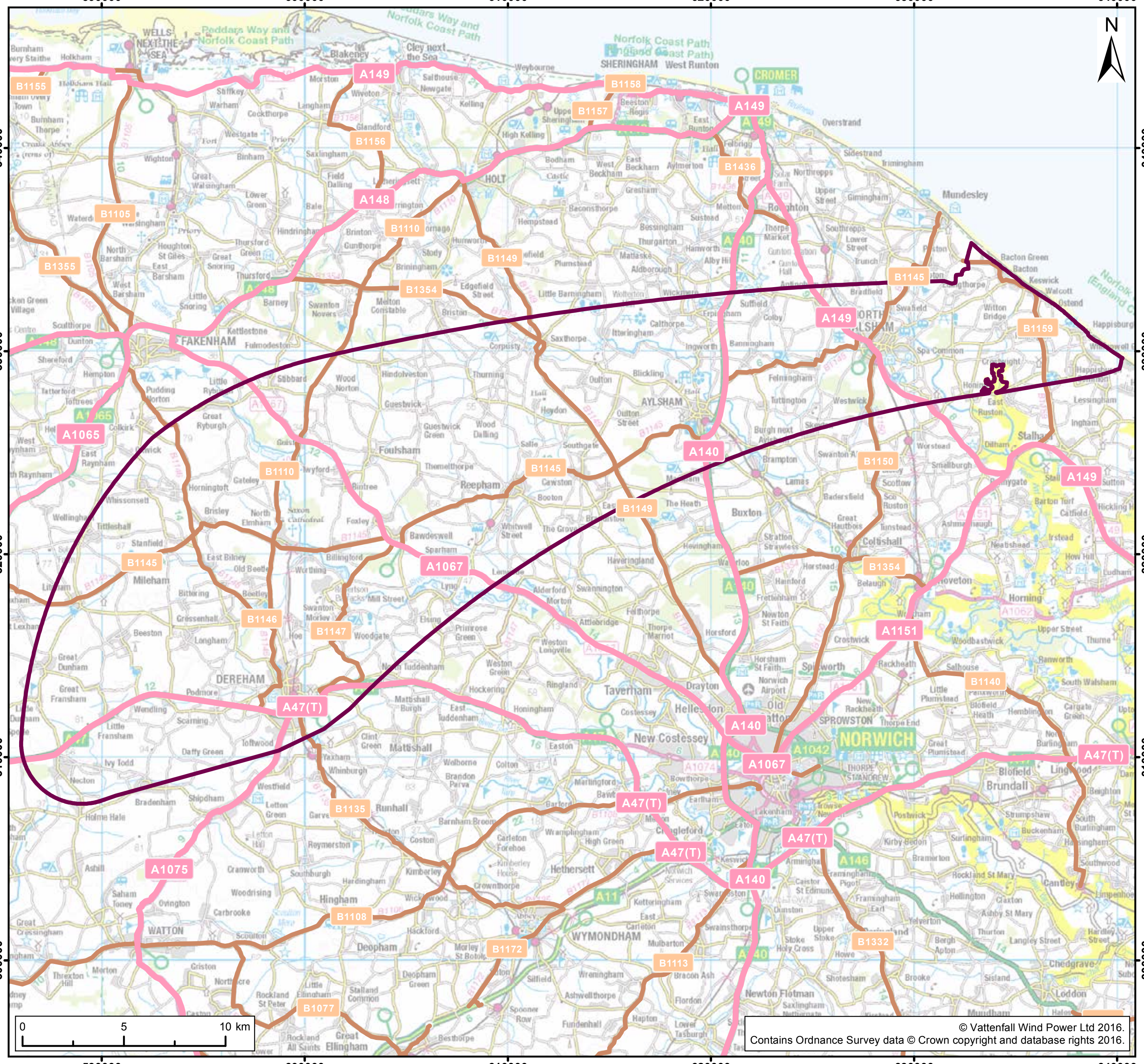
3.10 Traffic and Transport

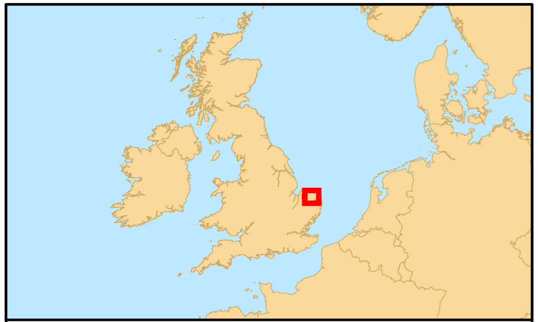
3.10.1 Baseline

1100. 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 3.10).

1101. 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 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 substation the A47 carries in the region of 15,380 vehicles per day of which 10.1% are HGVs.

1102. 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 Tuddenhanm and Easton.





Legend:
- Onshore Scoping Area
- A Road
- B Road

Project: Norfolk Vanguard Offshore Wind Farm	Report: Environmental Impact Assessment Scoping Report

Title: Strategic Road Network

Figure: 3.10 | Drawing No: PB4476-002-2-034

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	AB	ST	A4	1:275,000

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

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1103. 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.

1104. 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.

1105. 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.

1106. 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.

The major route for through traffic is the A148 and A149 from Kings Lynn via Cromer to Great Yarmouth…"

1107. 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. "

1108. 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).

1109. 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."

3.10.2 Potential impacts

3.10.2.1 Potential impacts during construction

1110. The construction phase will result in a requirement for the import of materials and plant to the onshore cable route, substation and cable relay station. At this scoping stage, no information is available with regards to likely material quantities and workforce numbers, however it is envisaged that daily traffic demand is likely to be significant with a large component being HGV deliveries and also the potential requirement for abnormal loads to consider.

1111. 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:

- Increasing traffic congestion impacting upon commuters and seasonal tourist traffic with associated effects including:
    - Driver delay;
    - Severance;
    - Pedestrian/cycle amenity (e.g. PRoW and cycle networks); and
    - Air quality, and noise and vibration (considered separately in Section 3.3 and Section 3.9).
- 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 delivery routes for HGVs, plant and abnormal loads.

1112. In addition to considering the onshore impacts there is also the potential for impacts associated with employee and HGVs movements for the offshore construction via the primary base port for the operations and maintenance.

1113. Section 1.1.3 identifies that at this stage no final decision has been made upon which port will be used, however it is noted this may be a facility on the Norfolk coast. The traffic impacts of the primary base port are likely to be of similar scope to those outlined in Section 1.1.3 and will be assessed when the actual site has been announced in context with any port operating permissions.

3.10.2.2 Potential impacts during operation

1114. The substation and cable relay station will not be permanently manned, however, O&M staff will visit on a regular basis (e.g. monthly) to carry out routine checks and maintenance. In addition, key maintenance campaigns will take place every summer, during which time there will be teams working 24/7 in order to complete the tasks quickly and return any affected equipment to service. Most annual maintenance campaigns will be short (approximately 1 week), but if required some campaigns may be longer (e.g. 1-2 months).

1115. Security at the cable relay station and substation will be provided using perimeter fencing and gates, plus intruder detection and CCTV systems. Occasional access will be required at the joint bays with cross-bonding.

1116. 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.

1117. 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 substation etc.

3.10.2.3 Potential impacts during decommissioning

1118. 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. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected the onshore cables will be removed from ducts and recycled, with the transition pits and ducts left *in situ*.

1119. 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.

1120. It is anticipated that the decommissioning impacts will be similar in nature to those of construction.

3.10.2.4 Potential cumulative impacts

1121. 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 Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

1122. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

1123. Cumulative impacts as a result of the works required by National Grid to connect Norfolk Vanguard to the existing Necton 400kV National Grid Substation will be included as part of this assessment.

3.10.2.5 Summary of potential impacts

Table 3.21 Summary of impacts relating to traffic and transport

Potential impacts	Construction	Operation	Decommissioning
Highway safety	✓	✓	✓
Driver delay	✓	✓	✓
Pedestrian amenity	✓	×	✓
Severance	✓	×	✓
Abnormal loads	✓	×	✓
Cumulative impacts	✓	×	✓

scoped in (✓) and scoped out (×)

3.10.3 Mitigation

1124. The environmental assessment will determine the requirement for the implementation of mitigation measures to reduce the significance of the impact to transport receptors. If it is assessed that there is the potential for significant impacts to arise, the following mitigation measures could be introduced to reduce the significance of the impact to an acceptable level (however this will be fully investigated during the environmental assessment):

- Identify suitable access points and identification of optimum routes and times for construction traffic to use (minimising the impact on sensitive receptors);
- Reducing points of access through the adoption of extra haul road and HDD under roads;
- Haul road and running track design to minimise requirement for importing materials;
- Consolidating HGV and employee movements at consolidation areas close to main roads to reduce vehicle movements along more sensitive local routes;
- Committing to the development of a Construction Traffic Management Plan (CTMP) to manage employee and HGV movements to avoid sensitive times, use only defined routes, comply with maximum HGV ‘caps’ and set out strategies to continually monitor and enforce;

- Committing to repair or make good any damage caused to existing highways due to construction traffic movements;
- Providing induction briefings to drivers covering topics such as agreed delivery routes and times, and any specific road safety risks; and
- Localised temporary speed limits and traffic management measures.

1125. The above list is not intended to represent an exhaustive list of potential mitigation measures; however such mitigation measures have potential to effectively manage the risk to transport receptors. Where possible mitigation measures will be embedded into the project design to reduce the residual impacts.

3.10.4 Approach to assessment and data gathering

1126. 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.

1127. GEART suggests the following rules to define the extent and scale of the assessment required:

- Rule 1: Include highway links where traffic flows are predicted to increase by more than 30% (or where the number of HGVs is predicted to increase by more than 30%).
- Rule 2: Include any other specifically sensitive areas where traffic flows are predicted to increase by 10% or more.

1128. The above criterion applied to the proposed scheme traffic demand will dictate the extent of the study area and the scale of the impact assessment.

1129. Traffic demand will be derived by way of a 'first principles' approach whereby traffic generation is calculated from an understanding of likely material demand and resourcing requirements. These numbers will be informed by industry experts, drawing on their experience of delivering and operating offshore wind farm projects.

1130. The project's traffic demand would be assigned to the highway links within the study area and the increase in traffic flow to baseline conditions determined. This would facilitate an assessment of the magnitude of effect as set out in Table 3.22.

Table 3.22 Magnitude of effects thresholds

<table>
<tr><th>Effect</th><th>Very Low</th><th>Low</th><th>Medium</th><th>High</th></tr>
<tr><td>Highway safety</td><td colspan="4">Informed by a derivation of collision rates at junctions based upon the existing personal injury collision records and the forecast increase in traffic</td></tr>
<tr><td>Driver delay</td><td colspan="2">Junction/link continues to operate with spare capacity</td><td>Junction/link is at or close to capacity</td><td>Junction/link is operating over capacity</td></tr>
<tr><td>Pedestrian amenity</td><td>Change in traffic flow (or HGV component) less than a 100%</td><td colspan="3">Greater than 100% increase in traffic (or HGV component) and a review based upon the quantum of vehicles, vehicle speed and pedestrian footfall</td></tr>
<tr><td>Severance</td><td>Change in total traffic flow of less than 30%</td><td>Change in total traffic flows of 30-60%</td><td>Change in total traffic flows of 60-90%</td><td>Changes in total traffic flows of over 90%</td></tr>
</table>

1131. 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. The sensitivity would be determined by the concentration of sensitive receptors served by that link (e.g. schools, tourist hot spots, recreational facilities, district centres).

1132. In addition, all proposed delivery routes will be assessed for their suitability to accommodate forecast HGV traffic and abnormal loads.

1133. 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.

1134. To facilitate the impact assessment, the following data will be obtained:

- 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 traffic at the preferred port location.

1135. 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

1136. The consideration of human health is 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

1137. The Health Impact Review (HIR) will identify potential impacts on the health of the local population in relation to the proposed project. 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.

1138. 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 substation search area is located around the village of Necton to the west of the larger town of Dereham. This is also rural in nature with the village of Necton containing the largest concentration of residential properties.

1139. 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.

3.11.2 Potential impacts

3.11.2.1 Potential impacts during construction

1140. 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:

- Noise impacts;
- Dust and other air emissions (including odour);
- Hazardous waste and substances;
- Temporary loss of access to green space;
- Disruption to local road network (reduced access to services and amenities); and
- Increased local employment.

3.11.2.2 Potential impacts during operation

1141. 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:

- Noise disturbance in the proximity of the operational substation and cable relay station;
- Electromagnetic Fields (EMFs) generated above the buried cable route;
- Increased local employment.

3.11.2.3 Potential impacts during decommissioning

1142. 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. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected the onshore cables will be removed from ducts and recycled, with the transition pits and ducts left *in situ*.

1143. 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.

1144. It is anticipated that the decommissioning impacts will be similar in nature to those of construction.

3.11.2.4 Potential cumulative impacts

1145. 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 Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

1146. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

1147. Cumulative impacts as a result of the works required by National Grid to connect Norfolk Vanguard to the existing Necton 400kV National Grid Substation will be included as part of this assessment.

3.11.2.5 Summary of potential impacts

Table 3.23 Summary of impacts relating to health

Potential impacts	Construction	Operation	Decommissioning
Noise disturbance	✓	✓	✓
Dust	✓	x	✓
Temporary loss of access to green space	✓	x	✓
Disruption to local road network	✓	x	✓
Increased local employment	✓	✓	✓
EMF (above buried onshore cables)	x	✓	x
Cumulative	✓	✓	✓

scoped in (✓) and scoped out (×)

3.11.3 Mitigation

1148. 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.

3.11.4 Approach to assessment and data gathering

1149. There are no specific guidelines which inform the management or assessment of health impacts. The Overarching National Policy Statement for Energy (EN-1) (DECC, 2011a) states that where the proposed project 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.

1150. 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.

1151. 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.

1152. 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.

3.12 Onshore Inter-relationships

1153. The EIA will identify the full range of inter-relationships which are likely to result from the construction, operation and decommissioning of Norfolk Vanguard. The inter-relationships relevant to the onshore environment are outlined in Table 3.24.

Table 3.24 Onshore inter-relationships

Onshore topics	Inter-relationships
Ground Conditions and Contamination	Will have effects on: • Land use • Onshore ecology
Air Quality	Is affected by: • Traffic and transport Will have effects on: • Health • Onshore Ecology • Onshore Ornithology
Water Resources and Flood Risk	Is affected by: • Ground conditions and contamination Will have effects on: • Health • Onshore Ecology • Onshore Ornithology
Land Use	Is affected by: • Ground conditions and contamination • Traffic and transport • Socio-economics
Onshore Ecology	Is affected by: • Water resources and flood risk • Air quality • Noise and vibration • Ground Conditions and Contamination
Onshore Ornithology	Is affected by: • Water resources and flood risk

Onshore topics	Inter-relationships
	• Air quality • Noise and vibration
Onshore Archaeology and Cultural Heritage	Is affected by: • Landscape and visual • Noise and vibration
Onshore Noise and Vibration	Is affected by: • Traffic and transport Will have effects on: • Onshore Ecology • Onshore Ornithology • Onshore Archaeology and Cultural Heritage • Health
Traffic and Transport	Will have effects on: • Noise and vibration • Air quality • Land Use • Health
Health impacts	Is affected by: • Water resources and flood risk • Air quality • Noise and vibration • Traffic and transport • Tourism and recreation • Socio-economics

1154. The approach to onshore inter-relationships will be discussed with relevant stakeholders during the EPP.

3.13 Cumulative Impacts Summary

1155. 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 Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

1156. The assessment will consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

1157. Cumulative impacts as a result of the works required by National Grid to connect Norfolk Vanguard to the existing Necton 400kV National Grid Substation will be included as part of this assessment.

1158. Table 3.25 collates the scoping of onshore cumulative impacts discussed in Sections 3.2 to 3.10.

Table 3.25 Summary of onshore cumulative impacts

Potential impacts	Construction	Operation	Decommissioning
Ground Conditions and Contamination	✓	✓	✓
Air Quality	✓	×	✓
Water Resources and Flood Risk	✓	✓	✓
Land Use	✓	✓	✓
Onshore Ecology	✓	✓	✓
Onshore Ornithology	✓	✓	✓
Onshore Archaeology and Cultural Heritage	✓	✓	✓
Onshore Noise and Vibration	✓	✓	✓
Traffic and Transport	✓	×	✓
Health	✓	✓	✓

scoped in (✓) and scoped out (×)

4 PART 4 WIDER SCHEME ASPECTS

4.1 Introduction

1159. This section presents the main baseline characteristics of the environment associated with wider scheme aspects, i.e. those which can be affected by the offshore project area and/or the onshore scoping area. The potential impacts of Norfolk Vanguard during construction, O&M, and decommissioning are considered. Where there is no pathway for a potential impact, impacts are proposed to be scoped out and not considered further within the EIA process. Where impacts are proposed to be scoped out these are clearly identified within the relevant section of this report. Where impacts are proposed to be scoped in to the full EIA, an overview of the approach to the EIA is provided along with potential mitigation measures.

1160. The following questions are suggested for consideration while reviewing each onshore section and providing responses for inclusion in the Scoping Opinion:

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

Q6. 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)

1161. The onshore scoping area is shown in Figure 1.2, the onshore cable search area is shown in Figure 1.5, the landfall search area is shown in Figure 1.3, the cable relay station search area is shown in Figure 1.6, and the onshore substation search area in Figure 1.4.

1162. The proposed study areas for the onshore components of the proposed project, in respect of the LVIA, would extend to define a limit beyond which professional judgement considers it would be unlikely for significant impacts to arise. This judgement is based on previous working knowledge of similar projects and an understanding of the character of the local landscape and scale of the construction and components of the onshore proposed project.

1163. Therefore, the proposed study area for the assessment of the onshore cable route would extend to a continuous band of 1km (500m on either side of the centre line of the cable). The proposed study area for the landfall would extend to a radius of 1km around the outer extent of the landfall site, and for the cable relay station, to a radius of 2km. In respect of the substation, a study area of a 5km radius would be applied. The scoping figures currently indicate the search area boundaries. The study areas used in the LVIA will be based on the above distances from the proposed site components, once they have been identified, rather than the broader extent of the search areas.

1164. The offshore project area is shown in Figure 1.1. The potential for significant impacts to arise in respect of the offshore components would be limited by the distance of the offshore wind farm sites as discussed in Section 1.1.1. Potential impacts associated with the presence of cable laying vessels close to the coast would be assessed in respect of onshore receptors along the coast (Section 1.4).

4.2.1.2 Landscape character

1165. The English Landscape is classified at the national level by National Character Areas (NCAs). The 159 NCAs, which cover the country, were originally identified by the Countryside Agency. This mapping and the associated descriptions have been revised and developed by Natural England into National Character Area profiles which provide a recognised, national, spatial framework.

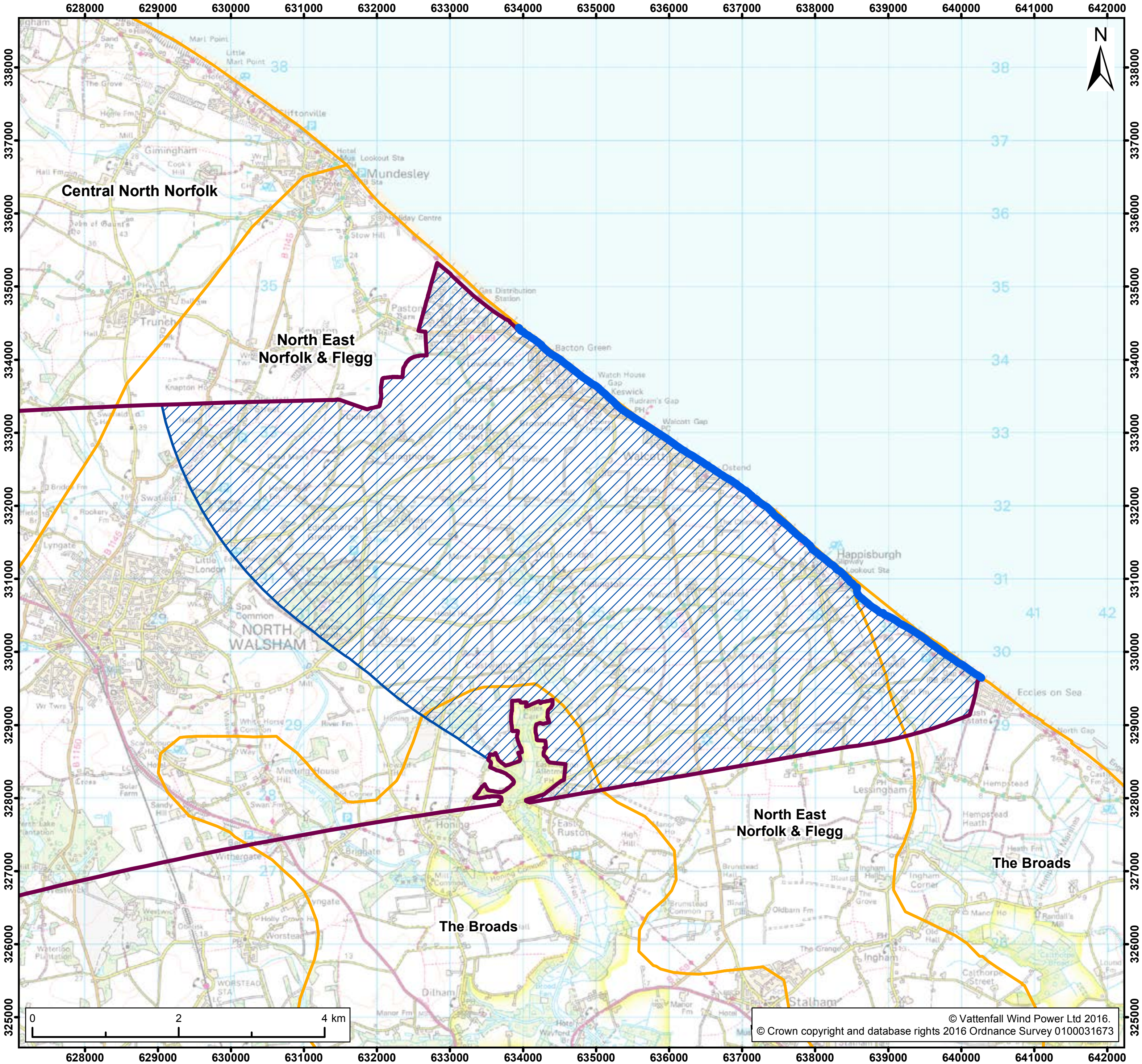
1166. The study areas for Norfolk Vanguard are subject to the following NCAs as shown in Figure 4.1 and Figure 4.2:

- Landfall – North East Norfolk and Flegg (79) and The Broads (80);
- Cable relay station – Central North Norfolk (78);
- Onshore cable route – Central North Norfolk (78) and Mid Norfolk (84); and
- Substation – Mid Norfolk (84).

1167. Local Authorities across England have produced Landscape Character Assessments (LCAs) for their areas which subdivide the broader NCAs into more detailed Landscape Character Types (LCTs) and units. The relevant LCAs in Norfolk include the following.

- North Norfolk Landscape Character Assessment (June 2009);
- Broadland District Landscape Character Assessment (Sept 2013);
- Breckland District Landscape Character Assessment (May 2007); and
- North and South Brecks Landscape Character Assessment (Oct 2013).

1168. The distribution of the LCTs within the potential study areas and described by these LCAs is shown in Figure 4.3 and Figure 4.4. The LVIA would prepare a baseline assessment of the relevant LCTs and units and assess the potential impacts of the onshore infrastructure on the LCTs as landscape receptors.



Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Landfall Search Area
- Cable Relay Station Search Area
- National Character Area[1]

[1] Natural England, 2016

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: National Character Area - Landfall/Cable Relay Station

Figure: 4.1 | Drawing No: PB4476-002-2-47

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	09/09/16	TH	LT	A4	1:75,000

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

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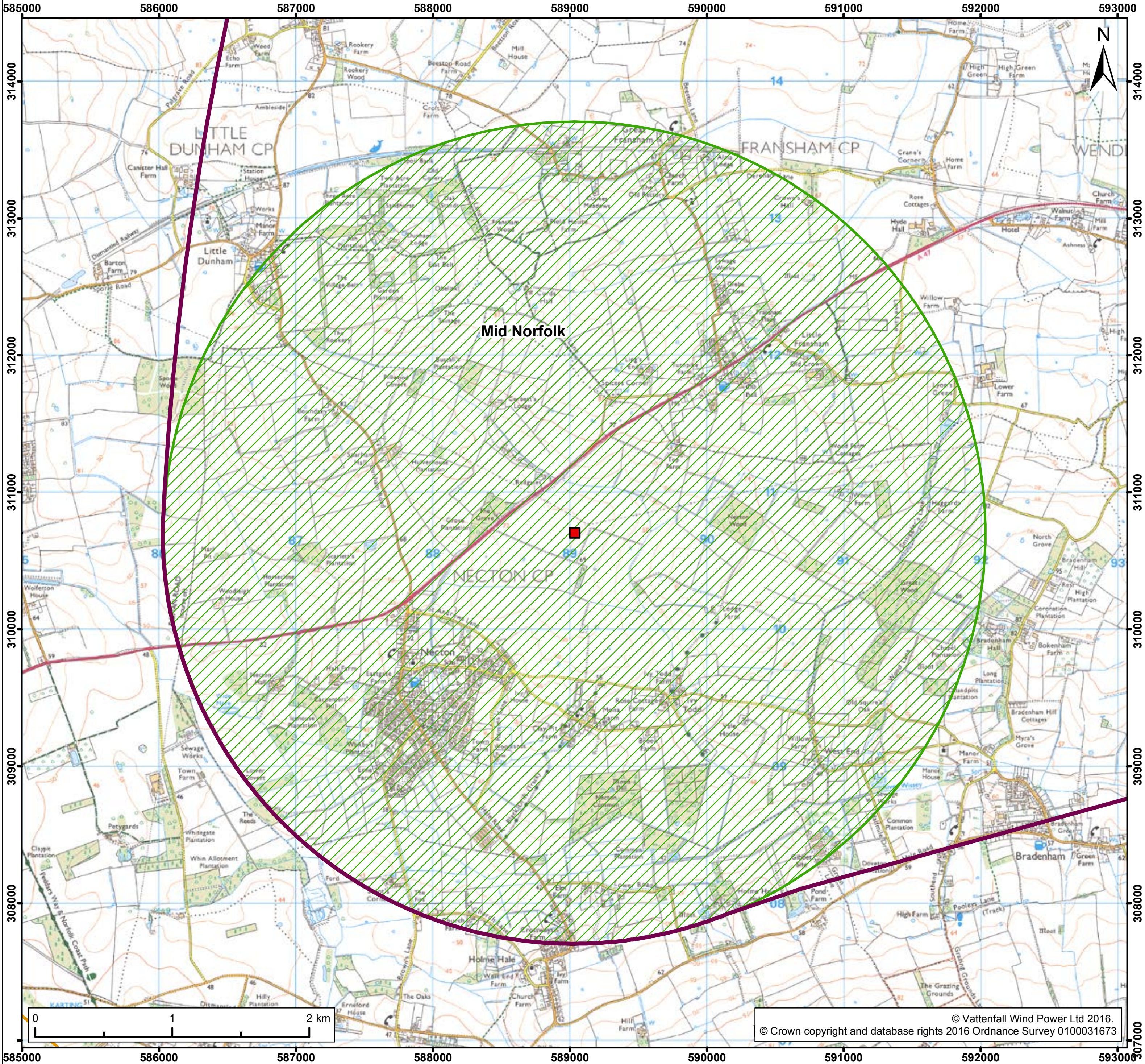

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Substation Seach Area
- National Character Area [1]

[1] Natural England, 2016

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: National Character Area - Substation

Figure: 4.2 Drawing No: PB4476-002-2-48

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	09/09/16	TH	LT	A4	1:40,000

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

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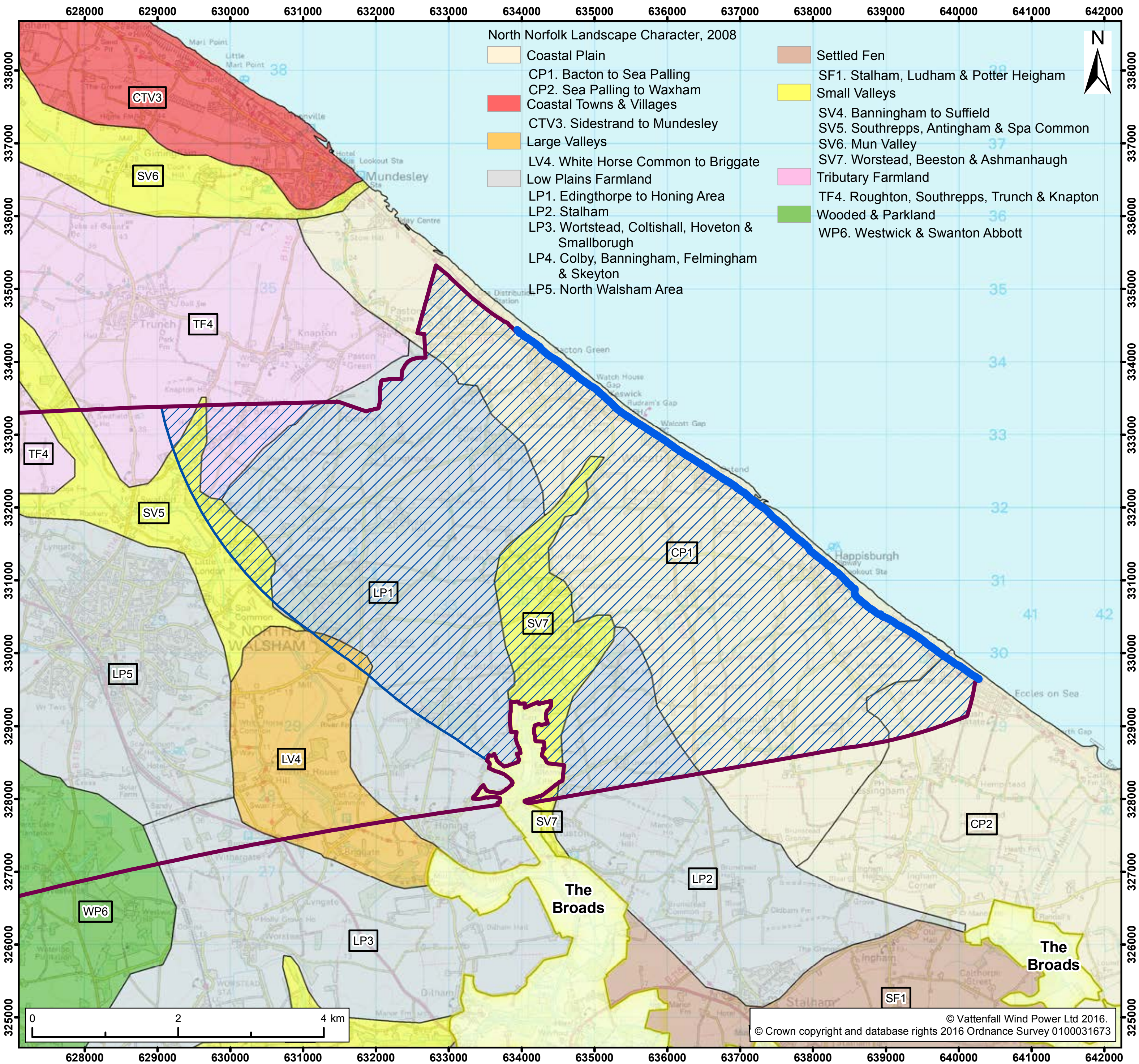

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Landfall Search Area
- Cable Relay Station Search Area
- National Park [1]

[1] Natural England, 2016

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Local Landscape Character Areas - Landfall/ Cable Relay Station

Figure: 4.3 | Drawing No: PB4476-002-2-49

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	09/09/16	TH	LT	A4	1:75,000

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

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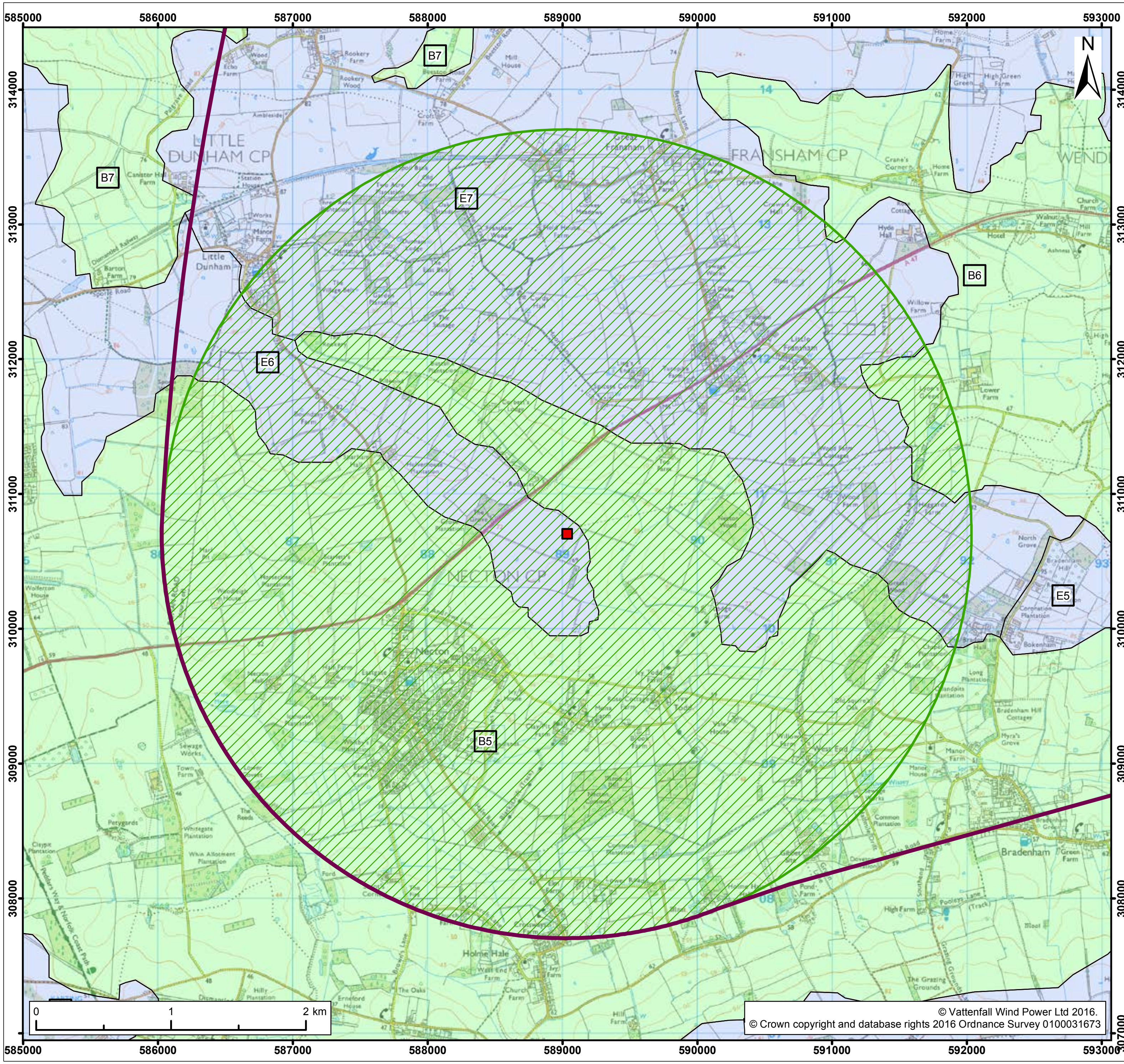

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Substation Seach Area

Breckland Landscape Character, 2007

- Settled Tributary Farmland
  - B5. River Wissey Tributary Farmland
  - B6. River Wensum & Tud Tributary Farmland
  - B7. River Nar Tributary Farmland
- Plateau Farmland
  - E5. Central Breckland Plateau
  - E6. North Pickenham Plateau
  - E7. Beeston Plateau

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Local Landscape Character Areas - Substation

Figure: 4.4 | Drawing No: PB4476-002-2-50

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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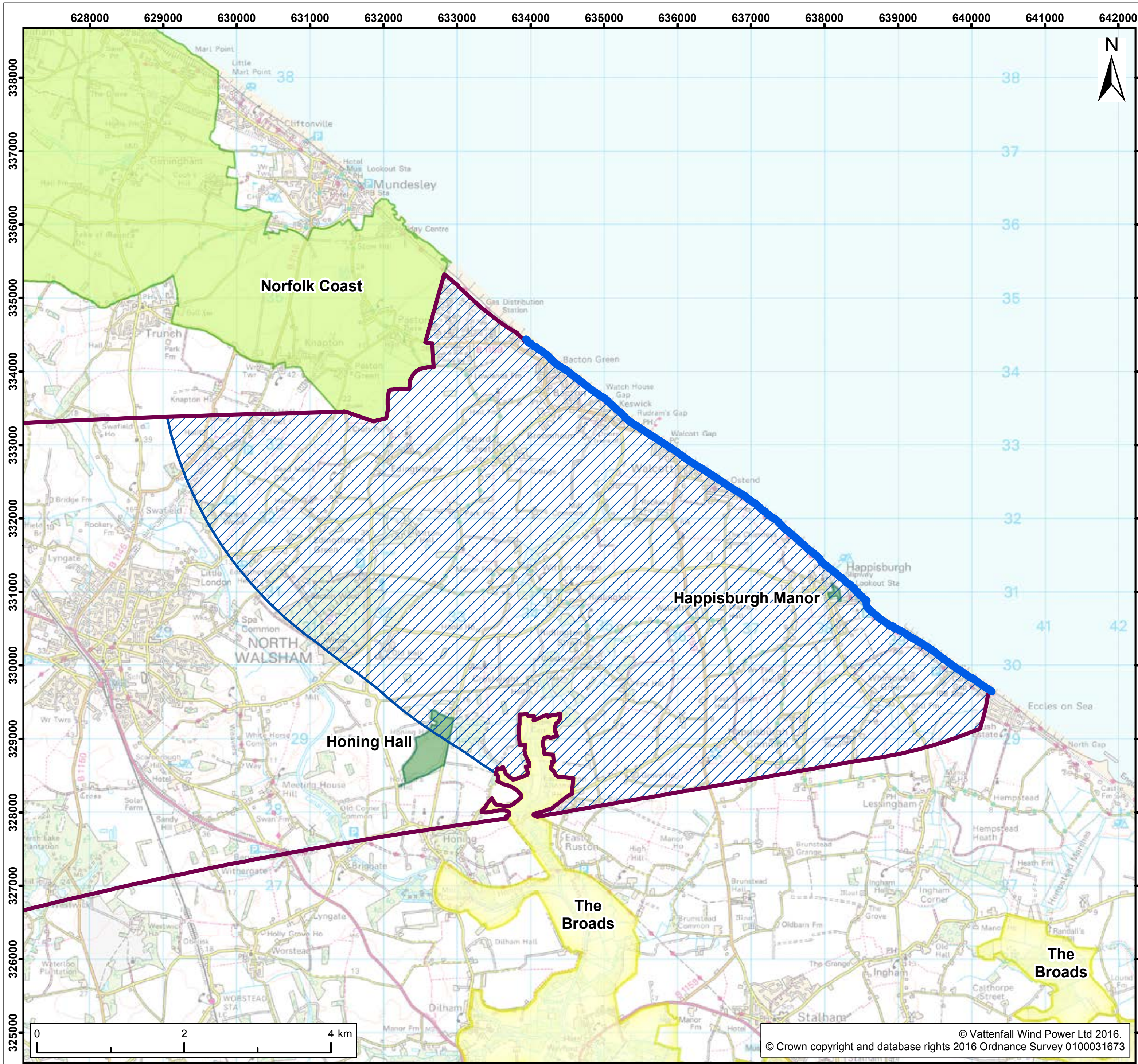
4.2.1.3 Landscape Designations

1170. The search areas for the onshore components of Norfolk Vanguard all lie outside land subject to any international, national or regional landscape designation intended to protect landscape quality as shown in Figure 4.5 and Figure 4.6. A number of landscape designations occur in the surrounding landscapes and include the nationally important Norfolk Coast AONB and The Broads National Park. Although it is unlikely that the proposed project would have a significant impact on these designated landscapes owing to their potential distance from the onshore components and the relative scale of the components and associated construction and decommissioning works. The potential for indirect impacts would be considered in the LVIA to reflect the sensitivity of the landscape receptors. Reference would be made to the Norfolk Coast AONB Management Plan and the Broads Plan 2011 as relevant to this assessment.

1171. In respect of the landfall search area there is one Registered Park and Garden, Happisburgh Manor, to the north of the village of Happisburgh, which would be considered during the site selection process and in the assessment of impacts.

1172. The LVIA would prepare a baseline assessment of the relevant landscape designations and assess the potential impacts of the onshore infrastructure on the designated areas as landscape receptors.



Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Landfall Search Area
- Cable Relay Station Search Area
- Area of Outstanding Natural Beauty (AONB) [1]
- National Park [1]
- Registered Parks and Gardens [2]

[1] Natural England, 2016
[2] English Heritage, 2016

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title: Landscape Designations - Landfall/Cable Relay Station

Figure: 4.5 Drawing No: PB4476-002-2-51

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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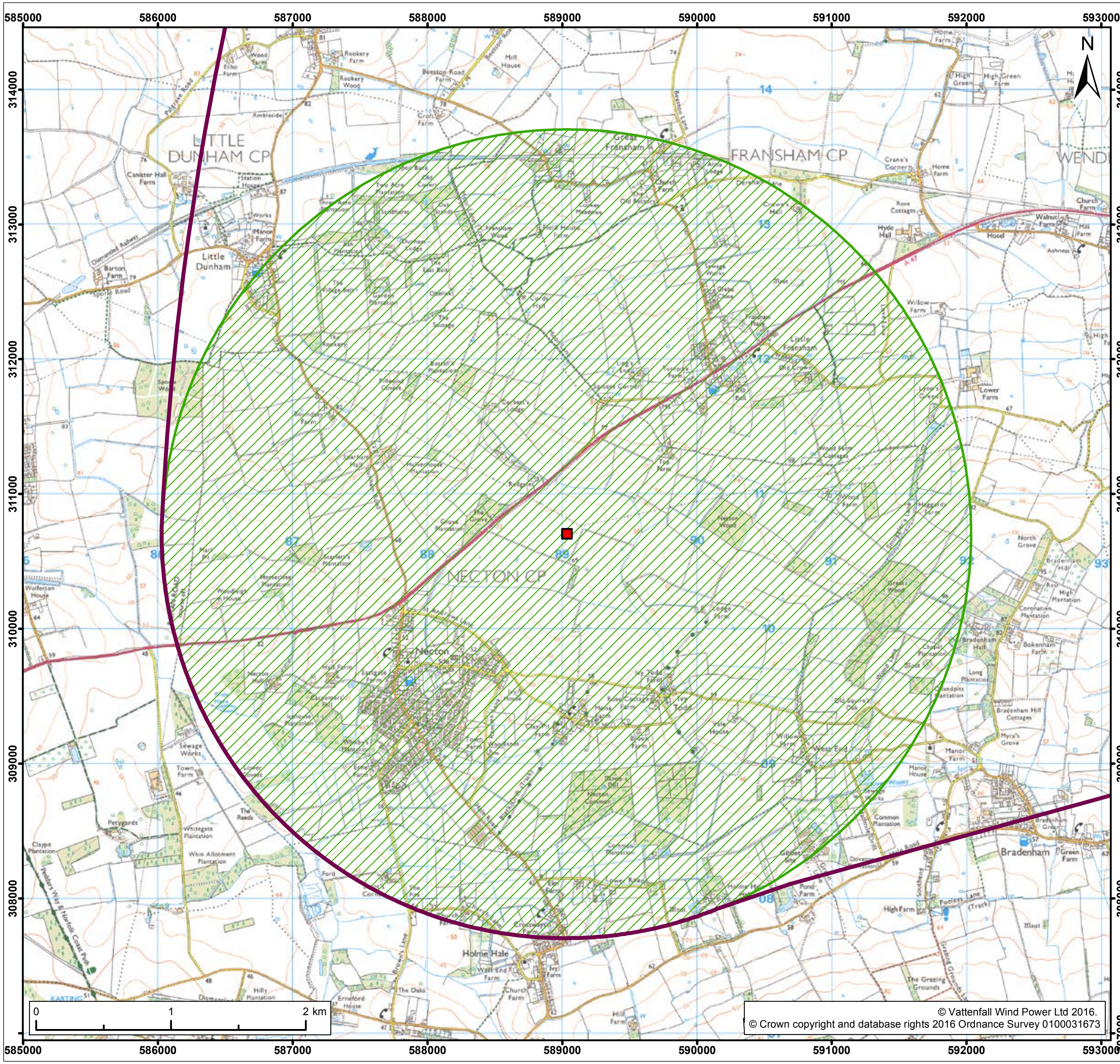

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Substation Seach Area

Note:
No landscape designations are found within the substation search area

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Landscape Designations - Substation

Figure: 4.6 | Drawing No: PB4476-002-2-52

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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4.2.1.4 Principal visual receptors

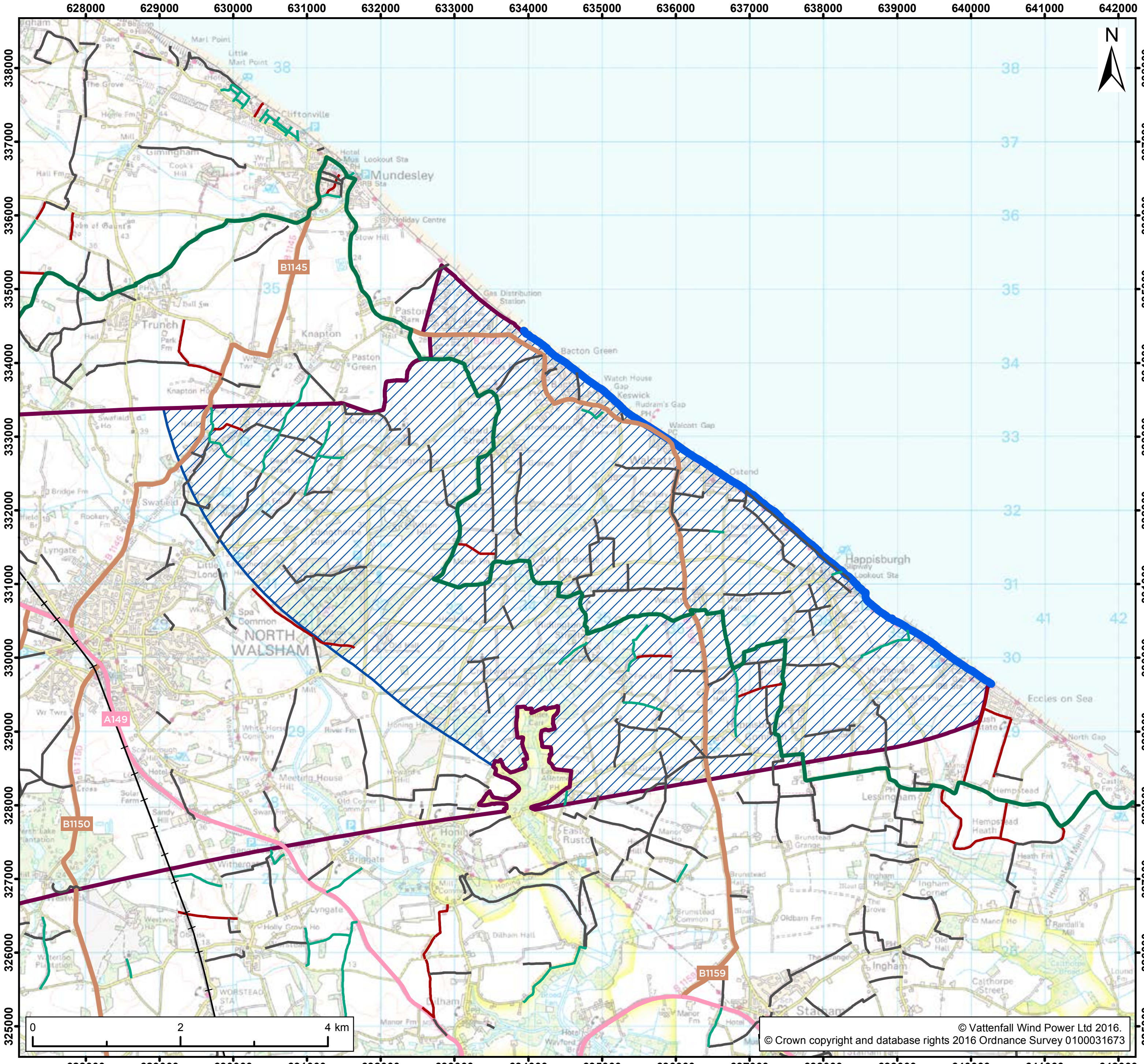
1173. The study areas associated with the proposed project cover a rural landscape in which agriculture is the predominant land use, but in which also settlements and roads are evident. Settlements are typically small in scale, occurring as villages and towns along the Norfolk coast, and intermittently across the landward landscape with a finer network of small clusters of properties and isolated farmsteads characterising the rural area.

1174. In respect of the landfall works, the principal visual receptors would include the coastal settlements of Bacton, Walcott, Happisburgh and Eccles-on-Sea. The extent to which these settlements would be affected depends on the 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 PRoW, including the Norfolk Coast Path.

1175. The cable relay station and onshore cable route would have the potential to impact on the villages, minor roads and PRoWs that occur across the rural landscape, as well as the A and B class roads and towns which occur more intermittently. The principal visual receptors associated with the cable relay station search areas 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 4.7.

1176. In respect of the substation, 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 settlements within the substation search area. 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 search area are shown in Figure 4.8.

1177. The LVIA would include a baseline assessment of the relevant principal visual receptors and assess the potential impacts of the onshore infrastructure on these as visual receptors.



Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Landfall Search Area
- Cable Relay Station Search Area
- A Road
- B Road
- Railway
- 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 Vanguard	Environmental Impact Assessment Scoping Report

Title: Visual Receptors - Landfall/Cable Relay Station

Figure: 4.7 Drawing No: PB4476-002-2-53

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	09/09/16	TH	LT	A4	1:75,000

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

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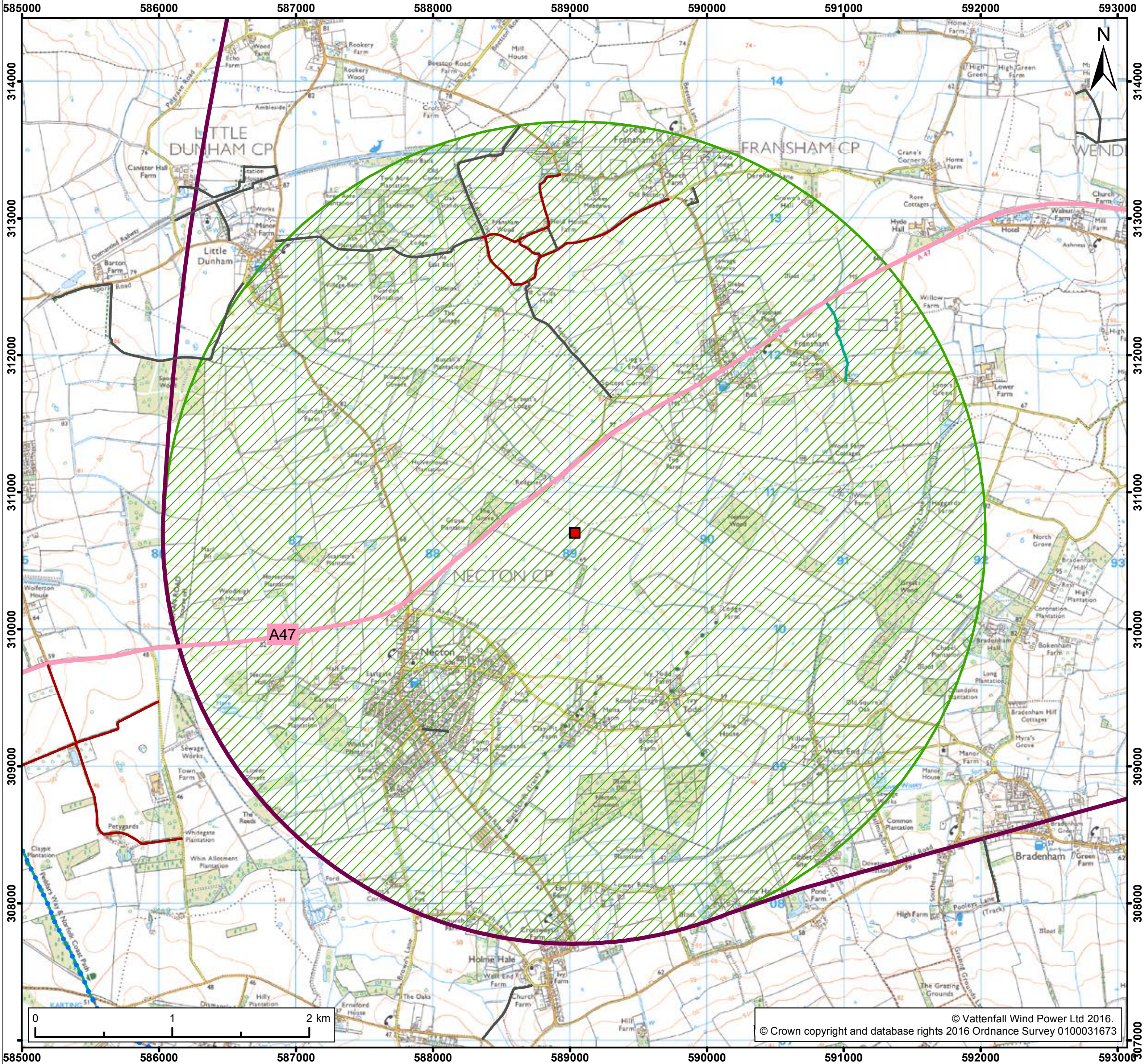

Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Substation Seach Area
- A Road
- Bridleway [1]
- Footpath [1]
- Restricted Byway [1]
- Peddar's Way and Norfolk Coast Path [2]

[1] Norfolk County Council, 2016
[2] Natural England, 2016

Project:	Report:
Norfolk Vanguard	Environmental Impact Assessment Scoping Report

Title:

Visual Receptors - Substation

Figure: 4.8 | Drawing No: PB4477-002-2-54

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
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Co-ordinate System: British National Grid **EPSG:** 27700

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4.2.2 Potential impacts

4.2.2.1 Potential impacts during construction

Offshore

1178. The potential for significant impacts to arise in respect of the offshore components during construction would be limited by the distance of the offshore wind farm sites from onshore landscape and visual receptors and the relative sensitivity of the offshore receptors. '*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.

1179. 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.'*

1180. As Norfolk Vanguard would be located an approximate distance of 47km (closest point) from the coast, this would be well beyond the 35km limit of visual significance identified in DTI guidance and more than double the recommended distance in OESEA3. Calculations establish that the WTGs would be visible to a range of 43km at sea level, based on their height and the curvature of the earth. There is a limited possibility that blade tips may be visible from elevated points onshore, although their very small scale, seen at a range of beyond 47km would make them barely discernible. The offshore wind farm would have a negligible impact on onshore receptors and therefore these potential impacts would not be assessed in the LVIA.

1181. It is proposed that the potential impacts of construction of the offshore wind farm on offshore receptors should also be scoped out. 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 2.29, a cluster of more than 30 platforms are shown located to the north west of the offshore wind farm sites, the closest at a minimum distance of 6.2km.

1182. 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 47km between the coast and the offshore wind farm and the curvature of the earth over this distance.

1183. 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.

1184. 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 receptors along the coast.

Onshore

1185. The potential impacts of the proposed project during construction would occur in relation to the construction of the landfall, cable relay station, onshore cable route and substation. These would include potential impacts on the physical elements of the sites where construction would take place, as well as impacts on the landscape character and visual amenity of the site and surrounding area. The impacts would relate principally to the construction process, associated plant, materials, infrastructure and temporary structures, as well as the presence of emerging structures, where they would be visible above ground.

1186. There is also the potential for effects in relation to the vessels associated with the construction of the offshore cable route, whereby their proximity to the coast may give rise to effects on onshore receptors. This potential would be considered in the LVIA.

4.2.2.2 Potential impacts during operation

Offshore

1187. As discussed above, due to the distance of the OWF sites (47km) from the coast the WTGs and associated navigational lighting would not be readily visible from the coastline. While there is the remote possibility that WTGs and associated lighting could theoretically be visible from more elevated landward locations, the relatively low-lying nature of Norfolk combined with the very small scale of any components that would be visible, would make any potential effects negligible. The offshore wind farm would have a negligible impact on onshore receptors and therefore it is proposed that these potential impacts are not assessed in the LVIA.

1188. It is proposed that the potential impacts of the offshore wind farm on offshore receptors should also be scoped out due to the relatively limited sensitivity of the seascape character and visual receptors. The baseline character of the seascape is already influenced by existing gas rigs and passing shipping vessels in this area, and their presence would reduce the sensitivity and potential magnitude of change arising in respect of the OWF sites. Visual receptors would comprise workers and passengers on passing shipping vessels. Their sensitivity would be reduced by the temporary nature and short duration of the visual impact, as well as the existing influence of other offshore development and shipping vessels.

Onshore

1189. The potential impacts of the proposed project during operation would relate principally to the presence of the substation and cable relay station. The impact of these developments on landscape character and visual amenity within their respective study areas would be assessed, with particular consideration of sensitive receptors such as designated landscapes, residents, recreational users of the countryside and road-users. It is anticipated that once operational, the potential impacts of the landfall and onshore cable route would be greatly reduced by their presence under ground level with a minimum amount of associated development visible above ground.

1190. The potential impacts during operation would be moderated by the presence and growth of mitigation planting. The gradual reduction in potential impacts during the operational life of the proposed project would be considered in the assessment.

4.2.2.3 Potential impacts during decommissioning

1191. 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. However, the substation and cable relay station equipment will likely be removed and reused or recycled. It is expected the onshore cables will be removed from ducts and recycled, with the transition pits and ducts left *in situ*.

1192. 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.

1193. It is anticipated that the decommissioning impacts will be similar in nature to those of construction, but will be more limited in geographical extent and timescale.

1194. 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.

4.2.2.4 Potential cumulative impacts

1195. 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 Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

1196. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

1197. Cumulative impacts as a result of the works required by National Grid to connect Norfolk Vanguard to the existing Necton 400kV National Grid Substation will be included as part of this assessment.

1198. 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 small scale of the construction and decommissioning operations would limit the potential for significant cumulative impacts to arise.

1199. 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 2km radii of the substation and cable relay station respectively.

4.2.2.5 Summary of potential impacts

Table 4.1 Summary of impacts relating to landscape and visual impacts

Potential impacts	Construction	Operation	Decommissioning
Landscape, visual and cumulative impacts of offshore components	×	×	×
Landscape and visual impacts of landfall	✓	×	×
Landscape and visual impacts of cable relay station	✓	✓	✓
Landscape and visual impacts of onshore cable route	✓	×	×

Potential impacts	Construction	Operation	Decommissioning
Landscape and visual impacts of substation	✓	✓	✓
Cumulative impacts of landfall	×	×	×
Cumulative impacts of cable relay station	✓	✓	✓
Cumulative impacts of onshore cable route	×	×	×
Cumulative impacts of substation	✓	✓	✓

scoped in (✓) and scoped out (×)

4.2.3 Mitigation

1200. Embedded mitigation in respect of the onshore infrastructure would involve the careful siting of the onshore infrastructure during site selection to ensure the potential impacts are notably 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. 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 and substation, which would add to the overall mitigation of the proposed project.

1201. Mitigation measures would be set out in the LVIA and taken into account in the assessment of potential impacts, with consideration given to the growth rate of new planting and how this would affect impacts over time.

4.2.4 Approach to assessment and data gathering

1202. The Applicant will be undertaking consultation with relevant consultees as part of the EPP, including Norfolk County Council, the Broads Authority and Natural England, in order to define the scope of the LVIA required for the proposed project. This would be based on the receptors cited above.

1203. 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 (December 2014). Visual Representation of Wind Farms: Version 2.1; and
- The Landscape Institute (2011). Landscape Institute Advice Note 01/11, Photography and photomontage in landscape and visual impact assessment.

1204. 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.

4.2.4.1 Methodology

1205. 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 would be agreed through more detailed consultation with Norfolk County Council, the Broads Authority and Natural England. This methodology reflects the 'Guidelines for the Assessment of Landscape and Visual Impacts: Third Edition'.

1206. The objective of the assessment of the proposed development 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.

1207. 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 the proposed development. 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.

1208. The objective of the Cumulative Landscape and Visual Impact Assessment (CLVIA) is to describe, visually represent and assess the ways in which the proposed development will have additional effects when considered together with other existing, consented or application stage developments and to identify related significant cumulative effects arising from the proposed development. 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.

1209. The LVIA will determine whether effects are beneficial, neutral or adverse in accordance with defined criteria.

1210. The effects of Norfolk Vanguard are of variable duration, and are assessed as short-term or long-term, and permanent or temporary/reversible.

4.2.4.2 Viewpoints

1211. Viewpoints for the LVIA assessment would be selected once the final site selection process has been completed for the onshore infrastructure. The selection process of viewpoints would be carried out in liaison with Norfolk County Council, the Broads Authority and Natural England. Viewpoints would be selected from areas where actual visibility of the proposed project would occur and chosen to represent the visual amenity of local residents, road-users, workers and recreational users of the landscape. They would look to represent the most sensitive viewpoints as well as show the fullest visibility of the proposed project. They would also aim to represent the different landscape character types, landscape designations and show the proposed project from varying directions and distances.

1212. Zone of Theoretical Visibility (ZTV) mapping would be prepared for the substation and cable relay station to indicate where theoretical visibility would occur. This would highlight potential viewpoints, which would be verified on site to determine actual visibility, taking into account the screening effect of trees and buildings. Viewpoints would also be selected to represent potential cumulative impact, taking into account the possibility of combined visibility with other developments where possible.

1213. The LVIA would include a baseline assessment of the representative viewpoints and assess the potential impacts of the onshore infrastructure on these as visual receptors.

1214. 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.

4.3 Socio-economics

4.3.1 Baselinedata sources

1215. Vattenfall commissioned a socio-economic study by Miller Research Consulting (2016) which provides a review of available information such as the Office for National Statistics (ONS). Additional sources include county, district and borough council plans and information.

4.3.1.1 Overview

1216. 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 England as a whole, 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).

1217. Average unemployment 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). The county of Norfolk was placed in the top six per cent of counties for employment deprivation in England, suggesting that access to jobs is a particular issue for the area (Office for National Statistics ONS, 2015). Female unemployment is higher than it is for men on average thoroughout the region and in some areas within Norfolk this gender difference is significantly bigger than in the UK as a whole (Office for National Statistics ONS, 2015b).

1218. The majority (87.9%) of businesses in Norfolk can be classified as 'Micro' with 0 to 9 employees (Office for National Statistics ONS, 2015c).

1219. Key industries have declined or have lower rates of growth in Norfolk compared to the UK between 2010 and 2015 (Office for National Statistics ONS, 2015). 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).

1220. Norfolk County Council (2016b) 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.

1221. The energy sector employs 7,700 people directly in Norfolk and Suffolk, and thousands more indirectly, and is worth approximately £994M per annum. 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.

1222. 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. As a CORE, the government and local partners aim to support businesses looking to invest in offshore wind in the area.

1223. There are areas of deprivation in education, skills and training in the region (Norfolk County Council, 2012b), however there are also areas of best practice. For example, 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 University of East Anglia, there are 42 colleges or sixth forms in the county that offer a diverse range of education and training to individuals. Overall, qualification levels are lower in Norfolk, compared with the wider East of England and Great Britain as a whole. Great Yarmouth Borough Council (2015) and New Anglia Strategic LEP (2016) recognise the need to develop local skills to enable employment in offshore industries.

1224. As discussed in Section 1, 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 the Scoping Report and feedback from the initial drop-in exhibitions.

1225. Once the onshore locations are known, a review of 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); and
- Local and regional employment and trends (extracted from ONS or other available).

1226. Social data relating to education, crime, health and leisure will also be considered where available.

4.3.1.2 Offshore project area

1227. The offshore project area is primarily used by commercial fisheries (see Section 2.8) and shipping (see Section 2.9). 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).

4.3.1.3 Landfall search area and cable relay station search area

1228. The main economic activities within the landfall and cable relay station search areas are arable farming, tourism, and employment associated with the Bacton Gas Terminal.

1229. The landfall and cable relay station search areas lie within North Norfolk which has an estimated population of 103,300. Of the working age population (16-64), 69.0% are economically active (employed or unemployed but able to work), of which a high proportion (15.3%) are estimated to be self employed and 51.6% are estimated to be employed (ONS, 2016a).

1230. Areas within the landfall search area, in particular Happisburgh, have suffered from coastal erosion and flooding. Happisburgh has received funding to demonstrate how coastal change can be managed and the area is undergoing a number of projects to enhance the area.

1231. The median ages in the coastal areas of Norfolk are generally higher than the wider region with the landfall search area having a median age of 50 to 55 (Miller Reserch Consulting, 2016).

1232. There are no large settlements within the landfall and onshore cable relay substation search area, however there are several villages including Happisburgh, Bacton and Walcott.

4.3.1.4 Cable corridor search area

1233. As discussed in Section 1.5.7, detailed feasibility and route selection studies are ongoing in order to identify the route for the buried cable system with least impact on the environment and local communities. The cable corridor search area lies within the county of Norfolk.

1234. As discussed above the baseline characteristics will be identified in further detail in the ES once the final cable corridor has been identified.

4.3.1.5 Substation search area

1235. The substation search area is in the district of Breckland which has an estimated population of 135,500. Of the working age population, 78.8% are economically active, of which 6% are estimated to be self employed and 75.1% are estimated to be employed (ONS, 2016).

1236. 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.

1237. Breckland Council (2015) states that small and medium scale rural enterprises represent a significant portion of the economic activities in Breckland due to the rural nature of the District. Therefore there is a need for diversity in enterprises to contribute to the prosperity of the District, including job opportunities.

4.3.2 Potential impacts

4.3.2.1 Potential impacts during construction, O&M and decommissioning

1238. 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 shipbuilding and North Sea oil) in order to secure supply chain and other employment opportunities in the UK.

1239. Norfolk Vanguard will require large-scale investment and will need to be supported by a substantial supply chain; a proportion of the capital expenditure will add to local, regional and UK-wide income during the lifetime of the project. There will 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 for goods (e.g. fuel, paints, other consumables) and services (e.g. accommodation, catering, security, transport) some of which will result in indirect economic impacts (e.g. training and education, day-to-day indirect spend from project employees). 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 will:

- Support the development of competition in supply chains;
- Support innovation in supply chains; and
- Support the development of skills in supply chains.

1240. 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 if not a vertically integrated project; and
- The wider long term impacts across the relevant low carbon electricity generation industry.

1241. The likely project expenditure for Norfolk Vanguard is not yet known, however, 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 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. 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.

1242. 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 Vanguard will contribute to the growth of an economically important industry. The EIA will seek to identify potential opportunities and benefits for the local economy.

1243. 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.

1244. Onshore impacts during construction will include job creation, training and employment retention, during all three phases of development. Some of the potential economic effects are listed below:

- Direct and indirect creation of jobs throughout construction operation and decommissioning phases of the project;
- Indirect impacts on services, such as infrastructure and housing; and
- Increased long term security and reliability of supply and more evenly distributed energy generation.

1245. 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.

1246. Offshore, there are potential impacts, primarily on commercial fisheries (Section 2.10) as well as shipping and navigation (Section 2.11). As discussed in Section 1.5.3, design work undertaken to locate the former zone, and to determine the offshore project area of Norfolk Vanguard, has considered potential constraints associated with other industries. Thus the potential for adverse impacts upon other sea-users has been reduced already by siting Norfolk Vanguard in its proposed location. Given the distance from shore there are unlikely to be significant direct impacts upon water sports and landscape impacts, therefore coastal tourism should not be adversely impacted.

4.3.2.2 Potential cumulative impacts

1247. There is potential for Norfolk Vanguard 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.

1248. 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.

4.3.2.3 Summary of potential impacts

Table 4.2 Summary of impacts relating to socio-economics

Potential impacts	Construction	Operation	Decommissioning
All socio-economic impacts	✓	✓	✓
Cumulative socio-economic impacts	✓	✓	✓

scoped in (✓) and scoped out (×)

4.3.3 Mitigation

1249. As discussed in Section 1.5, design work undertaken to locate the former zone, and to determine the offshore project area of Norfolk Vanguard, has considered and avoided potential constraints associated with other industries where possible.

1250. 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 the Scoping Report and initial drop-in exhibitions.

1251. This presents the opportunity for the Applicant to minimise potential negative socio-economic impacts through the design of the project.

1252. Further mitigation measures specific to existing industries e.g. shipping, commercial fisheries, tourism, farming and other local businesses will be developed during the EIA in consultation with relevant stakeholders where appropriate.

1253. Our supply chain and skills strategy will consider the interests and needs of the existing local workforce and seek to prepare new workers adequately for the roles that will become available.

4.3.4 Approach to assessment and data gathering

1254. The Overarching National Policy Statement for Energy (EN-1) (DECC, 2011a) 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;
- The impact of a changing influx of workers during the different construction, operation and decommissioning phases of the energy infrastructure; and
- Cumulative impacts.

1255. The assessment will 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.

1256. Establishing the baseline for the potential offshore and onshore impacts of Norfolk Vanguard will draw upon national and regional economic data and nationally available sources such as the:

- Census;
- ONS, for example;
    - 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.

1257. The approach to assessment and data gathering 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

4.4.1 Baseline

1258. 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.

1259. 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

1260. The baseline for this section was identified by undertaking an initial high level desk-based review using existing sources to characterise the area, including:

- Ordnance survey data;
- Google Earth;
- www.visitnorfolk.co.uk;
- www.broads-authority.gov.uk;
- www.happisburgh.org;
- www.tournorfolk.co.uk; and
- www.seapalling.com.

1261. Any additional data sets will be identified through feedback from stakeholders following this Scoping Request.

4.4.1.2 Coastal and marine

1262. 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 Vanguard.

1263. As the site of the wind farm is 47km offshore (to the nearest point of NV West), activities at the site are limited, with some sailing and sea angling taking place nearby. Therefore consideration will be focused on potential impacts as a result of installation at the landfall location.

Coastal Tourism

1264. 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.

1265. 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 search area at Mundesley and one south of the landfall search area at Sea Palling (Explore Norfolk, 2016). There are no golf courses in the landfall search area. A summary of coastal towns, villages and their tourism amenities is shown in Table 4.3.

Table 4.3 Summary of tourist amenities in the vicinity of the landfall search area area

Name of coastal resort	Number of hotels/B&Bs	Assets
Mundesley	25	Blue flag beach, clifftop walking, cinema, pubs
Bacton and Walcott	5 and caravan park	Sandy beaches, clifftop walking, St Andrews 15th century church, pubs, Bromholm Priory
Happisburgh	6	Archaeological heritage, lighthouse, St Marys 14th century church, RNLI lifeboat station, sandy beaches,
Eccles-on-Sea	Caravan park	Sandy beaches, Eccles Church Tower
Sea Palling	22	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

1266. 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).

1267. 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 search area.

1268. Recreational vessels for sailing and fishing are considered in Section 2.11.

1269. Within the landfall search area 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.

1270. Camping and caravan sites at the landfall search area are shown on Figure 4.9.

4.4.1.3 Onshore tourism and recreation

1271. 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. The footprint of the onshore infrastructure will avoid the Norfolk Broads National Park and the North Norfolk AONB.

1272. 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.

1273. 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.

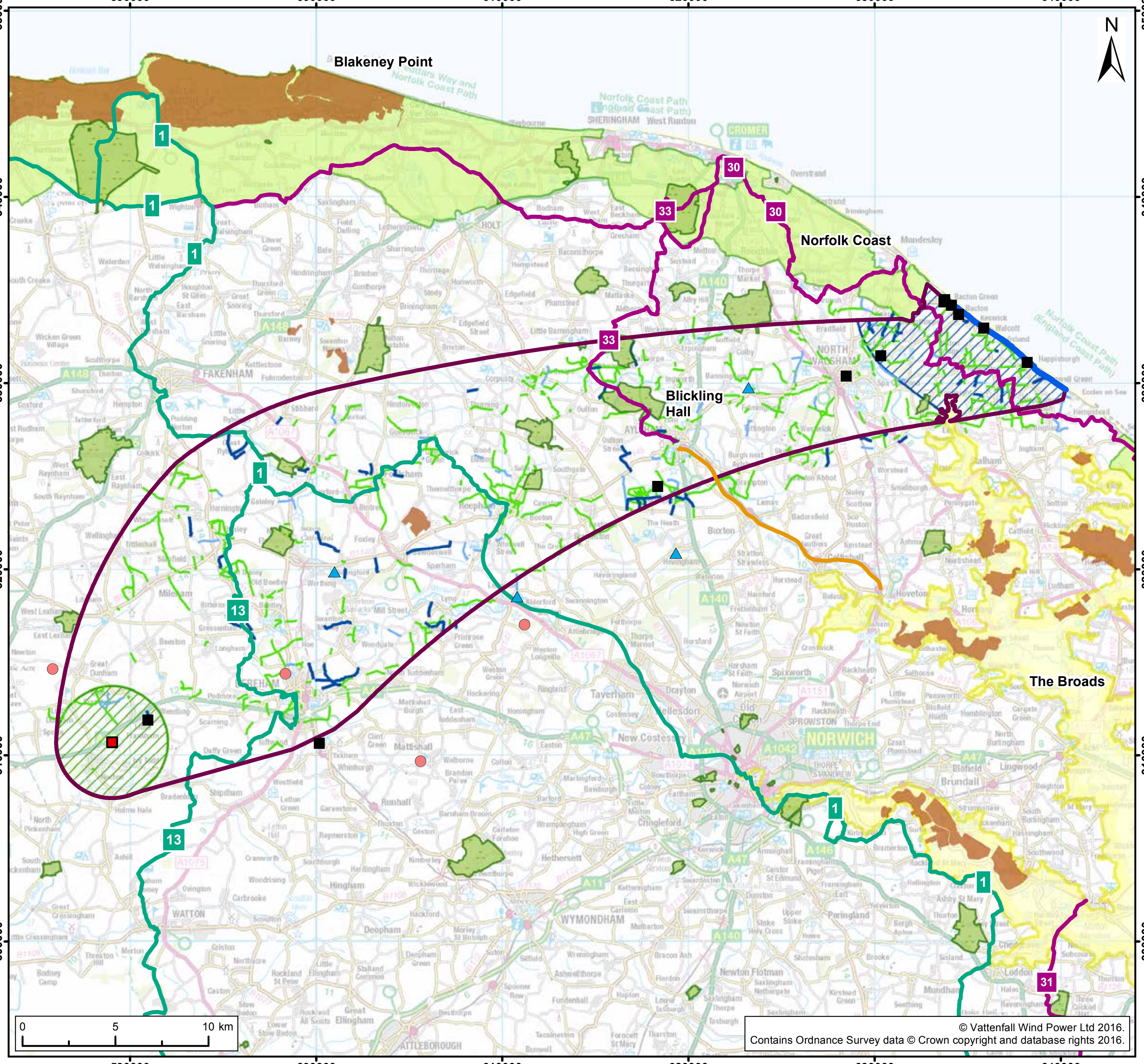
1274. Norfolk Lakes Activity Centre is also at Lyng, popular for school visits and providing a range of water and land based activities. At Weston Park there is also a family adventure park with dinosaur trails, canoeing, fishing, horse riding and camping.

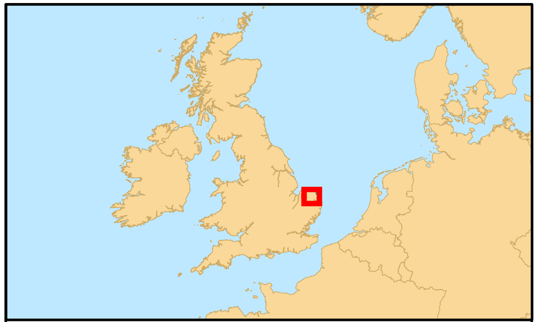
1275. National Cycle Route 1 crosses the onshore cable corridor area, as well as footpaths and bridleways. PRoWs and cycle routes are considered further in Section 3.5.

1276. Camping and caravan sites, golf courses, fishing lakes and other attractions in the cable route 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, draw 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 are host to many rare bird, insect and plant species. As a result, the Broads National Park attract a large number of visitors for sailing, fishing, walking and wildlife watching.

1277. For further consideration of designated sites such as SSSIs, rare species and scheduled ancient monuments, refer to Section 3.6 Onshore Ecology, and Section 3.8 Onshore Archaeology and Cultural Heritage. 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 the proposed project.

1278. 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.





Legend:

- Onshore Scoping Area & Cable Corridor Search Area
- Existing Necton 400kV National Grid Substation
- Landfall Search Area
- Cable Relay Station Search Area
- Substation Search Area
- Area of Outstanding Natural Beauty (AONB)[1]
- National Park[1]
- National Nature Reserve (NNR)[1]
- Registered Park and Garden[2]
- Bure Valley Railway[3]
- National Cycle Route[4]
- Regional Cycle Route[4]

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 Vanguard	Environmental Impact Assessment Scoping Report

Title:

Recreational Features and Tourism Facilities

Figure: 4.9 Drawing No: PB4476-002-2-046

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	05/09/16	JE	ST	A4	1:300,000

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

VATTENFALL

Royal HaskoningDHV
Enhancing Society Together

4.4.2 Potential impacts

4.4.2.1 Potential impacts during construction

Coastal and marine

1279. **Visual impacts:** Associated with cable laying vessels and vessels moving to and from the offshore construction zone.

1280. **Disruption to marine and coastal recreational activities:** Offshore construction activities and associated Safety Zones may disrupt marine and coastal recreational activities. This will be temporary in nature. Marine users will be informed of Safety Zones, and these will 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 2.9 Shipping and Navigation.

1281. **Restricted beach access:** There is the potential for beach access to be affected during construction works at the landfall during the laying of the cable, however this will be temporary in nature, with access restored on completion of construction.

Onshore (inland)

1282. **Disturbance including noise, dust and visual impact:** During the installation of the onshore cable, potential impacts could arise causing noise, dust and visual disturbance. However these will be temporary in nature. Impacts from dust and noise are considered in Section 3.3 Air Quality and Section 3.9 Onshore Noise and Vibration, and visual impacts are considered in Section 4.2.

1283. **Disruption to local recreation and tourism provisions and businesses:** Local businesses and tourism facilities may be temporarily disrupted through access route diversions as a result of construction work.

1284. **Alternate routes/closure of PRoWs:** Temporary closures or alternative routes for PRoWs could discourage visitors.

4.4.2.2 Potential impacts during operation

Coastal and marine

1285. **Disruption to coastal and marine recreational activities:** The only main source of impact is associated with Safety Zones during maintenance. Impacts on recreational vessels are considered in Section 2.9 Shipping and Navigation.

1286. **Visual impacts:** Visual impacts in the coastal and marine environment have been scoped out of the assessment, as detailed in Section 4.2.

Onshore (inland)

1287. **Loss of amenity land:** The presence of the onshore substation and cable relay station could potentially cause the permanent loss of amenity land for recreational activities such as walking and hiking depending on their location.

1288. **Noise:** Noise emissions from the substation have the potential to negatively affect local communities including tourists and recreational users.

1289. **Permanent 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.

4.4.2.3 Potential impacts during decommissioning

Coastal and marine

1290. Impacts from decommissioning are anticipated to be similar to those identified for construction activities, decreasing in extent and timescale.

Onshore (inland)

1291. **Reverting land and amenity to an improved condition:** 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.

4.4.2.4 Potential cumulative impacts

1292. 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 Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

1293. The assessment would consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage.

1294. Cumulative impacts as a result of the works required by National Grid to connect Norfolk Vanguard to the existing Necton 400kV National Grid Substation will be included as part of this assessment.

1295. 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.

4.4.2.5 Summary of potential impacts

Table 4.4 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	✓	✓	✓
Restricted beach access	✓	x	✓
Onshore (inland)			
Disturbance including noise, dust and visual impact	✓	x	✓
Noise at the substation and cable relay station	x	✓	x
Visual impacts from substation and cable relay station	✓	✓	✓
Disruption to local recreation and tourism provisions and businesses	✓	x	✓
Loss of amenity land	X	✓	x
Temporary/permanent closure of PRoWs	✓	✓	✓
Reverting land and amenity to an improved condition	x	x	✓
Cumulative impacts	✓	✓	✓

scoped in (✓) and scoped out (×)

4.4.3 Mitigation

1296. Mitigation measures will be incorporated into the ES as appropriate. Embedded mitigation will ensure that major tourism and recreation facilities such as golf courses, caravan and camp sites, fishing lakes and other local attractions are avoided, where possible, during the siting of the onshore electrical infrastructure.

1297. 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 agree mitigation with the relevant PRoW officers; and
- Siting discussions with landowners, occupiers and local communities during the site selection process.

4.4.4 Approach to assessment and data gathering

1298. The tourism and recreation assessment will include the following:

- A desk-based study to identify tourism and recreation provisions which may be affected by the proposed project, using maps and local sources;
- Consultation with land owners, occupiers and the local community; and
- An assessment of the impacts of the proposed project on recreation and tourist facilities and identification of appropriate mitigation.

1299. 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 Wider Scheme Inter-relationships

1300. The EIA will identify the full range of inter-relationships which are likely to result from the construction, operation and decommissioning of Norfolk Vanguard. The wider-scheme impacts of landscape and visual, socio-economics, and tourism and recreation are all closely interlinked. Inter-relationships between impacts associated with the offshore and onshore project areas will also be considered.

1301. The approach to offshore inter-relationships will be discussed with relevant stakeholders during the EPP.

4.6 Cumulative Impacts Summary

1302. 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 Vanguard will be identified during consultation as part of the EPP and following a review of available information. These projects will then be included in the CIA and therefore are scoped into the assessment.

1303. The assessment will consider the potential for significant cumulative impacts to arise as a result of the construction, operation and decommissioning of Norfolk Vanguard in the context of other developments that are existing, consented or at application stage. Table 4.5 collates the scoping of onshore cumulative impacts discussed in Sections 4.1 to 4.3.1.

Table 4.5 Summary of wider scheme cumulative impacts

Potential impacts	Construction	Operation	Decommissioning
Cumulative landscape and visual impacts of landfall.	×	×	×
Cumulative landscape and visual impacts of cable relay station.	✓	✓	✓
Cumulative landscape and visual impacts of onshore cable route.	×	×	×
Cumulative landscape and visual impacts of substation.	✓	✓	✓
Cumulative socio-economic impacts	✓	✓	✓
Cumulative tourism and recreation impacts	✓	✓	✓

scoped in (✓) and scoped out (×)

5 PART 5: CONSULTATION

5.1 Overview

1304. 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).

1305. 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.

1306. 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 Q4 2017 in advance of consultation on the PEIR. In advance of publishing the SoCC, informal consultation will be on going, as described below.

1307. 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 Statutory and Prescribed Bodies Consultation

1308. 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 Vanguard to ensure compliance with the EIA Regulations and Habitat Regulations.

1309. The EPP aims to assist all parties in the process during the evolution 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.

1310. Although the EPP is not part of the formal consultation, it will provide the audit trail 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. Statements of common ground provide details of the areas of agreement and disagreement between the Applicant and stakeholders with regards to the application, to aid the examination process.

1311. The EPP will include expert topic group meetings. The process will be monitored by a EPP steering group chaired by the Planning Inspectorate, and will be formulated to meet the requirements of Planning Act 2008 and DCO application process.

1312. Whilst there is some overlap between EIA and HRA topics there are also distinct areas of interest, 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.

1313. EIA topic areas for which there are established consultation processes will stand outside the EPP, namely:

- Commercial Fisheries (see Section 2.10.4);
- Shipping and Navigation (see Section 2.11.4); and
- Aviation and Radar (see Section 2.13.4).

1314. 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

1315. 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.

1316. Drop-in exhibitions will be held at specific intervals during the EIA process to allow ongoing engagement with local communities. The first phase of these events will be held in October 2016 (see Table 5.1), as consultation to enable members of the public to learn about the proposed project and to share their knowledge of the area to help inform the project design. Further community consultation events will take place during 2017 and following the publication of PEIR.

Table 5.1 Drop-in exhibitions dates, times and locations

Location	Date	Time
Aylsham	Tuesday 18th October	2pm – 6.30pm
Happisburgh	Wednesday 19th October	2pm – 6.30pm
Dereham	Thursday 20th October	2pm – 6.30pm
Necton	Friday 21st October	2pm – 6.30pm
North Walsham	Saturday 22nd October	11am – 4pm
Great Yarmouth	Friday 28th October	2pm – 6.30pm
Norwich	Saturday 29th September	11am – 4pm

1317. 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://norfolkvanguard.vattenfall.co.uk

1318. Consultation will also be ongoing with Norfolk County Council and relevant District Councils and Parish Councils.

6 PART 6: SUMMARY AND CONCLUSIONS

1319. The tables in this section of the report provide an overview of the potential impacts which are proposed to be scoped in (considered further) or scoped out (not considered further) in the EIA for Norfolk Vanguard.

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	✓	x	✓
Release of contaminated sediments	✓	x	✓
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
Impacts of airborne noise from nearshore works	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
Sites of Marine Conservation Interest	✓	✓	✓
Electromagnetic fields (EMF)	x	x	x

	Construction	Operation	Decommissioning
Cumulative impacts	✓	✓	✓
Transboundary impacts	x	x	x
Fish Ecology			
Physical Disturbance	✓	✓	✓
Suspended sediments	✓	✓	✓
Re-suspension of contaminants	×	×	×
Loss of habitat	×	✓	×
Noise and vibration disturbance	✓	✓	✓
Fish aggregation	×	✓	×
EMF	×	✓	×
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓
Marine Mammal Ecology			
Underwater noise	✓	✓	✓
Impacts upon prey species	✓	✓	✓
Vessel interactions	✓	✓	✓
Physical Barrier effects	×	×	×
EMF	×	×	×
Disturbance at haul out sites	×	×	×
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 within the OWF sites	✓	✓	✓
Indirect impacts through effects on habitats and prey species within the provisional offshore cable corridor	✓	×	×
Collision risk	×	✓	×
Barrier effect	×	✓	×
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓

	Construction	Operation	Decommissioning
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	×	✓	✓
Increased collision risk (to be covered by NRA)	✓	✓	✓
Increased steaming times	✓	✓	✓
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓
Shipping and Navigation			
Vessel Routeing	✓	✓	✓
Displacement of Third Party Activities	✓	✓	✓
Increased Collision Risk	✓	✓	✓
Collision 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)	x	x	x
Indirect disturbance of setting (landfall)	✓	x	x
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	✓	✓
Aviation and Radar			
Impact on radar systems	x	✓	x
Impact on helicopter routes	✓	✓	✓
Impact on military training area	x	x	x
Increased collision risk	✓	✓	✓
Cumulative impacts	✓	✓	✓
Transboundary impacts	✓	x	x

	Construction	Operation	Decommissioning
Infrastructure and Other Users			
Potential interference with other wind farms development	x	x	x
Potential interference with oil and gas operations	x	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

Table 6.2 Summary of potential onshore environment impacts

	Construction	Operation	Decommissioning
Ground Condition and Contamination			
Ground Conditions and Contamination	✓	×	✓
Human health(construction workers)	✓	×	✓
Human health(residents)	✓	×	✓
Surface water	✓	×	✓
Groundwater	✓	×	✓
WFD groundwater bodies	✓	×	✓
Designated geological sites	✓	×	×
Cumulative impacts	✓	✓	✓
Air Quality			
Increase in traffic based air quality pollutant concentrations – human receptor locations	✓	×	✓
Increase in traffic based air quality pollutant concentrations – ecological habitats	✓	×	✓
Construction dust impacts – human receptors	✓	×	✓
Construction dust impacts – ecological habitats	✓	×	✓
Cumulative impacts	✓	×	✓
Water Resource and Flood Risk			
Impacts on water resources	✓	✓	✓
Flood risk	✓	✓	✓
Cumulative impacts	✓	✓	✓

	Construction	Operation	Decommissioning
Land Use			
Agricultural productivity	✓	✓	✓
Drainage	✓	✓	✓
Disruption to farming practices	✓	✓	✓
Temporary closure of PRoWs/cycle paths	✓	✓	✓
Existing utilities	✓	×	✓
Public health and safety	✓	✓	✓
Permanent loss of land	×	✓	×
Permanent closure/diversion of PRoWs	×	✓	×
Soil heating	×	✓	×
Cumulative impacts	✓	✓	✓
Onshore Ecology			
Impacts to statutory and non-statutory designated sites	✓	✓	✓
Permanent and temporary loss of habitats	✓	✓	✓
Temporary habitat fragmentation and species isolation	✓	✓	✓
Impacts upon protected species or upon their resting or breeding sites	✓	✓	✓
Disturbance of bird populations	✓	✓	✓
Cumulative impacts	✓	✓	✓
Onshore Ornithology			
Temporary and permanent loss of habitat suitable for nesting, roosting and foraging birds	✓	✓	×
Noise, vibration and visual disturbance to birds	✓	✓	✓
Cumulative impacts	✓	✓	✓
Archaeology and Cultural Heritage			
Direct impacts upon buried archaeological remains, including palaeoenvironmental deposits	✓	×	×
Direct impacts upon above ground heritage assets e.g. historic earthworks	✓	×	×
Indirect impacts through the alteration of the settings of built heritage assets	✓	✓	✓
Indirect impacts through the alteration of the setting of the historic landscape	✓	✓	✓
Cumulative impacts	✓	✓	✓

	Construction	Operation	Decommissioning
Noise and Vibration			
Noise affecting human and ecological receptors	✓	✓	✓
Vibration affecting human and ecological receptors	✓	×	✓
Cumulative impacts	✓	✓	✓
Traffic and Transport			
Highway safety	✓	✓	✓
Driver delay	✓	✓	✓
Pedestrian amenity	✓	×	✓
Severance	✓	×	✓
Abnormal loads	✓	×	✓
Cumulative impacts	✓	×	✓
Health			
Noise disturbance	✓	✓	✓
Dust	✓	×	✓
Temporary loss of access to green space	✓	×	✓
Disruption to local road network	✓	×	✓
Increased local employment	✓	✓	✓
EMF (above buried onshore cables)	×	✓	×
Cumulative impacts	✓	✓	✓

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	×	×	×
Landscape and visual impacts of landfall	✓	×	×
Landscape and visual impacts of cable relay station	✓	✓	✓
Landscape and visual impacts of onshore cable route	✓	×	×
Landscape and visual impacts of substation	✓	✓	✓
Cumulative impacts of landfall	×	×	×
Cumulative impacts of cable relay station	✓	✓	✓
Cumulative impacts of onshore cable route	×	×	×
Cumulative impacts of substation	✓	✓	✓
Socio-economics			
All socio-economic impacts	✓	✓	✓
Cumulative socio-economic impacts	✓	✓	✓
Tourism and Recreation			
Coastal and marine - visual impacts	✓	✓	✓
Coastal and marine - disruption to marine and coastal recreational activities	✓	✓	✓
Coastal and marine - restricted beach access	✓	×	✓
Onshore - disturbance including noise, dust and visual impact	✓	×	✓
Noise at the substation and cable relay station	×	✓	×
Visual impacts from substation and cable relay station	✓	✓	✓
Disruption to local recreation and tourism provisions and businesses	✓	×	✓
Loss of amenity land	×	✓	×
Temporary/permanent closure of PRoWs	✓	✓	✓
Reverting land and amenity to an improved condition	×	×	✓
Cumulative tourism and recreation impacts	✓	✓	✓

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