

Hornsea Project Three  
Offshore Wind Farm



## Hornsea Project Three Offshore Wind Farm

Preliminary Environmental Information Report:  
Non-Technical Summary

Date: July 2017

**Hornsea 3**  
Offshore Wind Farm

**DONG**  
energy

Environmental Impact Assessment  
Preliminary Environmental Information Report

Non-Technical Summary

Report Number: P6.00

Version: Final

Date: July 2017

This report is also downloadable from the Hornsea Project Three offshore wind farm website at:

[www.dongenergy.co.uk/hornseaproject3](http://www.dongenergy.co.uk/hornseaproject3)

DONG Energy Power (UK) Ltd.

5 Howick Place,

London, SW1P 1WG

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## Table of Contents

1.	Introduction .....	1	5.6	Assessment of Effects .....	16
1.1	Purpose of this document .....	1	5.7	Additional mitigation measures .....	17
1.2	DONG Energy .....	1	5.8	Preliminary Environmental Information Report .....	17
1.3	Hornsea Zone .....	1	6.	Potential Environmental Impacts (Offshore) .....	18
1.4	Hornsea Three .....	3	6.1	Introduction .....	18
1.5	Consultation on the PEIR .....	3	6.2	Marine Processes .....	18
1.6	Next steps .....	4	6.3	Benthic Subtidal and Intertidal Ecology .....	19
2.	Policy and Legislation .....	4	6.4	Fish and Shellfish Ecology .....	20
2.1	Energy policy and the role of renewable sources of energy .....	4	6.5	Marine Mammals .....	21
2.2	Planning consents and EIA .....	5	6.6	Ornithology .....	23
2.3	Consultation process .....	5	6.7	Commercial Fisheries .....	24
3.	Project Description .....	6	6.8	Shipping and Navigation .....	26
3.1	Introduction .....	6	6.9	Aviation, Military and Communication .....	27
3.2	Agreement for Lease (AfL) .....	6	6.10	Marine Archaeology .....	28
3.3	Hornsea Three infrastructure overview .....	7	6.11	Seascape and Visual Resources .....	29
3.4	Turbine layouts .....	7	6.12	Infrastructure and Other Users .....	31
3.5	HVAC/HVDC transmission systems .....	7	6.13	Inter-Related Effects (Offshore) .....	32
3.6	Onshore infrastructure .....	10	7.	Potential Environmental Impacts (Onshore) .....	32
3.7	Construction programme .....	10	7.1	Introduction .....	32
4.	Site Selection and Consideration of Alternatives .....	12	7.2	Geology and Ground Conditions .....	32
4.2	Stage 1: Identification of the former Hornsea Zone .....	12	7.3	Hydrology and Flood risk .....	33
4.3	Stage 2: Identification of the Hornsea Three array within the former Hornsea Zone .....	12	7.4	Ecology and Nature Conservation .....	34
4.4	Stage 3: Identification of grid connection and strategic landfall appraisal .....	12	7.5	Landscape and Visual Resources .....	35
4.5	Stage 4: Refinement of project options .....	12	7.6	Historic Environment .....	36
4.6	Stage 5: Identification of project for Scoping, Statement of Community Consultation (SoCC) and Phase 1.A Consultation .....	13	7.7	Land Use and Recreation .....	37
4.7	Stage 6: Refinement of project for Phase 1.B Consultation and EIA preparation .....	13	7.8	Traffic and Transport .....	39
4.8	Stage 7: Refinement for PEIR and Phase 2 Consultation .....	13	7.9	Noise and Vibration .....	39
4.9	Stages 8 and 9: Refining the project between PEIR and Environmental Statement/DCO application submission .....	13	7.10	Air Quality .....	40
5.	Environmental Impact Assessment Methodology .....	14	7.11	Socio-economics .....	41
5.1	Introduction .....	14	7.12	Inter-related Effects (Onshore) .....	42
5.2	Structure of the EIA .....	14	8.	References .....	43
5.3	Maximum design scenario .....	14			
5.4	Environmental baseline conditions .....	14			
5.5	Measures adopted as part of Hornsea Three .....	16			

## List of Tables

Table 1.1: Venue, date and time of public exhibitions .....	3
Table 5.1: Definition of significance levels.....	17

## List of Figures

Figure 1.1: Location of the proposed Hornsea Three offshore wind farm project within the former Hornsea Zone.	2
Figure 3.1: Layout A and layout B .....	8
Figure 3.2: Main components of HVDC and HVAC transmission options for Hornsea Three.....	9
Figure 3.3: Hornsea Three onshore cable corridor search area, as well as location for the onshore HVAC booster station and onshore HVDC converter/HVAC substation.....	11
Figure 5.1: Extent of the offshore and onshore assessments.....	15
Figure 5.2: Interactive approach to mitigation within the Hornsea Three EIA.....	16
Figure 6.1: Species recorded during the underwater video survey of the Hornsea Three array area included (a) common starfish and (b) edible sea urchin.....	19
Figure 6.2: Fish and shellfish recorded in the vicinity of Hornsea Three including (a) whiting and flatfish recorded during trawl surveys and (b) brown crab known to occur in the inshore sections of the Hornsea Three offshore cable corridor.....	20
Figure 6.3: (a) Harbour porpoise, (b) Minke whale and (c) Grey seal seen during Hornsea Three marine mammal surveys.....	21
Figure 6.4: Designated sites with marine mammals as notified interest features within proximity to Hornsea Three.....	22
Figure 6.5: Vessel Monitoring System data for UK mobile vessels (≥ 15 m) actively fishing within regional commercial fisheries study area in 2015 indicating value of catch.....	25
Figure 6.6: Zones of theoretical visibility within Hornsea Three array study area.....	30
Figure 7.1: Great crested newts and survey sampling equipment.....	34
Figure 7.2: Exterior view of Baconsthorpe Castle.....	36
Figure 7.3: Shingle beach near the Hornsea Three landfall area.....	38
Figure 7.4: Noise monitoring equipment.....	40

## Glossary

Term	Definition
Aquifer	A subsurface layer or layers of rock or other geological strata of sufficient porosity and permeability to allow either a significant flow of groundwater or the abstraction of significant quantities of groundwater.
Bedrock	Term used for the main mass of rocks forming the Earth and present everywhere, whether exposed at the surface in outcrops or concealed beneath superficial deposits or water. The bedrock has formed over vast lengths of geological time ranging from ancient and highly altered rocks of the Proterozoic, some 2500 million years ago or older, up to the relatively young Pliocene, 2.6 million years ago.
Cumulative effects	The combined effect of Hornsea Project Three in combination with the effects from a number of different projects, on the same single receptor/resource.
Cumulative impact	Impacts that result from changes caused by other past, present or reasonably foreseeable actions together with Hornsea Project Three.
Design Envelope	A description of the range of possible elements that make up the Hornsea Project Three design options under consideration, as set out in detail in the project description. This envelope is used to define Hornsea Project Three for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known. This is also often referred to as the "Rochdale Envelope" approach.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Projects (NSIP).
DONG Energy Hornsea Project Three (UK) Ltd	The company promoting the development of the Hornsea Project Three offshore wind farm. DONG Energy Hornsea Project Three (UK) Ltd is owned by DONG Energy Power (UK) Limited, who is owned by DONG Energy Vind A/S, who is owned by DONG Energy VE A/S, who is owned by DONG Energy Wind Power A/S, who is owned by DONG Energy Wind Power Holding A/S, and who is owned by DONG Energy A/S.
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of the impact with the importance, or sensitivity, of the receptor or resource in accordance with defined significance criteria.
EIA Directive	European Union Directive 85/337/EEC, as amended by Directives 97/11/EC, 2003/35/EC and 2009/31/EC and then codified by Directive 2011/92/EU of 13 December 2011 (as amended in 2014 by Directive 2014/52/EU).
EIA Regulations	The Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 (as amended).
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Directive and EIA Regulations, including the publication of an Environmental Impact Assessment (EIA) Report.
European conservation site	A Special Area of Conservation (SAC) or candidate SAC, a Special Protection Area (SPA) or potential SPA, a site listed as a site of community importance or a Ramsar site.
Flood Risk Assessment (FRA)	An evaluation of the baseline onshore flood risk and effect as a result of Hornsea Project Three. The FRA will set out flood risk mitigation measures, as may be required.

Term	Definition
Former Hornsea Zone	The Hornsea Zone was one of nine offshore wind generation zones around the UK coast identified by The Crown Estate (TCE) during its third round of offshore wind licensing. In March 2016, the Hornsea Zone Development Agreement was terminated and project specific agreements, Agreement for Leases (AFLs), were agreed with The Crown Estate for Hornsea Project One, Hornsea Project Two, Hornsea Project Three and Hornsea Project Four. The Hornsea Zone has therefore been dissolved and is referred to throughout the Hornsea Project Three Scoping Report as the former Hornsea Zone.
Gross Value Added (GVA)	The value to the economy of activity generated through construction and operation and maintenance of the scheme. Gross Value Added is effectively a measure of the additional profits generated in businesses benefiting from the activity plus additional salaries that are paid to their employees.
High Voltage Alternating Current (HVAC)	High voltage alternating current is the bulk transmission of electricity by alternating current (AC), whereby the flow of electric charge periodically reverses direction.
High Voltage Direct Current (HVDC)	High voltage direct current is the bulk transmission of electricity by direct current (DC), whereby the flow of electric charge is in one direction.
Hornsea Project Four	The fourth offshore wind farm project within the former Hornsea Zone. Referred to as Hornsea Four throughout the Preliminary Environmental Information Report (PEIR).
Hornsea Project One	The first offshore wind farm project within the former Hornsea Zone. It has a maximum capacity of 1.2 gigawatts (GW) or 1,200 MW and includes all necessary offshore and onshore infrastructure required to connect to the existing National Grid substation located at North Killingholme, North Lincolnshire. Referred to as Project One throughout the PEIR.
Hornsea Project Three	The third offshore wind farm project within the former Hornsea Zone. It has a maximum capacity of 2.4 GW (2,400 MW) and includes offshore and onshore infrastructure to connect to the existing National Grid substation located at Norwich Main, Norfolk. Referred to as Hornsea Three throughout the PEIR.
Hornsea Project Two	The second offshore wind farm project within the former Hornsea Zone. It has a maximum capacity of 1.8 GW (1,800 MW) and includes offshore and onshore infrastructure to connect to the existing National Grid substation located at North Killingholme, North Lincolnshire. Referred to as Project Two throughout the PEIR.
Impact	Change that is caused by an action; for example, land clearing (action) during construction which results in habitat loss (impact).
Inter-related effects	Multiple effects on the same receptor arising from Hornsea Project Three. These occur either where a series of the same effect acts on a receptor over time to produce a potential additive effect or where a number of separate effects, such as noise and habitat loss, affect a single receptor, for example marine mammals.
Landfall Area	The area between (MHWS) and (MLWS) in which all of the export cables will be landed and is the transitional area between the offshore export cabling and the onshore export cabling.
Magnitude	A combination of the extent, duration, frequency and reversibility of an impact.
Marine Mammal Mitigation Protocol (MMMP)	A document detailing the protocol to be implemented in the event that driven or part-driven pile foundations are proposed to be used. The protocol identifies the methods for detection, potential mitigation and monitoring/reporting protocols for marine mammals.
Mean High Water Spring (MHWS)	The height of mean high water springs is the average throughout the year (when the average maximum declination of the moon is 23.5°) of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest.

Term	Definition
Measures adopted as part of the project	Enhancement, mitigation or monitoring commitment (which may include process or design measures) intended to avoid, reduce and where possible, remedy significant adverse impacts of a development.
National Policy Statement (NPS)	A document setting out national policy against which proposals for NSIPs will be assessed and decided upon.
Nationally Significant Infrastructure Project (NSIP)	Large scale development including power generating stations which requires development consent under the Planning Act 2008. An offshore wind farm project with a capacity of more than 100 MW constitutes an NSIP.
Norwich Main National Grid Substation	The existing National Grid Norwich Main substation which Hornsea Project Three will ultimately connect to.
Offshore cable corridor	The specific corridor of seabed (seaward of Mean High Water Springs (MHWS)) and land (landward of MHWS) from the Hornsea Project Three array area to the Norwich Main National Grid substation, within which the export cables will be located.
Onshore cable corridor	The corridor within which the onshore export cable will be installed.
Planning Act 2008	The key legislation providing for national policy guidance to assist in the delivery of Nationally Significant Infrastructure Projects (NSIPs). The 2008 Act led to the development of National Policy Statements (NPSs) to guide the decision making processes for NSIPs.
Planning Inspectorate (PINS)	The executive agency of the Department for Communities and Local Government responsible for operating the planning process for NSIPs.
Principal aquifer	Layers of rock or drift deposits that have high inter-granular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifers.
Project Description	A summary of the engineering design elements of Hornsea Project Three.
Receptor	A component of the natural or man-made environment that is affected by an impact, including people.
Secondary Aquifers	These include a wide range of rock layers or drift deposits with an equally wide range of water permeability and storage. Secondary aquifers are subdivided into two types.
Sensitivity	The extent to which a receptor can accept a change, of a particular type and scale
Significance	The significance of an effect combines the evaluation of the magnitude of an impact and the sensitivity of the receptor.
Superficial deposits	The youngest geological deposits formed during the most recent period of geological time, the Quaternary, which extends back about 2.6 million years from the present. They rest on older deposits or rocks referred to as bedrock.
Suspended sediments	Particulates in suspension in the water column, often comprising fine material such as clays and silts.
Transboundary	Crossing into other European Economic Association (EEA) States.
Water Framework Directive (WFD)	Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

## Acronyms

Acronym	Description
AC	Alternating Current
ADDs	Acoustic Deterrent Devices
AfL	Agreement for Leases
ASACS	Air Surveillance and Control Systems
CoCP	Code of Construction Practice
CCS	Carbon Capture and Storage
DC	Direct Current
DCO	Development Consent Order
EA	Environment Agency
EEA	European Economic Area
EIA	Environmental Impact Assessment
FLOWW	Fishing Liaison with Offshore Wind and Wet Renewables Group
FSA	Formal Safety Assessment
GVA	Gross Value Added
HDD	Horizontal Directional Drilling
HMR	Helicopter Main Route
HSC	Historic Seascape Character
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Cur
IAQM	Institute of Air Quality Management
LEP	Local Enterprise Partnership
LOS	Line of Sight
MCA	Maritime and Coastguard Agency
MDA	MOD Managed Danger Area
MGN	Marine Guidance Note
MHWS	Mean High Water Spring
MMMP	Marine Mammal Mitigation Protocol

Acronym	Description
MMO	Marine Management Organisation
MOD	Ministry of Defence
NETS	National Electricity Transmission System
NPS	National Policy Statements
NPS EN-1	Overarching National Policy Statement for Energy
NPS EN-3	National Policy Statement for Renewable Energy Infrastructure
NPS EN-5	National Policy Statement for Electricity Networks Infrastructure
NRA	Navigational Risk Assessment
NSIP	Nationally Significant Infrastructure Project
NTS	Non-Technical Summary
PEIR	Preliminary Environmental Information Report
PEMMP	Project Environmental Management and Monitoring Plan
PINS	Planning Inspectorate
PRoW	Public Right of Way
pSAC	proposed Special Area of Conservation
pSPA	proposed Special Protection Area
PSR	Primary Surveillance Radar
RES	Renewable Energy Strategy
REWS	Radar Early Warning Systems
SAC	Special Area of Conservation
SAR	Search and Rescue
SoCC	Statement of Community Consultation
SPA	Special Protection Area
SPZ	Source Protection Zones
SSSI	Site of Special Scientific Interest
SVIA	Seascape and Visual Impact Assessment
TCE	The Crown Estate
UCG	Underground Coal Gasification
UK	United Kingdom

Acronym	Description
WFD	Water Framework Directive
ZTV	Zone of Theoretical Visibility

## Units

Unit	Description
GW	Gigawatt (power)
Ha	Hectare
kJ	Kilojoules
km	Kilometre
kV	Kilovolt (electrical potential)
kW	Kilowatt (power)
m	Metre
MW	Megawatt (power)
nm	Nautical Mile

## 1. Introduction

### 1.1 Purpose of this document

- 1.1.1.1 DONG Energy Power (UK) Ltd. (hereafter referred to as DONG Energy), on behalf of DONG Energy Hornsea Project Three (UK) Ltd., is promoting the development of the Hornsea Project Three Offshore Wind Farm (hereafter referred to as Hornsea Three). Hornsea Three is a proposed offshore wind farm located in the southern North Sea, with a total generating capacity of up to 2,400 MW.
- 1.1.1.2 The Hornsea Three array area (i.e. the area in which the offshore wind turbine generators (hereafter referred to as turbines) are located) (referred to as the Hornsea Three array area) is approximately 120 km northeast of the Norfolk coast and 160 km east of the Yorkshire coast (Figure 1.1). The Hornsea Three array area lies to the east of Hornsea Project One (hereafter referred to as Project One) and Hornsea Project Two (hereafter referred to as Project Two) offshore wind farms, and is located within the former Hornsea Zone (as shown on Figure 1.1). Hornsea Three is a project that will consist of an offshore generating station(s) with a capacity of greater than 100 MW and therefore is a Nationally Significant Infrastructure Project (NSIP), as defined by Section 15(3) of the Planning Act 2008. As such, there is a requirement to submit an application for Development Consent to the Planning Inspectorate (PINS) to be decided by the Secretary of State for Business, Energy and Industrial Strategy.
- 1.1.1.3 The application for Development Consent will comprise full details of the development proposal and will be accompanied by an Environmental Statement prepared in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 (the 'EIA Regulations') as amended.
- 1.1.1.4 This document is a Non-Technical Summary (NTS) of the Preliminary Environmental Information Report (PEIR) prepared for Hornsea Three. The NTS provides summary details of Hornsea Three, as well as a description of the existing environment in and around Hornsea Three. The NTS also presents a summary of the main findings to date of the Environmental Impact Assessment (EIA) undertaken for Hornsea Three.
- 1.1.1.5 This NTS is intended to act as a stand-alone document that will provide an overview of the environmental effects of the proposed development in non-technical language. For more detailed information, the full PEIR should be referred to, which can be downloaded from [www.dongenergy.co.uk/hornseaproject3](http://www.dongenergy.co.uk/hornseaproject3).

1.1.1.6 The purpose of the PEIR is to provide the preliminary environmental information which has been gathered in order to carry out an assessment of the likely significant environmental effects of Hornsea Three, to enable consultees to understand the likely environmental effects of Hornsea Three and to help inform consultation responses. This affords an opportunity to engage with PINS, statutory and non-statutory consultees during the pre-application process, inviting them to review those assessments undertaken to date and to provide comment, which in turn will inform the EIA process and associated Environmental Statement. Hornsea Three welcomes comments from all stakeholders on the findings to date of the EIA (see section 1.5) and will continue to engage with relevant stakeholders throughout the pre-application consultation period on any updates or changes to the assessments presented within this PEIR.

1.1.1.7 The Environmental Statement, which will outline the full EIA for Hornsea Three, will be informed by stakeholder responses to this PEIR. The Environmental Statement, which will accompany the application for Development Consent, will be submitted to PINS in Quarter 2 of 2018.

### 1.2 DONG Energy

1.2.1.1 DONG Energy A/S (owner of DONG Energy Power (UK) Ltd. and DONG Energy Hornsea Project Three (UK) Ltd.) specialises in procuring, producing, distributing and trading energy and related products in Northern Europe. DONG Energy A/S is the world leader in the development, construction and operation of offshore wind farms, with more than 25 years' experience and a strong track record delivering successful projects, with approximately 3,849 MW of operational offshore wind farms worldwide, and a further 3,582 MW under construction in the lead up to 2020.

### 1.3 Hornsea Zone

1.3.1.1 The former Hornsea Zone was one of nine offshore wind generation zones around the UK coast identified by The Crown Estate (TCE) during its third round of offshore wind licensing. The former Hornsea Zone was located in the southern North Sea, approximately 31 km east of the Yorkshire coast and 1 km from the median line between UK and Dutch waters (Figure 1.1). As part of a competitive tender, SMart Wind Ltd. (a 50/50 joint venture between International Mainstream Renewable Power (Offshore) Limited and Siemens Project Ventures GmbH; hereafter referred to as SMart Wind) was awarded the rights to the development of the former Hornsea Zone by entering into a Zone Development Agreement (ZDA) with the TCE in 2009.

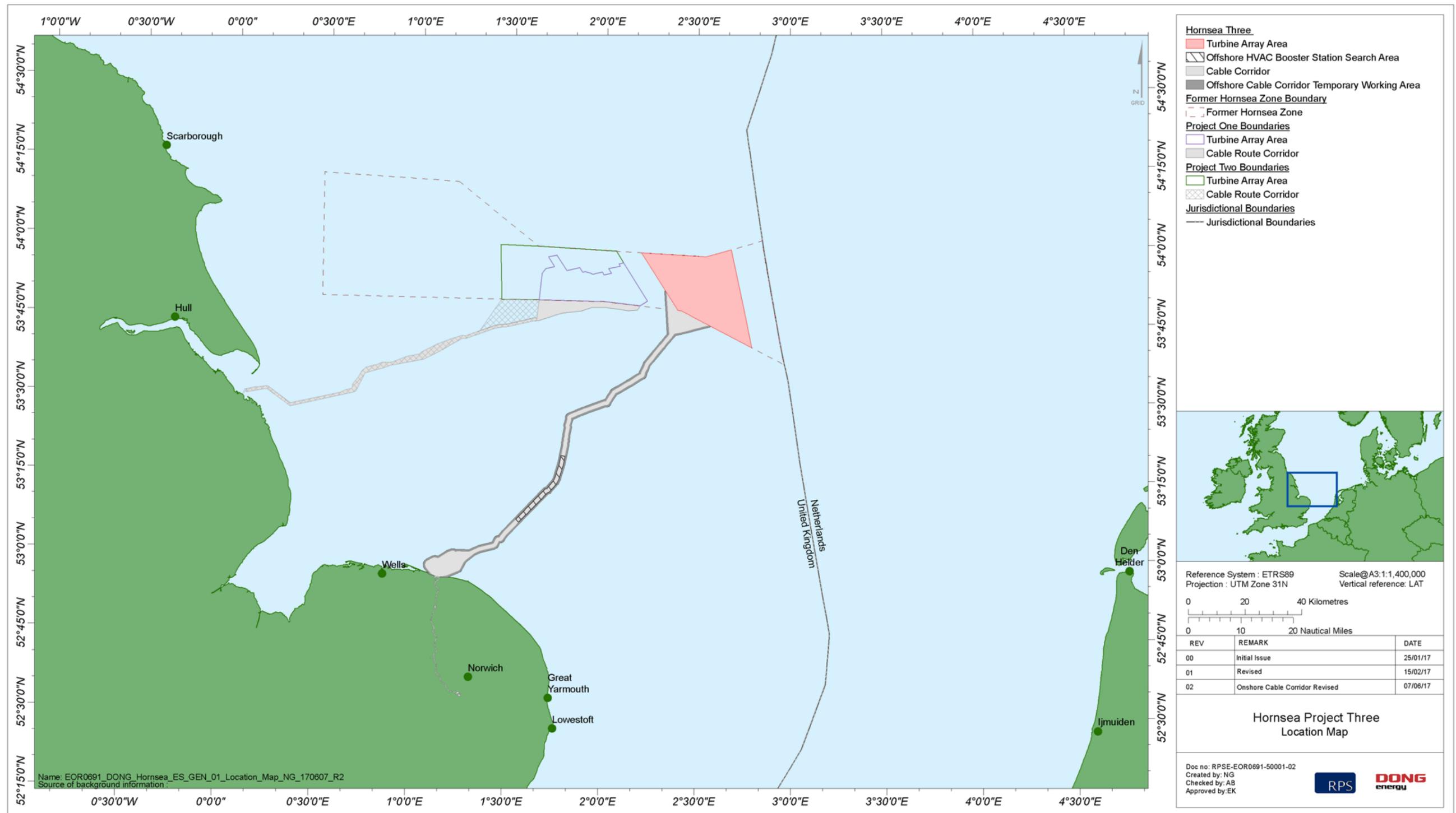


Figure 1.1: Location of the proposed Hornsea Three offshore wind farm project within the former Hornsea Zone.

1.3.1.2 DONG Energy Wind Power A/S acquired the development rights to Hornsea Project One in February 2015 and, in August 2015, DONG Energy Power (UK) Ltd. acquired SMart Wind Ltd and the then Hornsea Zone, together with the development rights for Hornsea Project Two, Hornsea Three and Hornsea Project Four offshore wind farm (hereafter referred to as Hornsea Four). Subsequently in March 2016, the Hornsea ZDA was terminated and project specific agreements, Agreement for Leases (AfLs), were agreed with TCE for Hornsea Project One, Hornsea Project Two, Hornsea Three and Hornsea Four<sup>1</sup>. The Hornsea Zone has therefore been dissolved and is referred to throughout the Hornsea Three PEIR and associated NTS as the former Hornsea Zone.

## 1.4 Hornsea Three

1.4.1.1 The Hornsea Three array area (i.e. the area in which the offshore wind turbine generators (hereafter referred to as turbines) are located) is approximately 696 km<sup>2</sup>, and is located approximately 121 km northeast off the Norfolk coast and 160 km east of the Yorkshire coast (Figure 1.1). The Hornsea Three offshore cable corridor extends from the Norfolk coast, offshore in a north-easterly direction to the western and southern boundary of the Hornsea Three array area. Hornsea Three has a different onshore and offshore cable route corridor, as well as grid connection, to Hornsea Project One and Hornsea Project Two (Figure 1.1).

1.4.1.2 The electricity generated from Hornsea Three will be transmitted via buried High Voltage (HV) cables using either Direct Current (DC) or Alternating Current (AC), or a combination of the two. From the Norfolk coast, underground onshore cables will connect the offshore wind farm to an onshore High Voltage Alternating Current (HVAC) substation (via an offshore HVAC booster station and/or onshore HVAC booster station (if required)) or/High Voltage Direct Current (HVDC) converter substation, which will in turn, connect to an existing National Grid substation. Hornsea Three will connect to the Norwich Main National Grid substation, located to the south of Norwich.

1.4.1.3 Further details of the project are provided under the "Project Description" sub-heading below (section 3).

## 1.5 Consultation on the PEIR

1.5.1.1 There are a number of ways that stakeholders can provide feedback on the NTS and PEIR. These include the provision of feedback through the public exhibitions and feedback forms, letter or email. All information pertaining to Hornsea Three is available from the DONG Energy website: [www.dongenergy.co.uk/hornseaproject3](http://www.dongenergy.co.uk/hornseaproject3).

1.5.1.2 Consultees are invited to consider all of the information provided in this PEIR and to advise on whether they agree with the conclusions.

1.5.1.3 Comments on the Hornsea Three PEIR should be made in writing and submitted:

- By post to: Hornsea Project Three Offshore Wind Farm, DONG Energy, 5 Howick Place, London, SW1P 1WG; and
- By email to: [HornseaProjectThree@dongenergy.co.uk](mailto:HornseaProjectThree@dongenergy.co.uk).

1.5.1.4 DONG Energy requests that any responses indicate who is making the representation, and provide an email address, postal address and telephone number to which any correspondence relating to the comments may be sent.

1.5.1.5 Hornsea Three will also hold a number of public exhibitions, in Local Authorities in and around the Hornsea Three onshore cable corridor search area. At these events, DONG Energy will specifically consult stakeholders and the local community on the contents of this PEIR. Anyone who could potentially be affected by, or may have an active interest in Hornsea Three is encouraged to attend. The consultation events are to be held from 4 to 13 September 2017 (see Table 1.1 below for their timings and locations, as well as the DONG Energy website ([www.dongenergy.co.uk/hornseaproject3](http://www.dongenergy.co.uk/hornseaproject3)) and June 2017 community newsletter).

1.5.1.6 The deadline for receipt of comments on the NTS and PEIR consultation is 20 September 2017. Any comments received will be provided to PINS and may be made public.

1.5.1.7 Comments received at all stages of the Hornsea Three pre-application consultation phase will be collated and considered prior to finalising the application for a DCO. A separate Consultation Report will set out the comments and feedback that have been received and describe how the comments raised have been taken into account and dealt with as part of the application. The Consultation Report will accompany the final application to the Secretary of State for a DCO.

Table 1.1: Venue, date and time of public exhibitions

Venue	Date	Time
Swardston Village Hall	Monday 4 September 2017	3pm to 7pm
King's Centre, Norwich	Tuesday 5 September 2017	4pm to 7:30pm
Corpusty and Saxthorpe Village Hall	Wednesday 6 September 2017	4pm to 8pm
Weybourne Village Hall	Thursday 7 September 2017	3:30pm to 7:30pm
Reepham Town Hall	Friday 8 September 2017	3:30pm to 7:30pm
Hall for All, Weston Longville	Tuesday 12 September 2017	4pm to 7:30pm
Holt Community Centre	Wednesday 13 September 2017	4pm to 7:30pm

<sup>1</sup> Hornsea Four is not shown on Figure 1.1 because it is in the early stages of the development process.

## 1.6 Next steps

- 1.6.1.1 DONG Energy will further refine the Hornsea Three project design and EIA based upon the consultation responses received. The final results of the EIA will be presented in an Environmental Statement and a summary of all the consultation responses received will be presented in a Consultation Report, both of which will accompany the DCO application to be submitted in Quarter 2 of 2018.

## 2. Policy and Legislation

### 2.1 Energy policy and the role of renewable sources of energy

- 2.1.1.1 In October 2014, the EU Council agreed on a policy framework for climate and energy in the period from 2020 to 2030, which included targets and policy objectives for that period. The targets to be achieved by 2030 include:
- A 40% cut in greenhouse gas emissions compared to 1990 levels;
  - At least a 27% share of renewable energy consumption; and
  - At least 27% improvement in energy efficiency.
- 2.1.1.2 In order to meet these targets, the European Commission published a proposal for a revised Renewable Energy Directive on 30 November 2016, which addressed the points in the Renewable Energy Directive's evaluation conducted between 2014 and 2016, stakeholder consultations, and expert independent studies commissioned by the Commission. This proposed revised Renewable Energy Directive seeks to build on the success of the Renewable Energy Directive.
- 2.1.1.3 A range of UK government strategies and measures, have defined the over-arching need for renewable energy generation in the UK. Key documents include:
- National Renewable Energy Action Plan for the UK (DECC, 2010);
  - UK Renewable Energy Strategy (RES; DECC, 2009a);
  - UK Low Carbon Transition Plan (DECC, 2009b);
  - The Renewable Energy Roadmap (DECC, 2013); and
  - The UK Carbon Plan (DECC, 2011a).
- 2.1.1.4 The central objective of Government energy policy is to ensure the security of energy supply, whilst responding to the challenge of climate change by reducing carbon emissions. To meet these objectives, more energy infrastructure is required with an increased emphasis on energy generation from renewable and low carbon sources.
- 2.1.1.5 The need for this infrastructure is fully recognised in many areas of Government policy. The Energy Act 2013 includes provisions intended to incentivise investment in low carbon electricity generation, ensure security of supply and help the UK meet its emission reduction and renewables targets.

2.1.1.6 In terms of planning, the UK's commitment to renewable energy has been captured in the publication of the following National Policy Statements (NPS):

- Overarching NPS for Energy (NPS EN-1; DECC, 2011b);
- NPS for Renewable Energy Infrastructure (NPS EN-3; DECC, 2011c); and
- NPS for Electricity Networks Infrastructure (NPS EN-5; DECC, 2011d).

2.1.1.7 NPS EN-3 and NPS EN-5 identify certain environmental topic-specific policy considerations. Where relevant, these are outlined within the PEIR chapters.

## 2.2 Planning consents and EIA

2.2.1.1 This section summarises the planning consents that will be required, under the Planning Act 2008 (as amended), in order to construct and operate Hornsea Three, as well as describing the UK and EU legal requirements for the Hornsea Three EIA.

2.2.1.2 The Planning Act 2008, and associated secondary legislation, sets out a comprehensive statutory framework for the principal consents required to develop, operate and decommission NSIPs, together with any related associated infrastructure. Hornsea Three is defined as an NSIP, as it will be an offshore generating station with a capacity of greater than 100 MW.

2.2.1.3 Permission to build and operate an NSIP is given in a Development Consent Order (DCO), granted by the Secretary of State in accordance with the policy framework provided in the NPSs. The application will cover all offshore and onshore works and the draft DCO will be submitted with the application for Development Consent.

2.2.1.4 Directive 2014/52/EU on the assessment of the effects of certain public and private projects on the environment was brought into force on 15 May 2014 and requires that an EIA be undertaken in support of an application for Development Consent for certain types of project. The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (EIA 2017 Regulations) implement the EIA Directive for consent applications made under the Planning Act 2008. It should be noted that as the Scoping Report was submitted in December 2016, the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 apply, however it has been decided that in the interests of good practice the spirit of the EIA 2017 Regulations will be adhered to where possible.

2.2.1.5 Only certain types of project require an EIA to be carried out under the EIA Regulations. According to Schedule 2 of the EIA Regulations, an EIA is required for installations for the harnessing of wind power for energy production likely to have significant effects on the environment. A full EIA will therefore be undertaken for Hornsea Three and an Environmental Statement produced. This PEIR, of which this NTS forms a part, presents the findings to date of the EIA.

2.2.1.6 The EIA process can be broadly summarised as consisting of three main elements that take place prior to the submission of the DCO and Environmental Statement:

- Scoping: Project promoters can request a formal Scoping Opinion from PINS on behalf of the Secretary of State;
- Consultation: The project promoter is required to conduct pre-application consultation in accordance with the Planning Act 2008 plus associated guidance and Regulations, which includes the above EIA Regulations. The Statement of Community Consultation (SoCC) identifies the proposed consultation activities (see section 2.3 for further information); and
- Environmental Statement Preparation: The Environmental Statement is prepared taking into account the responses to the consultation process. An additional consultation process also takes place where consultation responses on the PEIR are invited. The Environmental Statement is then prepared taking into account comments on the PEIR.

## 2.3 Consultation process

2.3.1.1 Hornsea Three has prepared a SoCC, which sets out how it plans to consult local communities on the proposed development. Hornsea Three must conduct its consultation in line with this statement. The SoCC in its final format was published on 30 September 2016 and copies were issued in local newspapers the following week. The Hornsea Three SoCC (DONG Energy, 2016a) can be downloaded from the DONG Energy website: [www.dongenergy.co.uk/hornseaproject3](http://www.dongenergy.co.uk/hornseaproject3).

2.3.1.2 The Hornsea Three SoCC sets out the two phase consultation programme for Hornsea Three. The phased approach allows for an iterative process in which consultees are able to observe the project changes in response to their feedback. These preliminary consultations form part of the project scoping (process of determining the content and extent of matters that should be covered in the environmental information to be submitted) alongside literature searches, site-visits and preliminary ecological surveys. As well as the two main phases of consultation as outlined in the SoCC, further engagement has and will continue to take place throughout the pre-application period.

### 2.3.2 Phase One Consultation

2.3.2.1 The publication of the Hornsea Three SoCC marked the start of the first phase of consultation for Hornsea Three, hereafter referred to as Phase One consultation. Consultation responses were requested before the end of November 2016. During Phase One consultation, Hornsea Three published and received feedback on its Scoping Report and held two rounds of Community Consultation Events (Phase 1.A and Phase 1.B).

### 2.3.3 Phase Two Consultation

2.3.3.1 Phase Two Consultation will be the beginning of formal statutory consultation (under Section 42 of the 2008 Act) on the PEIR and accompanying documents. The PEIR builds upon and utilises the Hornsea Three Scoping Report and Scoping Opinion, as well as comments received from the first two rounds of community consultation events under Phase One Consultation. As part of the Phase Two Consultation, Hornsea Three will hold a third round of community consultation events between 4 and 13 September 2017.

## 3. Project Description

### 3.1 Introduction

3.1.1.1 This section of the NTS provides an outline description of the potential design of both the onshore and offshore infrastructure, as well as the activities associated with the construction, operation and maintenance, and decommissioning of Hornsea Three. The full indicative project description is set out in volume 1, chapter 3: Project Description of the PEIR.

3.1.1.2 The boundary of Hornsea Three can be seen in Figure 1.1 above. This area encompasses the:

- Hornsea Three array area: This is where the offshore wind farm will be located, which will include the wind turbines, wind turbine foundations, array cables, and a range of offshore substations and offshore interconnector cables;
- Hornsea Three offshore cable corridor: This is where the offshore export cables, as well as the offshore HVAC booster station(s) if required, will be located; and
- Hornsea Three onshore cable corridor search area: This is where the onshore export cables, as well as the onshore HVAC booster station if required, onshore substation and connections to the National Grid will be located.

3.1.1.3 At this stage in the development process for Hornsea Three, the project description is indicative and the 'envelope' has been designed to include sufficient flexibility to accommodate further project refinement during detailed design. The PEIR, as summarised in this NTS, therefore sets out a series of options and parameters for which maximum values are shown. The maximum values constitute the realistic maximum design scenario in relation to Hornsea Three. The final design will be refined later in the project development from the parameters stated here. A further refined and detailed project description will be provided in the Environmental Statement that will accompany the application for Development Consent.

### 3.2 Agreement for Lease (AfL)

3.2.1.1 The Agreement for Lease (AfL) area for the Hornsea Three array area is broadly a diamond shape with a length of approximately 29 km west to east and 35 km north to south. The AfL area is where the offshore infrastructure, such as the turbines, offshore substation(s) and array cables will be located.

3.2.1.2 Hornsea Three does not yet have an AfL area for the offshore cable corridor. This will be applied for ahead of the DCO application to be submitted in Quarter 2 of 2018.

### 3.3 Hornsea Three infrastructure overview

3.3.1.1 Hornsea Three will have a total capacity of up to 2,400 MW as measured at an offshore metering point at the offshore substations. The precise number, size and model of turbine will depend upon technology available in the future but the maximum number would be 342. In addition, The other key components of Hornsea Three, described in the following sections, could consist of:

- Up to three offshore accommodation platform(s);
- Array cables linking the individual wind turbines to an offshore substation; and
- A HVAC or HVDC transmission system including either:
  - HVAC:
    - Up to 12 offshore HVAC collector substation(s);
    - Interconnector cables(s);
    - Offshore export cable(s);
    - Up to four offshore HVAC booster station(s) or up to six subsea HVAC booster station(s);
    - Onshore export cable(s);
    - Onshore HVAC booster station;
    - Onshore substation; and
    - Grid connection export cable(s).
  - HVDC:
    - Up to 12 offshore HVAC collector substation(s);
    - Offshore interconnector cables(s);
    - Up to four offshore converter substations;
    - Offshore export cables(s);
    - Onshore export cables(s);
    - Onshore substation; and
    - Grid connection export cable(s).

### 3.4 Turbine layouts

3.4.1.1 Designing and optimising the layout of the turbines and other offshore surface infrastructure (offshore substations and offshore accommodation platforms) is a complex, iterative process taking into account a large number of inputs and constraints.

3.4.1.2 The Hornsea Three layouts will have a spacing between neighbouring turbines of no less than 1 km and the layout will not breach the spacing limitation stated above. In order to inform the EIA, Hornsea Three has identified two indicative layout scenarios. The indicative layout scenarios have been used within the EIA for contextual purposes where appropriate. Layout A (Figure 3.1) includes the maximum number of structures (342 turbines and 19 platforms (offshore accommodation and substations)). It includes a dense border at an approximate spacing of 1 km, and varied internal spacing and orientation. As the locations of the infrastructure is not yet defined, the layouts do not distinguish between what type of infrastructure is placed in each location. Individual assessment chapters have therefore made assumptions as to which locations are turbines or platforms in order to inform the assessment. Layout B is shown in Figure 3.1. This layout shows an indicative scenario with larger turbines, and hence greater spacing between turbine locations. The total number of locations in this layout is 125, the border spacing is approximately 5.6 km and the internal spacing is varied. The final layout will be designed after the consent has been granted.

### 3.5 HVAC/HVDC transmission systems

3.5.1.1 There are a range of transmission system designs that can be used to transport the power from the Hornsea Three array area to the UK National Grid. These fall under two primary transmission types defined by how the current is delivered through the export cables; HVAC or HVDC. While offshore wind farms in the UK have traditionally used HVAC transmission systems, HVDC transmission systems become more technically and/or economically viable in the context of far from shore projects (such as interconnectors between countries) and are used on a number of projects in Germany.

3.5.1.2 Hornsea Three may use HVAC or HVDC transmission, or could use a combination of both technologies in separate electrical systems. As a consequence, depending on the option selected, the proposed project will have slightly different key components in addition to those listed above (Figure 3.2). If a combination of the two technologies is used, the total infrastructure installed will not exceed the maximum values assessed within this PEIR.

3.5.1.3 Hornsea Three requires flexibility in transmission system choice to ensure that anticipated changes in available technology and project economics can be accommodated within the Hornsea Three design, and will make a decision on which transmission type to use during the detailed design phase (likely post consent).

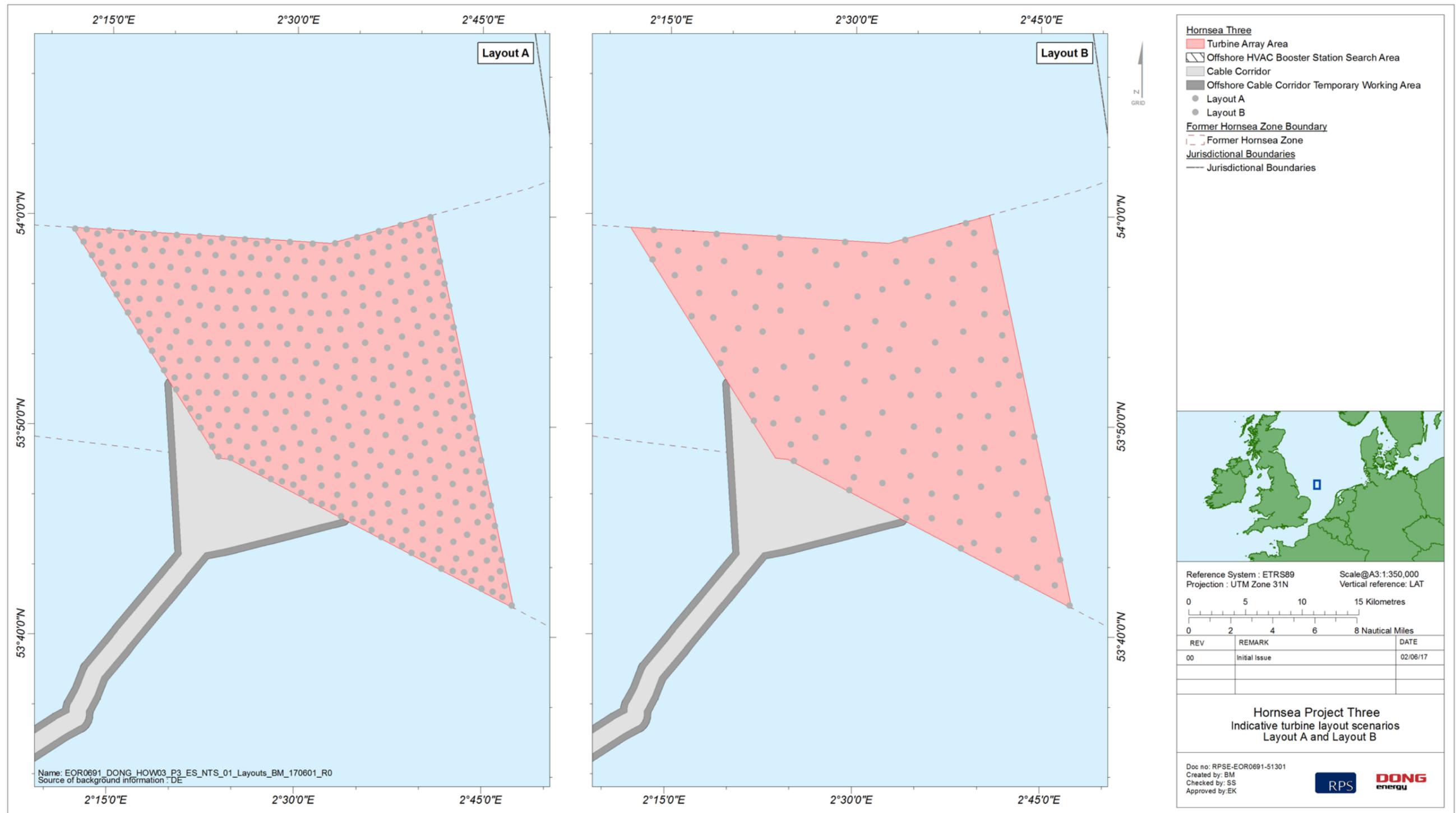


Figure 3.1: Layout A and layout B.

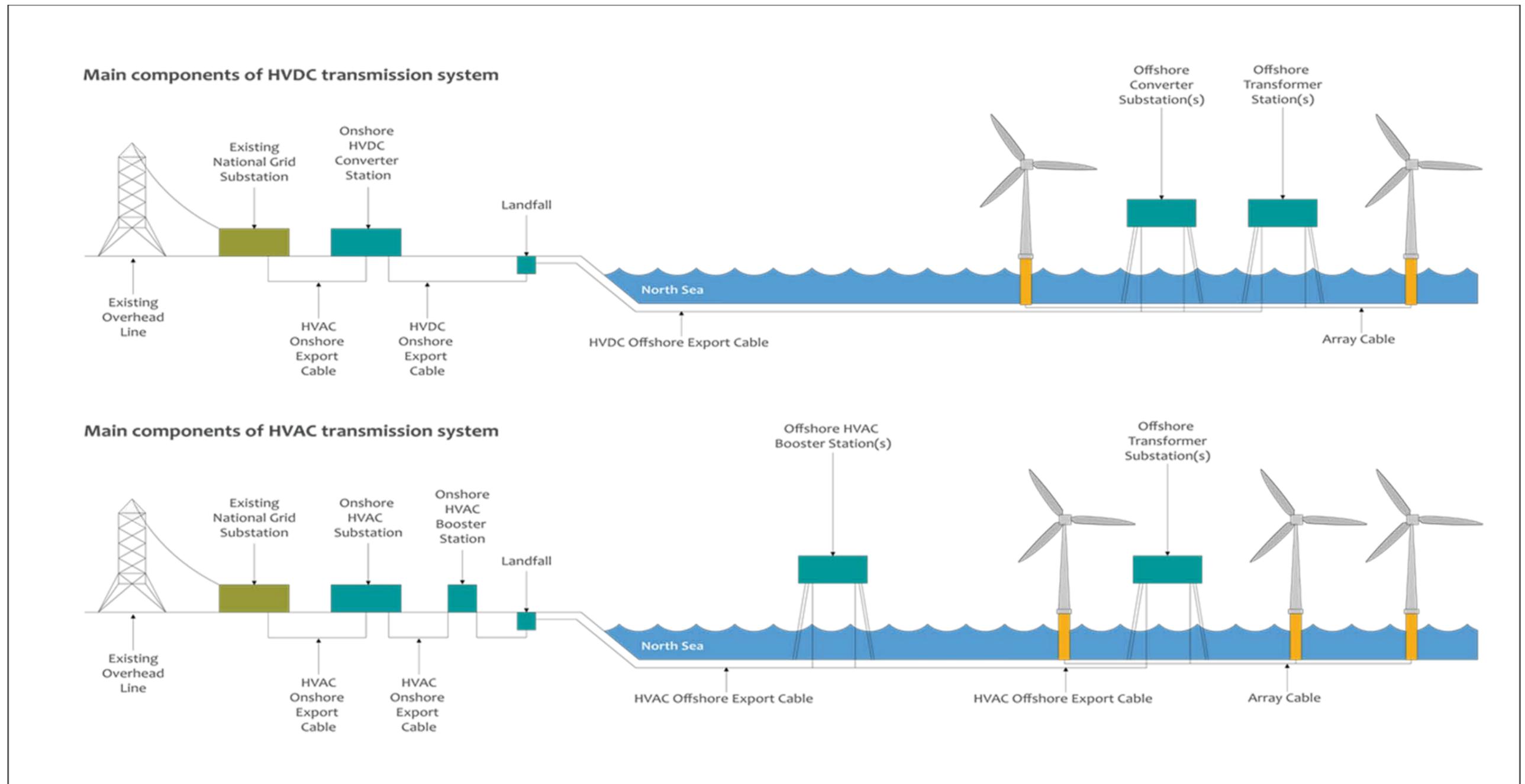


Figure 3.2: Main components of HVDC and HVAC transmission options for Hornsea Three.

## 3.6 Onshore infrastructure

- 3.6.1.1 Onshore export cables will be brought ashore on the north Norfolk coast in the vicinity of Weybourne (Figure 3.3). The cables will be buried underground along their entire length. The cables will be buried in a corridor up to 80 m wide and installed predominantly in agricultural land, minimising complex crossings of roads, watercourses and environmentally sensitive locations wherever possible. The cable will be brought to site in sections (typically 750 m to 1,000 m in length) which will be laid in the trenches, jointed together and buried.
- 3.6.1.2 If a HVAC electrical transmission system is developed it may be necessary to construct an onshore HVAC booster station (along with, or in addition to, an offshore HVAC booster station(s), designed to mitigate transmission losses. If an onshore HVAC booster station is required it would be constructed at the upper end of the Hornsea Three onshore cable corridor. A potential site for an onshore HVAC booster station has been identified between Edgefield and Saxthorpe, close to Little Barningham (Figure 3.3). If a HVDC electricity system is developed, an onshore HVAC Booster Station would not be required.
- 3.6.1.3 In order to connect Hornsea Three to the National Electricity Transmission System (NETS) it is necessary to construct a new HVDC converter station or HVAC substation (onshore HVDC converter/HVAC substation), depending on which transmission system is developed. Hornsea Three will connect to the NETS at Norwich Main Substation. A potential site for an onshore HVDC converter station or onshore HVAC substation (referred to throughout the NTS and PEIR as the onshore HVDC converter/HVAC substation), has been identified adjacent to the A47, northwest of Mangreen Quarry (Figure 3.3).
- 3.6.1.4 During the construction phase, temporary construction compounds will be installed at the landfall, HVAC booster station (if required) and HVDC Converter/HVAC substation sites. Temporary compounds will also be installed at intervals on the onshore cable route and will be restored upon completion of construction.

## 3.7 Construction programme

- 3.7.1.1 Hornsea Three may be constructed in a single phase or in up to three phases. There are various possible reasons for this including, for example, constraints in the supply chain or the requirements of the government's Contract for Difference process which offshore wind farms currently rely on to secure a price for the electricity produced by a project. As such there is the potential for an overlap or a gap between the completion of construction of one phase and the start of construction of another. The total durations for construction of each component will not exceed those stated in the PIER, however there may be periods where work stops as one phase is completed and is initiated again for the following phase after a gap. It is also possible that some activities may be carried out during an earlier phase for the benefit of a later one. However, any works completed for later phases would be left in a safe state, as agreed with the relevant authorities, to await the appropriate phase for completion. Onshore construction is currently planned to commence in 2021.

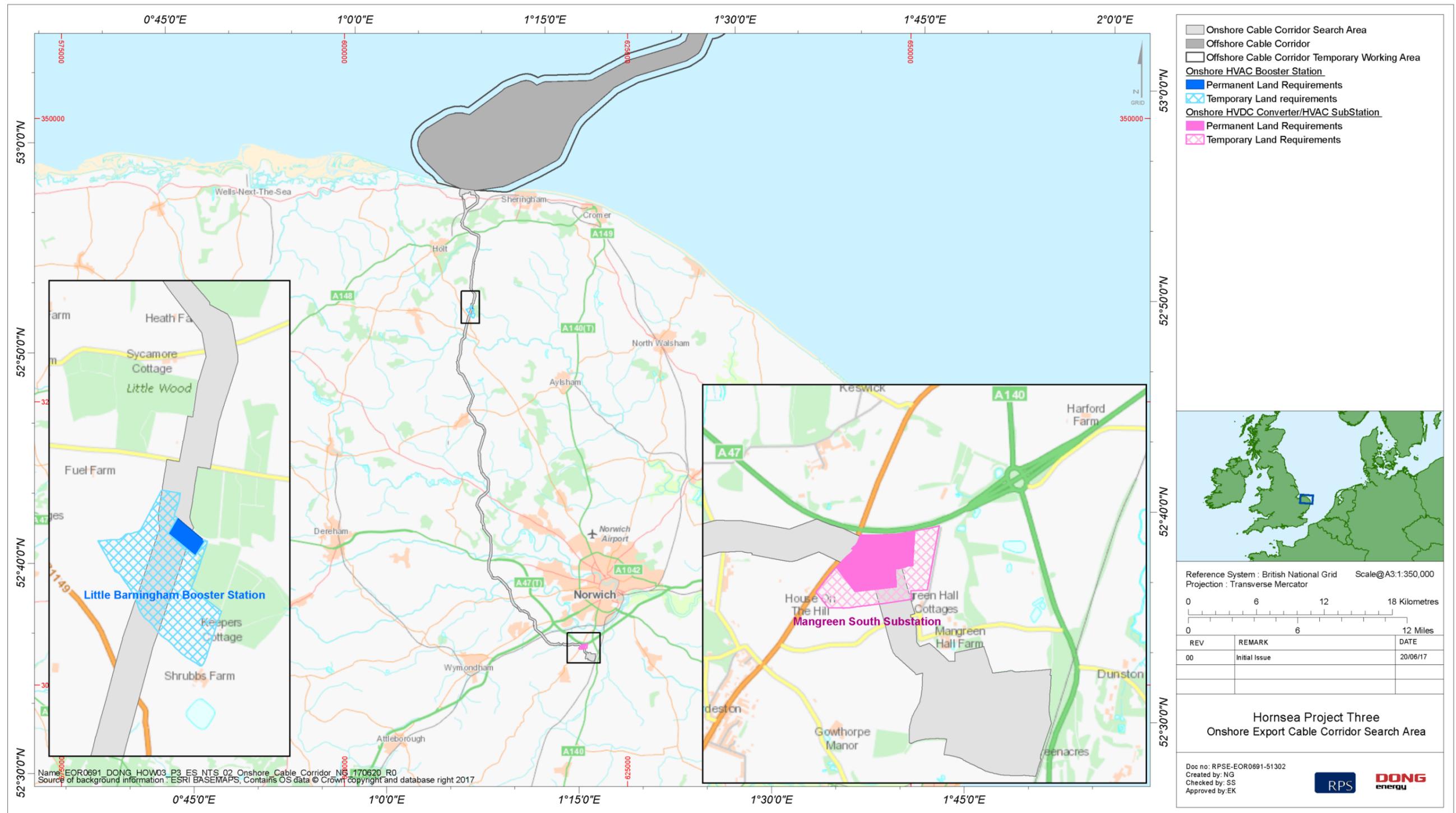


Figure 3.3: Hornsea Three onshore cable corridor search area, as well as location for the onshore HVAC booster station and onshore HVDC converter/HVAC substation.

## 4. Site Selection and Consideration of Alternatives

- 4.1.1.1 The site selection process for Hornsea Three is an ongoing and iterative process, combining technical, commercial and consenting workstreams alongside the feedback from stakeholder engagement undertaken throughout the consenting process.
- 4.1.1.2 The site selection and consideration of alternatives is a progressively more refined process. Chapter 4 of the PEIR document describes in detail the relevant stages of this process and they can be summarised as follows:
- Stage 1 - Identification of the former Hornsea Zone;
  - Stage 2 - Identification of the Hornsea Three array area within the former Hornsea Zone;
  - Stage 3 - Identification of grid connection and strategic landfall appraisal;
  - Stage 4 - Refinement of project options;
  - Stage 5 - Identification of project for Scoping, Statement of Community Consultation (SoCC) and Phase 1.A Consultation;
  - Stage 6 - Refinement of project for Phase 1.B Community Consultation Events and EIA preparation; and
  - Stage 7 - Refinement of project for PEIR, Section 42 and Section 47 consultation (Phase 2 Consultation);
- 4.1.1.3 The final two stages of the site selection process, which will take place following the issue of PEIR, are as follows:
- Stage 8 - Further Refinement of Project Design Post Review of Consultation Responses & EIA Studies; and
  - Stage 9 - Submit final preferred options as part of the DCO application.
- 4.1.1.4 Hornsea Three is currently at Stage 7 in this iterative process. Refinement of the project will continue, having regard to the responses received to consultation at all stages, and ongoing project engineering design work, in addition to further survey data collected increasing Hornsea Three's understanding of the environment, and engineering feasibility.
- 4.1.1.5 The following text provides a summary of the stages in the site selection and consideration of alternatives undertaken to date by Hornsea Three.

### 4.2 Stage 1: Identification of the former Hornsea Zone

- 4.2.1.1 The former Hornsea Zone within which Hornsea Three is located was identified as part of a UK wide process, led by the owners of the seabed (TCE) to identify a number of discrete areas in UK waters for the development of offshore wind required to meet the UK Government's commitments on climate change and renewable energy generation. The former Hornsea Zone was one of nine zones identified in 2009.

### 4.3 Stage 2: Identification of the Hornsea Three array within the former Hornsea Zone

- 4.3.1.1 A company named SMart Wind Ltd was awarded the rights to develop the former Hornsea Zone in 2009 and between this point and 2015 brought forward the first two projects (Hornsea Project One and Hornsea Project Two) within the Hornsea Zone. A further two potential projects were identified within the Hornsea Zone at this point in time.
- 4.3.1.2 In February 2015, DONG Energy (UK) Ltd acquired SMart Wind and the development rights to the Hornsea Zone. In March 2016 the formal "Zones" identified by TCE were terminated and individual projects were brought forward on a case by case basis where Agreement for Leases (AFLs) could be agreed with TCE. At this point DONG Energy (UK) Ltd secured an AFL with TCE for one of the projects originally identified by SMart Wind within the former Hornsea Zone. This project was termed Hornsea Three and had a potential capacity of 2.4 GW.

### 4.4 Stage 3: Identification of grid connection and strategic landfall appraisal

- 4.4.1.1 The connection of energy generating stations (such as offshore wind farm projects) to the national grid infrastructure is managed through a controlled process by National Grid Energy Transmission Limited. DONG Energy (UK) Ltd worked with the National Grid to identify a potential connection point to the national grid. In May 2016 National Grid Energy Transmission Limited offered a connection option for Hornsea Three at Norwich Main Substation.
- 4.4.1.2 Subsequent to this, high level exploratory work was undertaken to assess potential landfall areas for Hornsea Three along the North Norfolk coastline. This process was informed by engineering and environmental constraints. A total of five landfall zones were identified for further consideration.

### 4.5 Stage 4: Refinement of project options

- 4.5.1.1 Stage 4 of the site selection process comprised the refinement of landfall options, the identification of broad onshore and offshore search areas within which potential export cable routes from the wind farm to the grid connection at Norwich Main Substation would be located.

4.5.1.2 This process was primarily a desk based exercise informed through a consideration of technical, commercial and environmental constraints at the landfall zones, and then within the offshore and onshore environments between potential landfall zones and the array and grid connection point respectively.

4.5.1.3 This process resulted in a preferred landfall in the vicinity of Weybourne being identified.

#### 4.6 Stage 5: Identification of project for Scoping, Statement of Community Consultation (SoCC) and Phase 1.A Consultation

4.6.1.1 Subsequent to Stage 4, Hornsea Three established a preliminary set of “search areas” relating to the offshore export cable, landfall and onshore export cable routes for the purposes of consulting with a wide range of project stakeholders both formally and informally. These search areas comprised the Hornsea Three array, an offshore export cable search area approximately 10 km in width, a landfall zone north of Weybourne and an onshore export cable search area of approximately 5 km in width that extended south to the connection point at Norwich Main Substation. The boundary that was defined as a result of this process was consulted on through the Scoping Report, the SoCC and at a series of community consultation events.

4.6.1.2 The documents consulted on by Hornsea Three at this stage made clear that within the offshore search area there would potentially be further infrastructure (beyond just export cables) required, these comprise a new HVAC Substation/HVDC Converter Station located in proximity to the existing Norwich Main Substation, and in the event that a certain type of export cable transmission system is selected, then potentially both offshore and onshore facilities (termed HVAC Booster Stations) to ensure energy transmission losses are minimised en-route from the array to the substation.

#### 4.7 Stage 6: Refinement of project for Phase 1.B Consultation and EIA preparation

4.7.1.1 Stage 6 of the selection process comprised further refinement of the Project to identify the preferred offshore and onshore export cable routes within the search areas identified in Stage 5. These routes were refined in width from 10 km to 1.5 km for the offshore export cable corridor, and from 5 km to 200 m plus a 100 m technical buffer either side for the onshore export cable corridor. As part of this refinement process options were also identified for the potential HVAC Booster Stations and new HVAC Substation/HVDC Converter Station. In addition, the landfall area was also refined taking into account a number of technical, commercial and consenting constraints. Finally, an area was defined within the offshore export cable corridor as a potential offshore HVAC booster station search area.

4.7.1.2 These refinements were established from stakeholder feedback during consultation described in Stage 5, site investigation work, further engineering studies and results from early survey work undertaken as part of the EIA process. Effort was made to ensure the routes and sites selected sought to avoid or minimised overlap with key environmental and technical constraints.

4.7.1.3 Consultation was then undertaken on these refined routes and options.

#### 4.8 Stage 7: Refinement for PEIR and Phase 2 Consultation

4.8.1.1 During Stage 7 of the site selection process a number of refinements were made to the Project. This included the addition of a temporary work area to the offshore export cable route and offshore HVAC booster station search area (to encompass the area of seabed that may be affected by the construction vessel anchors or jack-up legs) and identification of a number of potential construction compounds. Onshore, a single preferred HVAC Booster Station site and a single preferred new HVAC Substation/HVDC Converter Station site were identified based on consultation feedback and outputs from further more in depth technical and environmental investigations.

4.8.1.2 The outputs of Stage 7 will be used to form the basis of this PEIR report and the associated Phase 2 Consultation process.

#### 4.9 Stages 8 and 9: Refining the project between PEIR and Environmental Statement/DCO application submission

4.9.1.1 Hornsea Three will continue to develop and refine the project as it progresses towards a final application for Development Consent and beyond this as it moves towards construction. This process will be informed by further stakeholder engagement and interpretation of the outputs from ongoing engineering, commercial and environmental investigations.

4.9.1.2 The final Project boundaries that are included within the final consent application will represent the culmination of this iterative site selection process, and will be considered reflective of the most appropriate location (from a technical, commercial and environmental perspective) for the proposed infrastructure.

## 5. Environmental Impact Assessment Methodology

### 5.1 Introduction

5.1.1.1 This section presents an outline of the EIA methodology that has been employed for Hornsea Three in the preparation of the PEIR. The EIA for Hornsea Three will describe the likely effects on the environment arising from the construction, operation and maintenance, and decommissioning of the project. Where significant effects are predicted, where possible it identifies mitigation to reduce the significance of these effects where that is practicable.

5.1.1.2 A Scoping Request, supported by a Scoping Report (DONG Energy, 2016b), for Hornsea Three was submitted to the Secretary of State in October 2016. Advice and information provided in the formal Scoping Opinion (PINS, 2016) has informed the EIA undertaken to date for Hornsea Three. Both of these documents can be downloaded from [www.dongenergy.co.uk/hornseaproject3](http://www.dongenergy.co.uk/hornseaproject3).

### 5.2 Structure of the EIA

5.2.1.1 This PEIR and the subsequent Environmental Statement contain separate chapters for the offshore and onshore aspects of the EIA. For the purposes of the EIA, including this PEIR, 'offshore' generally refers to the receptors on the seaward side of Mean High Water Springs (MHWS) and 'onshore' refers to the receptors on the landward side of MHWS. Where particular onshore and offshore assessments in volume 2 and volume 3 of the PEIR respectively overlap in the intertidal area, the extent of the study area is defined. This is shown in Figure 5.1 below.

### 5.3 Maximum design scenario

5.3.1.1 In order to ensure that the full range of all potential development options being considered (i.e. the design envelope) which could give rise to significant environmental effects are fully assessed within the EIA, the maximum design scenario from within the range of potential options for each development parameter (foundations, turbines, cables etc.) is identified, and the assessment undertaken on this basis (see volume 1, chapter 3: Project Description chapter of the PEIR for details of the design envelope considered for Hornsea Three). By employing the maximum design scenario approach the Developer retains flexibility in the design of the offshore wind farm and associated offshore and onshore infrastructure within certain maximum extents and ranges, all of which are fully assessed in the Environmental Statement.

5.3.1.2 The use of the maximum design scenario approach has been recognised in National Policy Statements (NPSs) such as NPS EN-1 and NPS EN-3. The NPSs acknowledge that not all of the precise details of the design of an NSIP may be settled at the time an application is made. This approach has been used in the majority of offshore wind farm EIAs and has been fully discussed and agreed with statutory bodies.

### 5.4 Environmental baseline conditions

5.4.1.1 A systematic, evidence-based approach was utilised for the Hornsea Three EIA. An evidence based approach to EIA involves utilising existing data and information from sufficiently similar or analogous studies to inform baseline understanding and/or impact assessments for a new proposed development. In this way, the evidence based approach does not always require new data to be collected, or new modelling studies to be undertaken, in order to characterise the potential impact with sufficient confidence for the purposes of EIA.

5.4.1.2 Hornsea Three is located within the former Hornsea Zone, for which extensive data and knowledge regarding the baseline environment is already available. This data/knowledge has been acquired through zonal studies and from the surveys and characterisations undertaken for Hornsea Project One and Hornsea Project Two. There is also detailed existing technical work (including modelling and comprehensive assessments) available from Hornsea Project One, Hornsea Project Two and other publically available desktop data sources (e.g. from other Environmental Statements) that provide a valuable source of evidence to inform the assessment of likely significant environmental effects associated with Hornsea Three. It is therefore Hornsea Three's intention to maximise, where possible, the use of these data and assessments, in order to:

- Characterise the baseline environment to inform the EIA where data is sufficient and appropriate to do so;
- Scope out impacts where there is a clear evidence basis; and
- Where impacts are scoped in, to draw upon the existing evidence base and previous impact assessment work where appropriate.

5.4.1.3 It is also important to maximise the use of this existing relevant data and assessments to the extent possible and appropriate to do so, in the context of the offshore wind industry positively responding to government drivers to reduce the cost of offshore wind.

5.4.1.4 In addition to the historical data that is already available, the EIA was also informed by a number of project-specific data collection surveys. Key offshore surveys undertaken to date include geophysical surveys of the Hornsea Three array area and offshore cable corridor to gather data on seabed conditions and sediments, marine ecological surveys to identify key seabed communities and aerial surveys of birds and marine mammals.

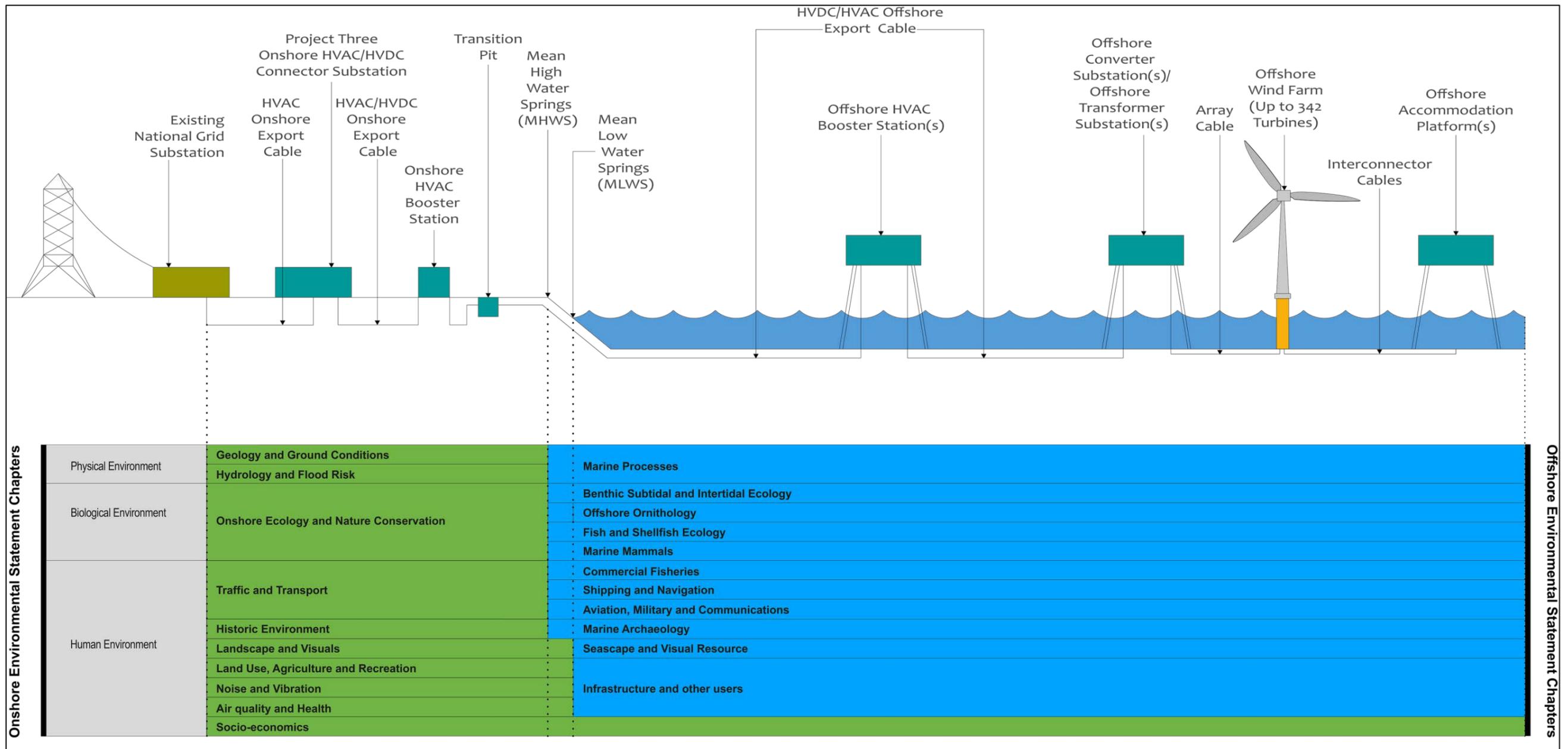


Figure 5.1: Extent of the offshore and onshore assessments.

5.4.1.5 Onshore surveys undertaken to date include ecological field surveys (bird, bat, badger, invertebrate and reptile), archaeological desktop and geophysical surveys, baseline noise surveys and landscape and visual assessments.

5.4.1.6 In addition to the surveys which have already been undertaken, a number of surveys are either ongoing (such as the aerial surveys of birds and marine mammals, and onshore ecology surveys) or are proposed (e.g. geophysical survey of the nearshore extent of the Hornsea Three offshore cable corridor) and will inform the EIA presented in the Environmental Statement.

## 5.5 Measures adopted as part of Hornsea Three

5.5.1.1 The Hornsea Three assessment uses an iterative approach. This approach has been employed in order to demonstrate commitment to appropriate mitigation of project-related impacts. The process of EIA has therefore, been used as a means of informing the Hornsea Three design.

5.5.1.2 The iterative approach to EIA employed in this PEIR, as outlined in Figure 5.2, involves a feedback loop during the impact assessment process. A specific impact is initially assessed for its significance of effect, and if this is deemed to be significant adverse in EIA terms, changes are considered and then made (where practicable) to relevant project parameters in order to reduce the magnitude of that impact.

## 5.6 Assessment of Effects

5.6.1.1 Data from project-specific surveys and studies is used to inform the impact assessment stage of the EIA so that site-specific issues are identified and addressed. The magnitude of each impact, defined by the spatial extent, duration, frequency and reversibility of the impact is then identified. The sensitivity of receptors (e.g. marine archaeology, onshore ecology etc.) is then determined, based on the vulnerability, recoverability and value/importance of each receptor. The overall significance of effect is then determined by consideration of the magnitude of impact alongside the sensitivity of receptor using a matrix approach. The definitions for each of the significance levels are shown in Table 5.1 below. Where a differing methodology is required in a specific topic assessment, the methodology has been explained within the PEIR chapter.

5.6.1.2 The PEIR sets out the aspects of the environment likely to be significantly affected by the project (as required by the EIA Directive). Only effects, in general, judged to be of moderate significance or greater are considered 'significant' in EIA terms (where this differs for specific assessments, this is explained within the appropriate PEIR chapters). Where effects are considered significant in EIA terms, this will normally trigger additional analysis, consultation and possibly further mitigation measures, where practicable. When the determining authority (in this case, the Secretary of State) makes a decision for consent, it therefore, does so in the knowledge of all likely significant effects on the environment.

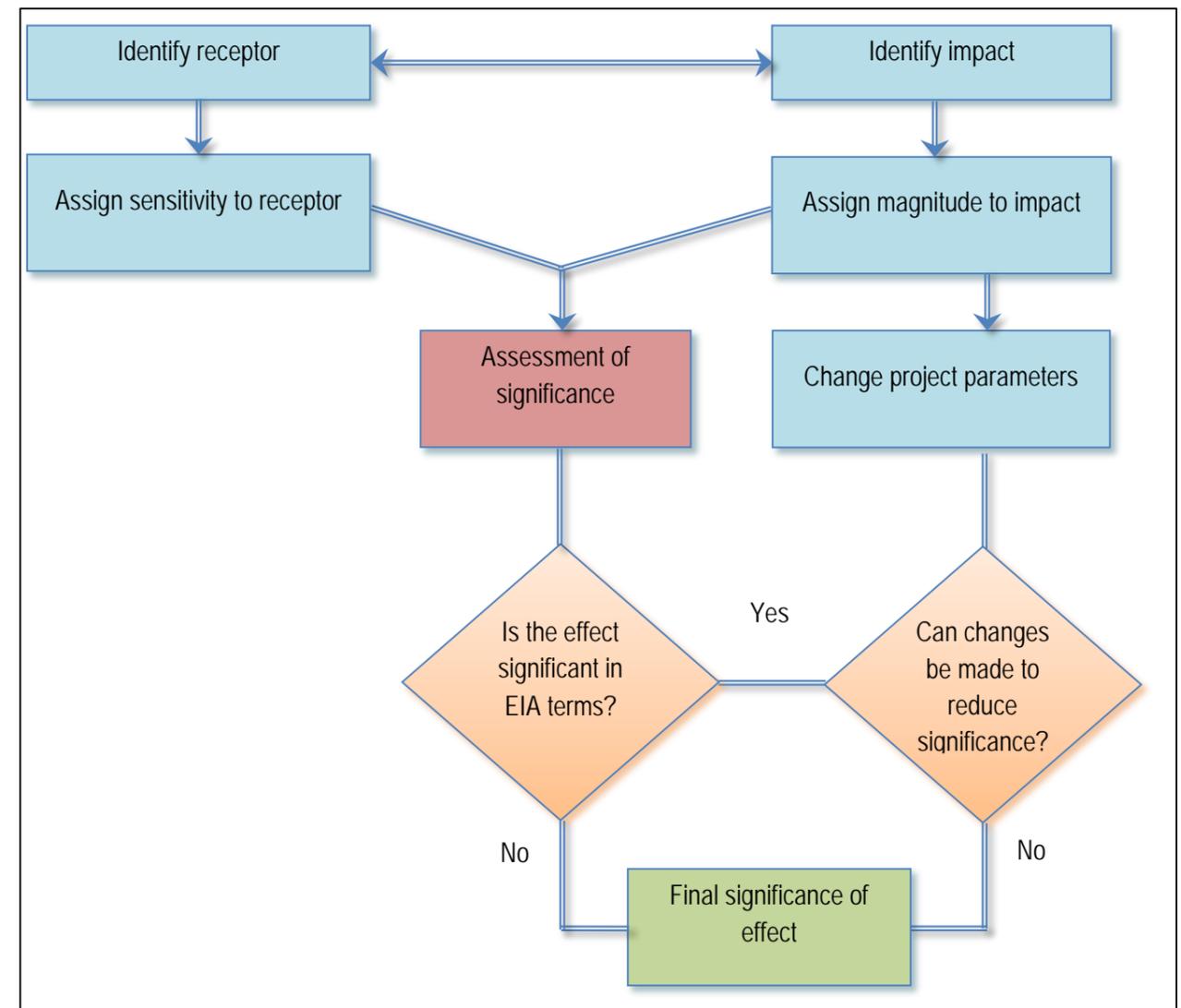


Figure 5.2: Interactive approach to mitigation within the Hornsea Three EIA.

Table 5.1: Definition of significance levels.

Term	Definition
Negligible significance	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.
Minor significance	These beneficial or adverse effects are generally, but not exclusively, raised as local factors. They are unlikely to be critical in the decision making process, but are important in enhancing the subsequent design of the project.
Moderate significance	These beneficial or adverse effects have the potential to be important and may influence the decision-making process. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse or beneficial effect on a particular resource or receptor.
Major significance	These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process.
Substantial significance	Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category. Effects upon human receptors may also be attributed this level of significance.

5.6.1.3 The EIA also included a full consideration of potential cumulative, transboundary and inter-related effects:

- **Cumulative impacts:** The potential for Hornsea Three to interact with other projects, plans and activities both within parts of Norfolk (including planned developments) and in the southern North Sea (including other offshore wind farm projects) was assessed and the significance of any effects identified;
- **Transboundary impacts:** The significance of transboundary impacts were defined using the matrix approach outlined above; and
- **Inter-related effects:** The significance of inter-related effects was not assessed. Instead the EIA considered the potential for inter-related effects to increase as a result of Hornsea Three.

## 5.7 Additional mitigation measures

5.7.1.1 In certain cases, additional mitigation measures have been outlined within the topic chapters. This includes mitigation measures where:

- An issue is significant in EIA terms, when already including designed in mitigation measures; and there are additional mitigation measures that could further reduce the level of effect.
- Mitigation has been proposed but has not yet been confirmed as feasible or deliverable (i.e. awaiting sign-off from regulators, stakeholders etc.) as agreed mitigation, or is as yet unproven (i.e. the mitigation is not yet proven to be effective at reducing the residual significance of effect).

## 5.8 Preliminary Environmental Information Report

5.8.1.1 The findings to date of the EIA for Hornsea Three are presented within the PEIR, of which this NTS forms a part. The Hornsea Three PEIR includes a description of the project, the main alternatives studied by the applicant and an indication of the main reasons for site selection. Each topic chapter of the PEIR includes:

- A review of the existing environmental baseline established from desk studies, and consultation;
- Identifies the potential environmental effects arising from Hornsea Three, based on the information gathered and the analysis and assessments undertaken to date;
- Identifies any assumptions and limitations encountered in compiling the environmental information; and
- Highlights any necessary monitoring and/or mitigation measures which could prevent, minimise, reduce or offset the possible environmental effects identified in the EIA process.

5.8.1.2 Hornsea Three welcomes comments from all stakeholders on the findings to date of the EIA (see section 1.5) and will continue to engage with relevant stakeholders throughout the pre-application consultation period on any updates or changes to the assessments presented within this PEIR.

## 6. Potential Environmental Impacts (Offshore)

### 6.1 Introduction

6.1.1.1 The EIA process has assessed the potential for the construction, operation and decommissioning of Hornsea Three to create impacts upon the offshore environment, as characterised by the review and analysis of site-specific data collected from the surveys outlined above, peer reviewed papers, desk based studies and modelling of specific parameters. This section provides a non-technical summary of the offshore assessments undertaken to date for Hornsea Three. Further information on the assessments undertaken to date can be found in each of the topic chapters in volume 2 of the PEIR.

### 6.2 Marine Processes

6.2.1.1 Marine processes is a collective term for the following:

- Water levels;
- Currents;
- Waves (and winds);
- Water column stratification and frontal systems;
- Sediments and geology: (including seabed sediment distribution and sediment transport);
- Seabed geomorphology; and
- Landfall geology and geomorphology.

6.2.1.2 Baseline characterisation of the above parameters was achieved through consideration of a range of pre-existing data and surveys undertaken to characterise the former Hornsea Zone and Hornsea Project One and Hornsea Project Two. This information was supplemented by publicly available information, as well as academic literature and industry reports.

6.2.1.3 The Hornsea Three array area is situated in an area with a mean spring tidal range of between 2 and 2.5 m. The tidal range increases with proximity to the Norfolk and Lincolnshire coast, such that at the Hornsea Three landfall area, the mean spring tidal range is approximately 5.0 m. Tidal currents across the Hornsea Three array area and offshore sections of the Hornsea Three offshore cable corridor generally increase in strength towards the coast. The dominant wave direction within the Hornsea Three array area is from the northwest to north, although there is also a large contribution of waves from southerly sectors.

6.2.1.4 Within the Hornsea Three array area, water depths vary from approximately -26.6 mLAT to -72.7 mLAT. The shallowest depths are found in the central eastern parts of the site. Deeper areas are also present within the Hornsea Three array area with depths of up to approximately -60 mLAT along the northern boundary (associated with Outer Silver Pit) and depths of up to approximately -73 mLAT in central areas (associated with Markham's Hole). The water depth of the Hornsea Three offshore cable corridor is typically less than -30 mLAT.

6.2.1.5 The majority of the Hornsea Three array area and offshore cable corridor is characterised by the presence of coarse grained sands and gravels of variable thickness. In many areas, sands and gravel are either present as a thin layer (<1 m thick) or absent, although where sandwaves are present, may be up to 6 m thick. Finer grained muddy material is present in places although the fines component of the collected sediment samples very rarely exceeds 50%. Active tidal bedforms are present in many areas and include sandwaves, megaripples and sand ribbons.

6.2.1.6 Physical changes to the shoreline, offshore sandbanks and the Flamborough Front arising from modification of the hydrodynamic, wave and/or sediment transport regime were considered during the operation and maintenance phase of Hornsea Three. All assessments result in effects of either **minor** or **negligible adverse** significance (not significant in EIA terms).

6.2.1.7 Sandwaves are present in several locations along the Hornsea Three offshore cable corridor and are often associated (moving) with the sandbanks of the North Norfolk Sandbanks and Saturn Reef Sites of Community Importance (SCI). These sandwaves may require partial removal via dredging or jetting to enable cable installation into the upper few metres of the sandbank. Although dredging/ jetting will cause a localised disturbance of the sandwave, the patterns of processes governing the overall evolution of the wider sandwave system (the flow regime, water depths, sediment availability and sandbank evolution) are at a much larger scale, and so would not be affected by, the proposed works. As such, effects on sandbanks are predicted to be of **minor adverse** significance (not significant in EIA terms).

6.2.1.8 Parts of the Norfolk and Lincolnshire coast are potentially sensitive to modification of the wave regime, through resulting changes to the rate and direction of sediment transport. An assessment of the extent to which waves could be modified by the presence of turbine and substation foundations was undertaken using the existing modelling evidence from Hornsea Project One and Hornsea Project Two, together with a quantitative rule-based model. It was found that any changes to the wave regime at the coast would be very small and as such, the potential for change to the form and structure of the shoreline would be extremely limited. Accordingly, effects on the shoreline are predicted to be of **negligible adverse** significance (not significant in EIA terms).

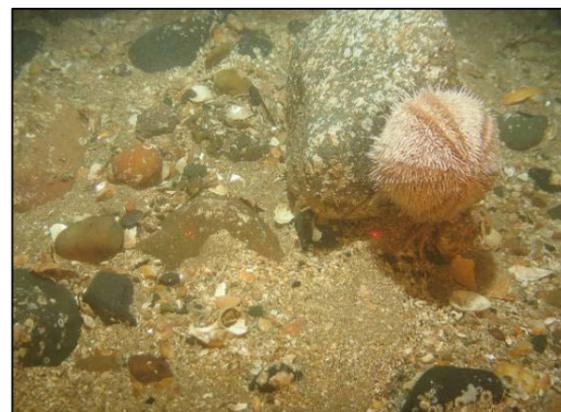
6.2.1.9 No transboundary effects with regard to marine processes from Hornsea Three on the interests of other European Economic Area (EEA) States were predicted.

## 6.3 Benthic Subtidal and Intertidal Ecology

- 6.3.1.1 Benthic ecology refers to the communities of animals and plants which live on or in the seabed and the relationships that they have with each other and with the physical environment. The subtidal and intertidal benthic ecology of Hornsea Three was characterised via a detailed desktop study and data from a series of historic and site-specific surveys comprising grab sampling, underwater video and fish trawls.
- 6.3.1.2 These surveys indicated that the seabed within Hornsea Three supports a variety of plant and animal communities that are typical of this part of the southern North Sea. Key habitats recorded included shallow coarse and mixed sediments supporting a range of species such as worms and amphipods, as well as deeper, fine sand, coarse and mixed sediment habitats characterised by marine worms, amphipods and bivalves. Overlying these sediment based communities, were plant and animal assemblages comprised of larger, more mobile species, such as brown shrimp, hermit crab, common starfish and brittlestars (Figure 6.1). A subtidal chalk habitat was identified within part of the inshore approach of the offshore cable corridor, which supported a community of seaweed, starfish, anemones, crab, and lobster.



(a)



(b)

Figure 6.1: Species recorded during the underwater video survey of the Hornsea Three array area included (a) common starfish and (b) edible sea urchin.

- 6.3.1.3 A number of potential impacts on benthic subtidal and intertidal communities/species, associated with the construction, operation and maintenance, and decommissioning of Hornsea Three, were identified. These included increased suspended sediment concentrations and deposition, temporary habitat disturbance and potential release of contaminants during construction, and long term habitat loss, introduction of new habitat, introduction of invasive non-native species and habitat disturbance via scour and vessel activities during operation. With the proposed designed-in measures in place, the majority of these impacts result in effects of either **negligible** or **minor adverse** (not significant in EIA terms).
- 6.3.1.4 For the majority of benthic receptors in the benthic ecology study area, temporary and long term habitat loss/disturbance was deemed to be of **minor adverse** significance (not significant in EIA terms), as the proportion of habitat lost is predicted to be small in the context of available habitats in the southern North Sea. Should cable installation occur within subtidal chalk or peat and clay exposures, these will result in the permanent loss of these habitat features, with no potential for recovery. However, only a relatively small proportion of this habitat would be potentially affected by Hornsea Three. Effects on subtidal chalk or peat and clay exposures are predicted to be moderate adverse significance (significant in EIA terms). Hornsea Three is currently investigating the feasibility of avoiding these features and will seek to use this to mitigate these potential impacts, where possible. This will be implemented by undertaking a pre-construction survey of the final offshore cable corridor and where necessary and possible, employing appropriate mitigation to avoid direct impacts on the subtidal chalk or peat and clay exposures.
- 6.3.1.5 Temporary increases in suspended sediment concentrations and associated deposition were also deemed to be of **minor adverse** significance (not significant in EIA terms) due to the short term nature of the impact and the fact that the seabed plants and animals in this area have a low sensitivity to this type of impact. Additionally, no significant effects were predicted on protected potential reef habitats (such as ross worm reefs and chalk reefs) within Hornsea Three, on the assumption that measures to avoid direct impacts to these features will be implemented.
- 6.3.1.6 Cumulative impacts from aggregate extraction activities and other offshore wind farm developments were assessed and predicted to result in effects of **negligible** or **minor adverse** significance (not significant in EIA terms) upon subtidal and intertidal benthic communities within a 50 km buffer of Hornsea Three.
- 6.3.1.7 No transboundary effects with regard to benthic subtidal and intertidal ecology from Hornsea Three on the interests of other EEA States were predicted.

## 6.4 Fish and Shellfish Ecology

- 6.4.1.1 The fish and shellfish ecology assessment focusses on the fish and shellfish communities within the Hornsea Three site and surrounding area. These include fish and shellfish populations which are important to commercial fisheries in the area (although the effects on those fisheries themselves have been assessed in the Commercial Fisheries assessment (see section 6.7 below)), species which are protected under national and international conservation legislation and those species which provide an important ecological function to the marine ecosystem (e.g. as food for birds, marine mammals and larger fish species). The fish and shellfish ecology of the Hornsea Three site was characterised via a detailed desktop study and pre-existing data from surveys across the former Hornsea Zone, including beam trawl and otter trawl surveys.
- 6.4.1.2 The baseline characterisation indicated that the fish and shellfish communities recorded within Hornsea Three are typical of the southern North Sea. Some of the key species reported in abundance in the offshore parts of Hornsea Three included whiting (Figure 6.1), sprat, dab, plaice, gurnard and solenette. Within the inshore section of the offshore cable corridor, many of these fish species also occur, with crab (Figure 6.1) and lobster populations also known to be important, with local fisheries targeting these species.
- 6.4.1.3 Spawning and nursery habitats were identified for a range of species including plaice, lemon sole, dab, common sole, cod, whiting, sandeel, sprat, brown crab and *Nephrops*. Migratory fish species, including sea and river lamprey, Atlantic salmon, sea trout, allis and twaite shad, European smelt and European eel, have the potential to occur in the Hornsea Three site. Many of these species are protected under the Habitats Regulations with some of these listed as features of Special Areas of Conservation (SACs) in both the UK and continental Europe, including sea and river lamprey which are listed as features of the Humber Estuary SAC.

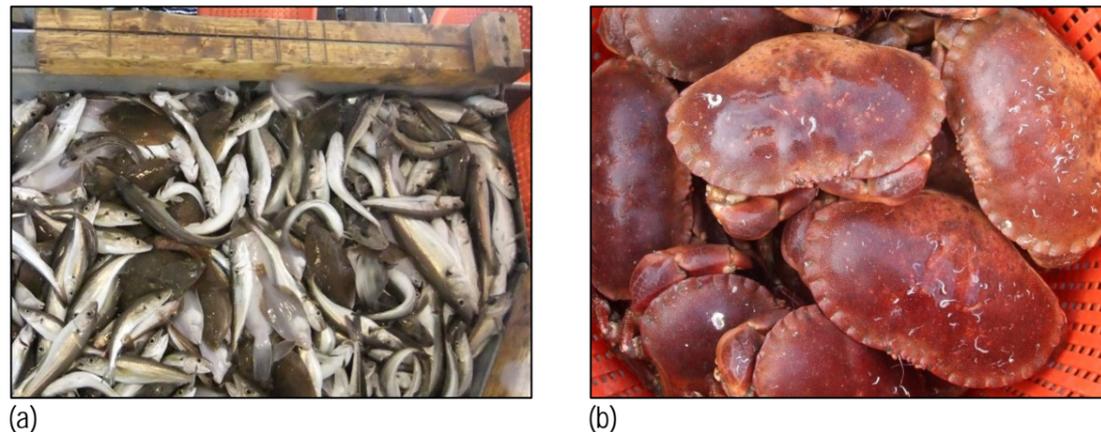


Figure 6.2: Fish and shellfish recorded in the vicinity of Hornsea Three including (a) whiting and flatfish recorded during trawl surveys and (b) brown crab known to occur in the inshore sections of the Hornsea Three offshore cable corridor.

- 6.4.1.4 A number of potential impacts on fish and shellfish communities, associated with the construction, operation and decommissioning phases of Hornsea Three, were identified. These included underwater noise, increased suspended sediment concentrations and associated sediment deposition, temporary habitat disturbance, long term habitat loss, electromagnetic field emissions from subsea cables, introduction of new habitat and potential for reduced fishing pressure during operation. With the proposed mitigation measures (i.e. a Code of Construction Practice (CoCP) and Project Environment Management and Monitoring Plan (PEMMP) implemented, cables to be buried and a soft start during piling operations) in place, the majority of these impacts result in effects of either **negligible, minor adverse** or **minor beneficial significance** (not significant in EIA terms).
- 6.4.1.5 Temporary and long term habitat loss/disturbance from Hornsea Three was predicted to be of **minor adverse** significance (not significant in EIA terms) to fish and shellfish receptors, as the proportion of habitat lost/disturbed was predicted to be small in the context of available habitats in the southern North Sea.
- 6.4.1.6 Effects associated with electromagnetic field emissions from subsea cables were predicted to be of **minor adverse** significance (not significant in EIA terms), due to the highly localised spatial extent of any potential effects on sensitive species. Electromagnetic field emissions were also not anticipated to act as barriers to migratory fish species.
- 6.4.1.7 Noise disturbance effects on fish communities, as a result of piling to install foundations, were predicted to be of **minor adverse** significance (not significant in EIA terms). In addition, there was no potential for noise during the construction of Hornsea Three to lead to barrier effects on migratory fish species when transiting to/from spawning grounds in estuarine environments or SACs along the coasts of the UK or continental Europe.
- 6.4.1.8 Cumulative impacts from other activities or developments in the southern North Sea, including aggregate extraction activities, other offshore wind farms and cables and pipelines were assessed and predicted to result in effects of **negligible to minor adverse** significance (not significant in EIA terms) upon fish and shellfish communities.
- 6.4.1.9 Transboundary effects, with regard to fish and shellfish ecology, on the interests of other EEA States from Hornsea Three were also investigated. Potential exists for transboundary effects only for Annex II migratory species as a result of direct habitat loss or disturbance to fish and shellfish habitat and underwater noise. These effects have been assessed to be of **negligible to minor adverse** significance (not significant in EIA terms) with Hornsea Three construction or operation not predicted to represent a barrier to migration to/from estuaries along the coast of continental Europe (some of which are designated as SACs). In addition there is potential for effects on fish species which are targeted by fishing fleets from other EEA states, although the predicted **negligible to minor adverse** significance (not significant in EIA terms) will not lead to significant effects on these populations.

## 6.5 Marine Mammals

- 6.5.1.1 The marine mammal assessment considers the effects of Hornsea Three on cetaceans (i.e. whales, dolphins and porpoises) and pinnipeds (i.e. seals). Aerial surveys, boat based surveys and a desktop review of published marine mammal data were used to describe the distribution, abundance and density of marine mammals in the Hornsea Three marine mammal study area. Aerial surveys of the Hornsea Three array area plus a 4 km buffer are scheduled to continue until October 2017, the results of which will be incorporated into the Environmental Statement.
- 6.5.1.2 Results identified that Hornsea Three lies within an important area for some species of marine mammal, in particular harbour porpoise and harbour seal. During surveys, harbour porpoise (Figure 6.3a) were the most frequently occurring species of marine mammal within the Hornsea Three marine mammal study area, with minke whale (Figure 6.3b), white-beaked dolphin, grey seal (Figure 6.3c) and harbour (common) seal also being recorded throughout the survey area.
- 6.5.1.3 The above species are protected under the 'Habitats Regulations'<sup>2</sup> with some listed as features of Special Areas of Conservation (SACs) or Sites of Community Importance SCIs in both the UK or other European member states' territorial waters. These include grey seal which is listed as a qualifying interest feature of the Humber Estuary SAC, and harbour seal which is a primary reason for designation of The Wash and North Norfolk SAC. Harbour porpoise is listed as a qualifying interest feature of a number of SACs/SCIs of other EU states, as well as of the Southern North Sea proposed SAC (pSAC) which lies in close proximity to the Hornsea Three array area and overlaps with the Hornsea Three offshore cable corridor (Figure 6.4).
- 6.5.1.4 A number of potential impacts on marine mammals associated with the construction, operation and maintenance, and decommissioning phases of Hornsea Three were identified. Increased suspended sediments, changes to prey (fish) resources, accidental release of contaminants, increased vessel traffic and electric and magnetic effects from subsea cables were assessed. With the proposed Marine Mammal Mitigation Protocol (MMMP) in place, these impacts were predicted to result in effects of either **negligible** or **minor adverse** significance (not significant in EIA terms).
- 6.5.1.5 The potential impact of underwater noise from piling activities on marine mammals, ranging from auditory injury to possible avoidance behaviour, was also examined. However due to proposed refinements in the project design parameters, noise assessment criteria, and magnitude and sensitivity criteria, conclusions on the significance of effect of noise impacts on marine mammals was not possible. Following further discussion with statutory stakeholders, significance of these potential impacts will be presented in the Environmental Statement.



Figure 6.3: (a) Harbour porpoise, (b) Minke whale and (c) Grey seal seen during Hornsea Three marine mammal surveys.

Picture source: <http://commons.wikimedia.org> Attribution Sebastiaan Koreman.

<sup>2</sup> Habitats Regulations refer to 'the Conservation of Habitats and Species Regulations 2010 (as amended in England and Wales' and the 'Offshore Marine Conservation (Natural Habitats, & c.) Regulations 2007 (as amended).

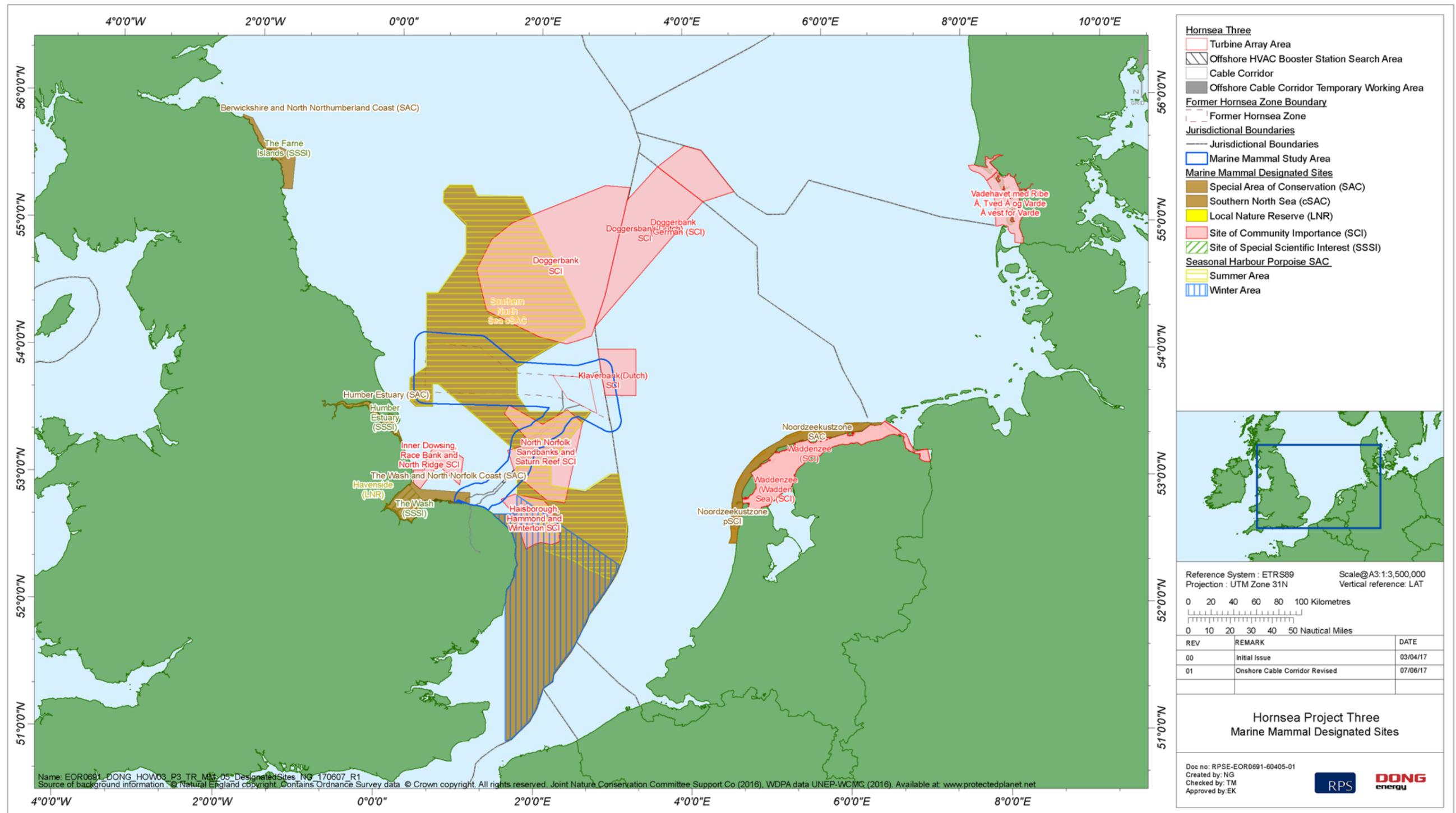


Figure 6.4: Designated sites with marine mammals as notified interest features within proximity to Hornsea Three.

- 6.5.1.6 As part of the Hornsea Three construction piling process, a number of mitigation measures will be implemented to reduce the potential impact of physical injury or behavioural disturbance on marine mammals. A 30 minute soft-start will be employed and a MMMP will also be implemented. The MMMP will use Acoustic Deterrent Devices (ADDs) as the primary mitigation measure prior to soft start to ensure marine mammals are deterred beyond the range at which injury could occur.
- 6.5.1.7 Cumulative impacts from other offshore wind farm developments, aggregate extraction activities, disposal areas, cables and pipelines and coastal developments in conjunction with Hornsea Three were also assessed. These were mainly predicted to result in effects of **minor adverse** significance (not significant in EIA terms) on marine mammal receptors. Potential cumulative impacts due to underwater noise generated during construction piling were also examined. However, due to proposed refinements in the Hornsea Three project design parameters, noise assessment criteria, and magnitude and sensitivity criteria, conclusions on the significance of effect of noise impacts on marine mammals was not possible. Following further discussion with statutory stakeholders, significance of these potential impacts will be presented in the Environmental Statement. .
- 6.5.1.8 Potential transboundary impacts with regards to marine mammals, on the interests of other EEA States from Hornsea Three, were also investigated. For the majority of cases, transboundary effects have been assessed to be of **minor adverse** significance (not significant in EIA terms). The exception to this are potential transboundary effects of underwater noise from construction piling, where a conclusion on significance of effect is not presented for the reasons outlined in paragraph 6.5.1.5 above. This will be presented in the Environmental Statement following further discussion with statutory stakeholders.

## 6.6 Ornithology

- 6.6.1.1 The offshore ornithology chapter describes the abundance, spatial and temporal distribution, and behaviour of the bird assemblage present within the Hornsea Three ornithology study area. The study area encompasses both the Hornsea Three array area and offshore export cable route corridor area that is seaward of MHWS tidal level. The offshore bird chapter presents a description of the environmental baseline from desk studies and dedicated offshore surveys considered within the wider context of the North Sea.
- 6.6.1.2 Initial results from the on-going digital aerial baseline surveys indicate that the bird assemblage present is typical of that in the offshore environment of the central North Sea. A total of 19 seabird species were recorded in the survey area during the period April 2016 to February 2017. 'True' seabird groups such as gannet, small and large gulls, auk species were the most abundant. Also present are some species which spend part of their annual life cycle at sea (e.g. divers). Guillemot was the most frequently encountered species, representing 58% of all birds recorded. Kittiwake and razorbill were respectively the second and third most abundant species. These three species accounted for over 82% of all bird recorded.

- 6.6.1.3 Abundances of the most frequently recorded species tended to peak during summer and early winter (November/December). The summer peak may pertain to species breeding within the Flamborough and Filey Coast proposed Special Protection Area (pSPA) at 149 km distant, including gannet, fulmar, kittiwake, and auk species. Migratory species (skuas, terns and little gull) were typically most abundant during spring and autumn.
- 6.6.1.4 A number of potential impacts on the offshore ornithological assemblage, associated with the construction, operation and decommissioning of Hornsea Three, were identified. These included disturbance-displacement impacts, habitat loss, collision mortality, barrier effects, and indirect effects associated with impacts on prey items. With the proposed mitigation measures in place, the identified impacts for Hornsea Three alone will have no more than a **minor adverse** significance (not significant in EIA terms).
- 6.6.1.5 The impact of barrier effects from the physical presence of turbines preventing clear passage to birds on migration is considered to be of **negligible** or **minor adverse** significance (no significant in EIA terms) for all receptors. All species are considered to be of low vulnerability to barrier effects with respect specifically to Hornsea Three array, and Hornsea Three is likely to be transited at most on two occasions per year by the vast majority of birds from any population.
- 6.6.1.6 Mortality due to potential collision with operational turbines was estimated for each species, using standard offshore collision risk modelling as well as a migratory collision model for potentially under-recorded migratory species. The level of mortality is species-specific and is a reflection of abundance, flight behaviour and biological characteristics. Overall its predicted an effect of **negligible** or **minor adverse** significance (not significant in EIA terms) for all receptors.
- 6.6.1.7 Operational displacement effects to seabird species caused mainly by the presence of turbines are species-specific, with gulls in particular likely remaining unaffected. Evidence suggests that auks may be more susceptible to operational displacement effects. A range of mortality rates and displacement rates were used to consider receptor sensitivity to displacement. A range of population sizes were used to consider the magnitude of impact during different seasons (breeding, post-breeding, non-breeding and post breeding as most applicable to species). During the breeding season and non-breeding period, the significance of effect for fulmar, gannet and razorbill was considered to be **negligible** or **minor adverse** (not significant in EIA terms). Based on the defined population sizes over different seasons, the significance of effect to puffin and guillemot is predicted to be **minor adverse** (not significant in EIA terms).

- 6.6.1.8 Cumulative impacts from other offshore wind farm developments were assessed along the east coast of Britain, as well as non-UK projects in the North Sea. The main cumulative impacts identified for offshore ornithology were operational displacement and collision mortality. A seasonal approach considered impacts on the receptor populations during relevant biological seasons, based on presented values from Hornsea Three and other offshore projects' Environmental Statements. At a cumulative level when considering other projects and activities, several effects of **moderate** or **major adverse** significance (significant in EIA terms) are predicted. It is however considered that these predictions involve considerable precaution and further investigation on the age structure and source of individuals / populations affected is required.
- 6.6.1.9 As part of the project design process, a number of designed-in measures have been proposed to reduce the potential for these impacts, including a CoCP being developed and implemented to cover the construction phase and a PEMMP being produced and followed. The PEMMP will cover the operation and maintenance phase of Hornsea Three and will include planning for accidental spills, address all potential contaminant releases and include key emergency contact details (e.g. Environment Agency, Natural England and Maritime and Coastguard Agency (MCA)).
- 6.6.1.10 Transboundary impacts of Hornsea Three on offshore ornithological receptors were considered based on the potential connectivity with continental Special Protection Areas (SPAs) or other important bird areas such as Dogger Bank and Brown Ridge in the breeding and non-breeding seasons for the following species: fulmar, gannet, kittiwake, great black-backed gull, puffin, razorbill and guillemot. No important sites were considered to be within regular foraging range of Hornsea Three during the breeding season, and although some degree of connectivity may exist during winter months, when seabird species are wider ranging, no significant impacts are predicted on any site, with any associated impacts being short-term. A significance of no more than **minor adverse** (not significance in EIA terms) is predicted across all species of assessment. No transboundary impacts with regard to offshore ornithology from Hornsea Three on the interests of other EEA States were therefore predicted.
- 6.7.1.2 The data analysis indicates that within the Hornsea Three array area the dominant fisheries are flatfish (sole, plaice and mixed species) and shellfish (*Nephrops* and mixed species) which are targeted by UK (Figure 6.5), Dutch, Belgian and German vessels using beam trawl, fly shooting and otter trawl fishing gear. Shoals of pelagic species including mackerel and anchovy are occasionally caught by UK and French vessels. Danish vessels target specific sandeel grounds across the Hornsea Three site. The total annual value of commercial fisheries landings from within the Hornsea Three array area is estimated to be €3.2 million.
- 6.7.1.3 The Hornsea Three offshore cable corridor covers habitat important to inshore shellfish species including brown crab, lobster and whelk, which are targeted by UK potting vessels.
- 6.7.1.4 A number of potential impacts on commercial fisheries, associated with the construction, operation and maintenance, and decommissioning of Hornsea Three, were identified. These included reduction in access to or exclusion from fishing grounds, displacement leading to gear conflict and increased fishing pressure elsewhere, displacement or disruption of commercially important fish and shellfish resources, additional steaming to alternative fishing grounds, increased vessel traffic leading to interference with fishing activity, and gear snagging. With the proposed mitigation measures in place (advance warning and accurate location details of construction operations and associated Safety Zones, advisory safety distances and on-going liaison with all fishing fleets), the majority of these impacts result in effects of **minor adverse** significance (not significant in EIA terms), however effects of **moderate adverse** (significant in EIA terms) significance are also identified as noted below.
- 6.7.1.5 During the construction of the Hornsea Three offshore cable corridor, the reduction in access to fishing grounds and displacement leading to gear conflict was deemed to be of **moderate adverse** significance (significant in EIA terms), for UK potting vessels targeting brown crab, lobster and whelk. An additional measure to offset this effect will be that any disturbance payment will be in accordance with the procedures as outlined in the Fishing Liaison with Offshore Wind and Wet Renewables Group (FLOWW) guidance (2014 and 2015) wherever possible.

## 6.7 Commercial Fisheries

- 6.7.1.1 Commercial fishing is defined as any form of fishing activity legally undertaken for taxable profit. The activity of UK and non-UK commercial fishing fleets operating across the Hornsea Three array area and offshore cable corridor was characterised via analysis of landing statistics and mapping of fishing grounds, including vessel monitoring system data, aerial surveillance, vessel plotter data and consultation with the industry.

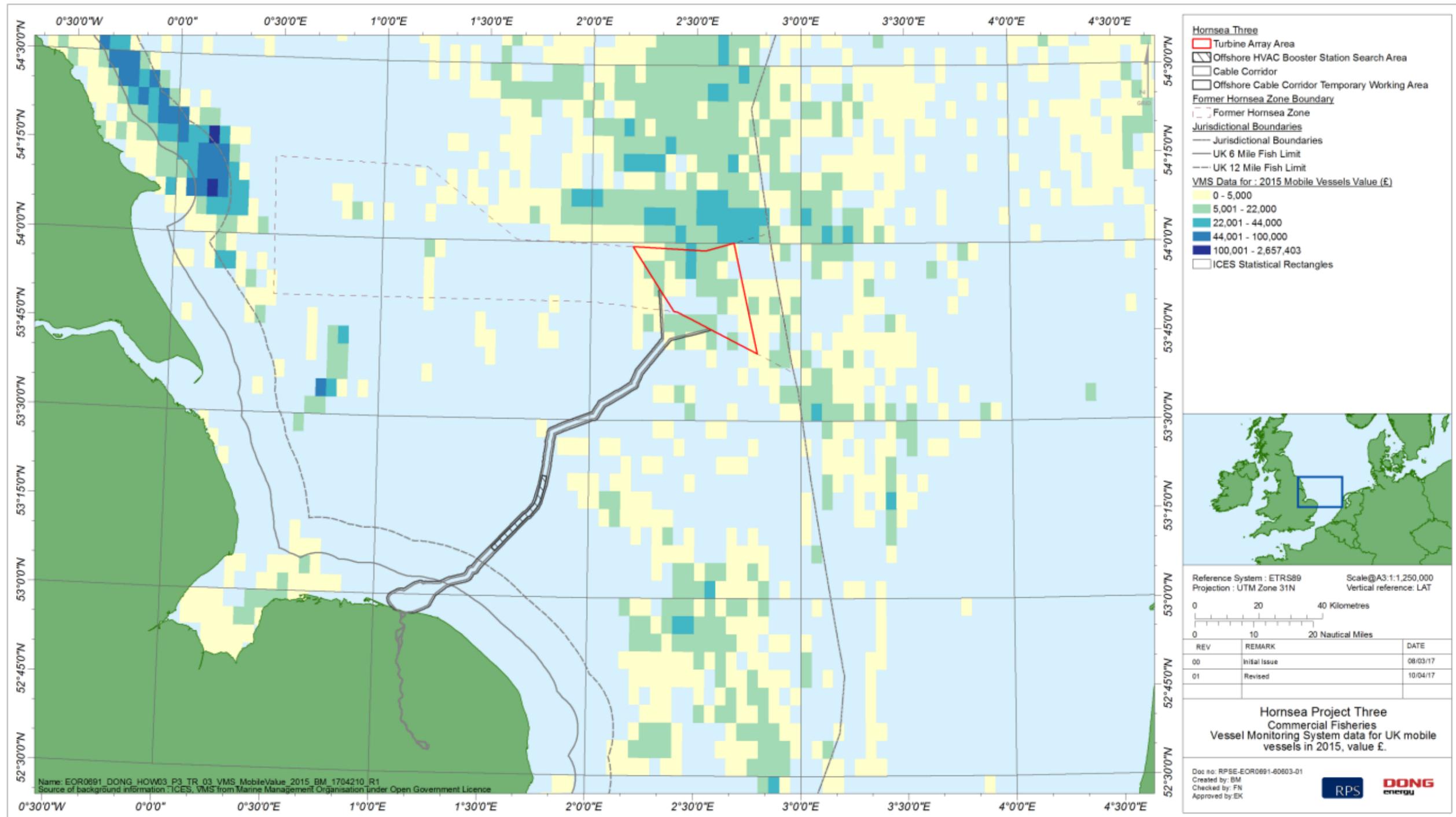


Figure 6.5: Vessel Monitoring System data for UK mobile vessels (≥ 15 m) actively fishing within regional commercial fisheries study area in 2015 indicating value of catch.

- 6.7.1.6 During the construction, operation and maintenance and decommissioning phases, due to the mooring and anchor systems of floating turbines (i.e. turbines that are anchored to the seabed via mooring lines), the assessment assumed that all fishing within the Hornsea Three array area would be prevented for the entire duration of the design life of the project, which, based on the level of fishing activity, was deemed to be of **moderate adverse** significance (significant in EIA terms), for UK, Dutch and Belgian trawling fleets targeting flatfish, Nephrops and mixed species. The assessment for this impact considered a certain type of floating turbine concept to present the maximum design scenario. There are a range of floating foundations, as well as other technologies (such as monopiles and jacket foundations), which will be considered for Hornsea Three. If such alternative technologies were to be used (those foundations that are more 'tried and tested' by the offshore wind farm industry or alternative floating concepts) or if the spatial extent of deployment of the floating foundation design considered in this assessment was reduced, then it is considered likely that this impact would be reduced because fishing is expected to continue within the Hornsea Three array area once the project is operational.
- 6.7.1.7 Cumulative impacts from other offshore wind farm developments, existing and proposed/recommended marine environmental designations, gas fields, oil fields, pipelines and aggregate dredging were assessed and predicted to result in overall effects of **major adverse** significance (significant in EIA terms) upon demersal trawling commercial fishing fleets. This assessment takes account of a high degree of uncertainty. The mitigation measures mentioned previously (sections 6.7.1.5 and 6.7.1.6) will also serve to assist in reducing this potential impact.
- 6.7.1.8 Transboundary effects with regard to commercial fisheries from Hornsea Three on the interests of other EEA States were predicted. The commercial fisheries assessment considered the potential impact of Hornsea Three on commercial fishing fleets from all EEA States. Transboundary impacts within UK waters have therefore been intrinsically considered throughout the commercial fisheries EIA process and are consistent to those presented in the impact assessment.

## 6.8 Shipping and Navigation

- 6.8.1.1 Shipping and navigation considers the transport of goods or persons by sea (for commercial or recreational purposes) as well as navigational activities associated with extraction resources such as marine aggregates, oil and fish. Shipping and navigation activity within the Hornsea Three array area and offshore cable corridor has been characterised using a review of existing data and project-specific studies, including four vessel based marine traffic surveys at the Hornsea Three array area and Hornsea Three offshore HVAC booster station search area, carried out by vessel crews tasked to monitor all vessel movements within the area. It is noted that the final location of the Hornsea Three offshore HVAC booster station(s) have not yet been identified and the survey data collected will contribute to the assessment of the search area to identify a suitable location.

- 6.8.1.2 Based on existing records, the 26 days analysed for the Hornsea Three array area in summer 2016 were considered to represent the highest traffic levels and recorded an average of 42 different vessels per day passing within the Hornsea Three array area shipping and navigation study area. All survey requirements were agreed in advance with key stakeholders and met the regulatory requirements set out in the main guidance document produced by the Maritime and Coastguard Agency (MCA) – Marine Guidance Note (MGN 543) (MCA, 2016).
- 6.8.1.3 Following a review of the baseline environment, a Navigation Risk Assessment (NRA) for Hornsea Three was undertaken. The assessment was based around the IMO Formal Safety Assessment (FSA) and MGN 543 as required by the key regulator for shipping and navigation, the MCA. The FSA assessed the marine traffic survey data alongside a combination of key stakeholder consultation, regular operator consultation, a hazard workshop and collision (vessel to vessel) and allision (vessel to structure) risk modelling to assess risks for all phases of the development (construction, operation and maintenance and decommissioning) as well as an assessment of cumulative effects.
- 6.8.1.4 The findings of the NRA were then used to inform the overall impact assessment for shipping and navigation and identified which risks were assessed within the shipping and navigation assessment. The chapter has considered impacts including route deviations, adverse weather, vessel to vessel collision risk, vessel to structure allision risk (for passing vessels and vessel transiting internally within the array), gear snagging and the effect upon emergency response including search and rescue (SAR) impacts. The impact assessments initially considered impacts for all phases of the development in isolation and then cumulatively with other developments within the southern North Sea area.
- 6.8.1.5 With measures adopted as part of Hornsea Three in place as part of the project, the majority of impacts result in effects of **minor adverse** significance (not significant in EIA terms) for Hornsea Three in isolation.
- 6.8.1.6 For the construction phase, the assessment shows that there are no impacts which result from the Hornsea Three development which have an effect of major or moderate adverse significance on shipping and navigation.
- 6.8.1.1 For the operation and maintenance phase, the presence of infrastructure within the Hornsea Three array area increasing vessel to structure allision risk internally within the array for recreational and fishing vessels has been identified as an effect of **major adverse** significance (significant in EIA terms) due to the potential for under keel clearance allision. Floating turbine technology is currently at an early stage of development and this impact assessment assumes the presence of catenary mooring lines close to the sea surface throughout a significant part of the Hornsea Three array area as the maximum design scenario, hence the major adverse significance of effect to under keel clearance allision risk.

- 6.8.1.2 There are a range of floating foundations as well as other technologies (such as monopiles and jacket foundations) which will be considered for Hornsea Three. If such alternative technologies were to be used (those foundations that are more “tried and tested” by the offshore wind industry or alternative floating foundation concepts that had a reduced seabed/water column footprint) or if the spatial extent of deployment of the floating foundation design considered in this assessment was reduced, then it is considered likely that this impact would be reduced because these options may present a lesser risk in terms of under keel clearance. It is noted that other foundation types, including floating foundations that have mooring lines touching down close to the turbine position, are not considered to present a significant adverse effect.
- 6.8.1.3 An effect of **moderate adverse** significance (significant in EIA terms) is also assessed for the allision and collision risk associated with the offshore HVAC booster stations. Given that the final location of the Hornsea Three offshore HVAC booster stations has not been defined, additional mitigation included consideration for the placement of the Hornsea Three offshore HVAC booster station(s) so as to be sympathetic to shipping routes (by minimising deviation and allision risk) and the potential requirement for additional aids to navigation in consultation with the MCA and Trinity House which will reduce the risk to not significant in EIA terms.
- 6.8.1.4 For the decommissioning phase the assessment shows that there are no impacts which result from the Hornsea Three development which have an effect of **major** or **moderate** adverse significance on shipping and navigation.
- 6.8.1.5 All cumulative impacts were deemed to be of **minor adverse** significance (not significant in EIA terms) with measures adopted as part of Hornsea Three. Consultation with Hornsea Project One and Hornsea Project Two is a key mitigation for cumulative impacts to ensure that aids to navigation for the developments are considered at a cumulative level to avoid proliferation of lights and to mitigate the effects of the proposed navigational corridor.
- 6.8.1.6 It was identified that transboundary issues could arise from the Hornsea Three array area having an effect upon commercial shipping routes transiting between the UK and other EEA ports. However given the minor deviations expected, the impact is assessed to be not significant.

## 6.9 Aviation, Military and Communication

- 6.9.1.1 Aviation, military and communication considers the impact of Hornsea Three on civil en-route operations; Ministry of Defence (MOD) Air Defence operations and training; helicopter support to offshore oil and gas operations; and aircraft using various communication systems. The aviation, military and communication study area includes the airspace between the Hornsea Three array area and the UK mainland from Norwich airport to the south and RAF Staxton Wold to the north and a 9 nm consultation zone around the Hornsea Three array area crossing into the Dutch territorial waters. Information on aviation, military and communication within the aviation, military and communication study area was collected through a detailed desktop review of existing datasets and through consultation. Point-to-point Line of Sight (LOS) analysis was also undertaken for the assessment of effects on radar.
- 6.9.1.2 There are a number of aviation, military and communication related interests in the vicinity of the Hornsea Three array area and offshore cable corridor. This includes Air Traffic Services, MOD Managed Danger Areas (MDAs), Aerial Tactics Areas, an Offshore Safety Area, and submarine practice areas. In addition, two Helicopter Main Routes (HMRs) cross the Hornsea Three array area, and the boundary of the Hornsea Three array area extends into the 9 NM consultation zones surrounding nine offshore gas platforms (the Schooner A, Ketch, Chiswick, ST-1, J6A, Grove, Windermere, Cutter and Carrack QA platforms). Hornsea Three is also located within the operational ranges of the NATS Claxby Primary Surveillance Radar (PSR) and the MOD's Air Surveillance and Control Systems (ASACS) Air Defence PSRs located at Staxton Wold and Trimmingham. There are networks of microwave links in the vicinity of the Hornsea Three array area; however there are no microwave links which pass through the array area.
- 6.9.1.3 A number of potential impacts on aviation, military and communication, associated with the construction, operation and maintenance, and decommissioning of Hornsea Three, were identified. These included interference with operations within Military Practice Areas, disruption to HMRs, effects on available airspace, restriction to cross-zone transit helicopter traffic, and disruption of helicopter access to offshore gas platforms, drilling rigs and subsea infrastructure. Other impacts include disruption to civil and military radar coverage and interference with microwave and other communication links. With the proposed mitigation measures in place, there will be no significant effects arising from the development of Hornsea Three in isolation during the construction, operation and maintenance, or decommissioning phases on aviation, military and communication, with these impacts resulting in effects of either **negligible** or **minor adverse** significance (not significant in EIA terms).
- 6.9.1.4 The sensitivity however of the operator Centrica to impacts potentially affecting their licenced acreage have not been assessed. Discussions are ongoing between Hornsea Three and Centrica. There is not enough certainty in regard to future plans to assign sensitivity (and therefore significance of effect) at this stage and these applicable impact assessments will be included in the Environmental Statement which will be submitted in Quarter 2 of 2018.

- 6.9.1.5 Cumulative impacts from other offshore wind farm developments, oil and gas fields and cables and pipelines were assessed and these impacts were predicted to result in effects of **minor adverse** significance (not significant in EIA terms). The potential effect however from the construction, operation and maintenance, and decommissioning of Hornsea Three forming an aerial obstruction resulting in disruption to helicopters using HMRS, considered alongside other Tier 1 projects has not been assessed. Further consultation is to be held with the operators of the platforms to the north of the Hornsea Three array area, their helicopter service providers and NATS to validate the alternative route options to enable the assessment. The impact assessment will be included in the Environmental Statement which will be submitted in Quarter 2 of 2018.
- 6.9.1.6 Transboundary impacts relate to the aviation requirements of Centrica Netherlands in regard to helicopter access to the Markham group of platforms and cross zone helicopter transit. The significance of effect for both assessments has been assessed as **minor adverse** significance (not significant in EIA terms).
- 6.9.1.7 Transboundary impacts also relate to the aviation requirements of Centrica Netherlands in regard to helicopter access to their licenced acreage within 9 nm of the Hornsea Three array area. The sensitivity of the operator Centrica Netherlands to impacts potentially affecting their licenced acreage have not been assessed. Discussions are ongoing between Hornsea Three and Centrica Netherlands. There is not enough certainty in regard to future plans to assign sensitivity (and therefore significance of effect) at this stage and this assessment will be included in the Environmental Statement which will be submitted in Quarter 2 of 2018.

## 6.10 Marine Archaeology

- 6.10.1.1 Marine archaeology considers the impact of Hornsea Three on marine archaeology seaward of MHWS. The Hornsea Three marine archaeology study area encompasses the offshore components of Hornsea Three (see Figure 6.6). In addition the regional marine archaeology study area (a 20 km buffer from the Hornsea Three array area and offshore cable corridor, extended to include the Hornsea Project One and Hornsea Project Two array areas) was defined on the basis that it is considered to be a fair representation of archaeology within the wider southern North Sea, and includes the Hornsea Project One and Hornsea Project Two array areas to incorporate survey data undertaken to inform these developments. The regional marine archaeology study area is the area covered by the desktop review and therefore provides a wider context for the site-specific data, as well as the extent of the marine archaeology cumulative effect assessment (CEA).
- 6.10.1.2 A detailed literature search was carried out to establish the baseline of information available in the regional marine archaeology study area. Recent survey data collected from the Hornsea Three array area, offshore cable corridor and landfall area in 2016 have been used to inform the baseline characterisation.

- 6.10.1.3 An archaeological assessment of geophysical survey data was carried out. Archaeological potential was assigned to each contact identified during the geophysical surveys. Contacts assessed as having archaeological potential were then compiled into a gazetteer.
- 6.10.1.4 The desktop study and Hornsea Three field surveys have identified extensive remains within the regional marine archaeology study area of marine archaeological potential and/or significance. These comprise largely buried remains of palaeolandscapes, wrecks and possible aviation losses. The evidence indicates that palaeolandscapes are discreetly grouped within the regional marine archaeology study area. Seabed remains of wrecks and aviation losses are relatively easy to recognise from geophysical surveys and thus are likely to be largely avoided and preserved.
- 6.10.1.5 Construction activities within the Hornsea Three array area and offshore cable corridor have the potential to result in a range of potential impact on marine archaeology. These include the removal or disturbance of sediments resulting in a potential effect on near-surface prehistoric land surfaces and deeply buried prehistoric land surfaces along with potential effects on shipwrecks, aircraft wrecks and a variety of heritage assets; These potential impacts have all been assessed as being of **minor adverse** significance (not significant in EIA terms).
- 6.10.1.6 Maintenance operations may affect prehistoric land surfaces through the removal or disturbance of sediments and also have the potential to affect shipwrecks and aircraft wrecks. These impacts have also been assessed to be of **minor adverse** significance (not significant in EIA terms).
- 6.10.1.7 Decommissioning activities are predicted to have an impact of **minor adverse** significance (not significant in EIA terms) on prehistoric landscapes and shipwrecks and aircraft wrecks.
- 6.10.1.8 The cumulative impact upon marine archaeology when the construction, operation and decommissioning phases of Hornsea Three has been considered together with the construction and operation of other planned nearby wind farm projects, planned oil and gas operations, cables and pipelines and applications for aggregate extraction. Overall, effect will be of **minor adverse** significance (not significant in EIA terms).
- 6.10.1.9 A screening of transboundary impacts has been carried out and identified that there was no potential for significant transboundary effects with regard to marine archaeology from Hornsea Three upon the interests of other EEA States.

## 6.11 Seascape and Visual Resources

- 6.11.1.1 The seascape and visual resources assessment describes the existing and historic character of the seascape and views gained by people within and around Hornsea Three including the Hornsea Three array area and offshore cable corridor. This also includes an assessment of the changes to the character of the seascape and views as a result of the proposed development during construction, operation and maintenance, and decommissioning.
- 6.11.1.2 A Zone of Theoretical Visibility (ZTV) of Hornsea Three has been generated to establish the study area (referred to as the 'array SVIA study area') within a 50 km radius of the Hornsea Three array area based on a maximum 325 m blade tip height of turbines (see Figure 6.6). A further ZTV has been generated to establish the study area (referred to as the 'offshore HVAC booster SVIA study area') within a 25 km radius of the offshore HVAC booster stations search area, based on a maximum 70 m height of the offshore HVAC booster stations.
- 6.11.1.3 Information on seascape and visual resources within the relevant array SVIA and offshore HVAC booster stations study areas was collected through a detailed desktop review of existing studies and datasets. Present day seascape character is based on the 'Seascape Character Area Assessment for East Inshore and East Offshore Marine Plan Areas' published by the Marine Management Organisation (MMO) in October 2012. The character of the seascape in the centre of the North Sea is generally defined by consistent horizons across extensive and unchanging tracts of open water that have a remote and isolated quality. The coastal seascapes of Norfolk are defined by the extensive linear landform with open and exposed sandy beaches creating long sweeping views out to sea, busy shipping and sailing areas and offshore arrays.
- 6.11.1.4 There are no national or regional seascape designations within the array SVIA study area and the seascape is considered to be of low sensitivity to change. There are a relatively small number of visual receptors within these seascapes due to the location of the Hornsea Three array area approximately 120 km from the nearest coastline. The majority of people are at their place of work or travelling for leisure purposes on vessels and people working on oil or gas platforms.
- 6.11.1.5 A Historic Seascape Characterisation (HSC) of the area from the Humber to Norfolk was published in 2013 (Aldred 2013a, b and c). The array SVIA study area lies within the HSC East Yorkshire to Norfolk Project Area 2. The characterisation includes the four marine tiers of sea surface, water column, sea floor and subsea floor. The Hornsea Three array area and offshore cable corridor extend predominantly over the 'Fishing' Broad Character Types which include drift netting and bottom trawling sub types, but also include communications and industry Broad Character Types which include telecommunications cables and gas and oil installations.
- 6.11.1.6 Offshore wind energy development, wherever it occurs, is usually visible in some form. Hornsea Three would have the following general attributes typical of most wind farms: engineered, large scale, simple in form, smooth texture, monochrome/muted colour and strong vertical form. Responses by people to wind farms can vary from 'beautiful' to 'offensive', with respondents perceiving wind turbines as potentially rhythmic, unusual, safe, interesting, invigorating, majestic and spiritual on the one hand and degrading, jarring, overbearing, industrial, clashing and ugly on the other. Wind energy development thus gives rise to a spectrum of responses from individuals and organisations who perceive its effects ranging from strongly adverse to strongly beneficial. For the purposes of this assessment, effects have been defined based on the scenario of an individual who may perceive the turbine array as a negative addition to the seascape or view. Effects are therefore defined as adverse throughout the assessment; but may in fact be seen as beneficial or positive by large numbers of viewers. An individual who perceives offshore wind farms as a positive addition to the seascape or view may consider the same effects to be beneficial or neutral in nature.
- 6.11.1.7 During the construction and decommissioning phases, temporary changes to the existing present day seascape character, HSC and views gained by people at sea, during the daytime and at night would occur. The effect was predicted to be of **negligible to moderate adverse** significance (not significant in EIA terms, when considered against the seascape and visual resources assessment methodology). During the operational and maintenance phase of Hornsea Three, the long term change to these same receptors, during the daytime and at night would result in direct or indirect effects. These effects are considered to be of **negligible to minor adverse** significance (not significant in EIA terms).
- 6.11.1.8 The cumulative impact upon seascape character, HSC and visual receptors during the construction, operation and maintenance, and decommissioning phases of Hornsea Three has been considered alongside the construction and operation of other planned nearby offshore wind projects, planned oil and gas operations, cables and pipelines, and applications for aggregate extraction. Cumulative impacts are predicted to result in effects of **negligible to moderate adverse** significance (not significant in EIA terms, when considered against the seascape and visual resources assessment methodology).
- 6.11.1.9 A screening of transboundary impacts has identified that there was no potential for significant transboundary effects with regard to seascape and visual receptors or the HSC from Hornsea Three upon the interests of other EEA States.

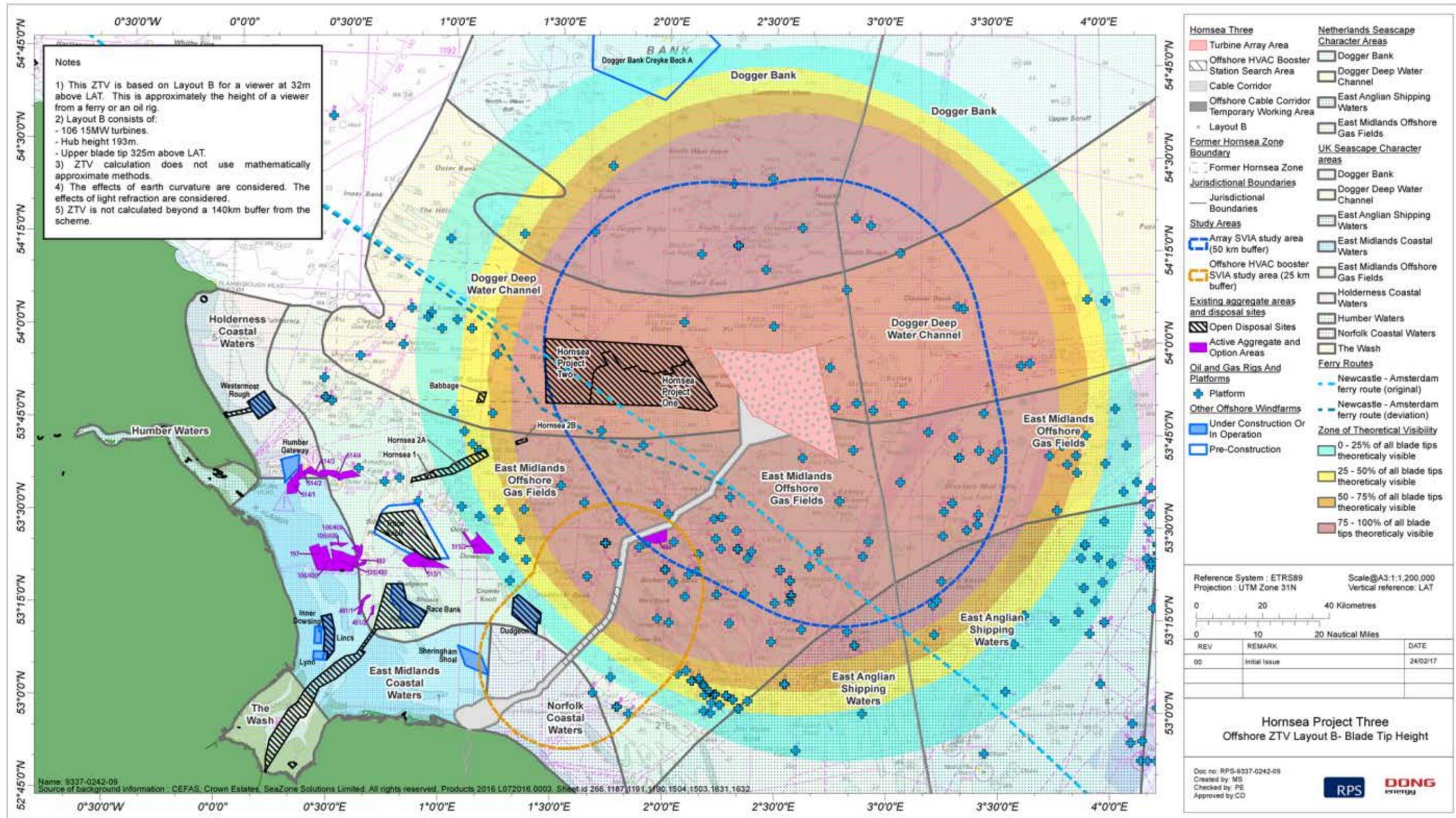


Figure 6.6: Zones of theoretical visibility within Hornsea Three array study area.

## 6.12 Infrastructure and Other Users

6.12.1.1 Infrastructure and other users considers the impact of Hornsea Three on the following:

- Recreational receptors (including receptors carrying out sailing and motor cruising, kite surfing, surfing, windsurfing, sea/surf kayaking and canoeing, and SCUBA diving);
- Recreational fishing receptors;
- Cable and pipeline operators;
- Carbon Capture and Storage (CCS), natural gas storage and Underground Coal Gasification (UCG) operators;
- Aggregate extraction and disposal site operators; and
- Oil and gas operators including effects on the Radar Early Warning Systems (REWS).

6.12.1.2 The infrastructure and other users study area for Hornsea Three includes all infrastructure and other users receptors within an area which has the potential to be affected by Hornsea Three, which varies in scale depending on the particular receptor but at its largest extent includes the Hornsea Three array area and offshore cable corridor, which comprises the offshore development footprint, and extends from the Hornsea Three array area to the UK coastline from Robin Hood's Bay in the north to Walcott in the south, and in a 35 km radius around the Hornsea Three array area.

6.12.1.3 Information on infrastructure and other users was collected through a detailed desktop review of existing studies and datasets and through consultation.

6.12.1.4 Due to the distance from the UK coast, the level of recreational activity within the Hornsea Three array area is low, and recreational fishing activity is likely to be limited. There is low to medium recreational vessel activity in the nearshore area of the Hornsea Three offshore cable corridor, a number of offshore routes, and a general boating area crossing the inshore section of the offshore cable corridor. Boat angling and shore angling also takes place, particularly within 1 nm of the shoreline. Kite surfing, surfing, wind surfing, kayaking and canoeing all have the potential to occur within the nearshore and inshore sections of the offshore cable corridor and there are several SCUBA diving sites in the vicinity.

6.12.1.5 The closest offshore wind farms to the Hornsea Three array area are Hornsea Project One and Hornsea Project Two (both consented), with the closest offshore wind farms to the offshore cable corridor being Dudgeon (under construction) and Sheringham Shoal (operational). There is one active telecoms cable crossing the Hornsea Three array area, and two active telecoms cables crossing the Hornsea Three offshore cable corridor. In the landfall location, the Hornsea Three offshore cable corridor also crosses the export cables for the Dudgeon and Sheringham Shoal offshore wind farms. There are 27 active pipelines which intersect the Hornsea Three offshore cable corridor. There are no aggregate extraction sites within the Hornsea Three array area, although one site overlaps marginally with the offshore cable corridor.

6.12.1.6 Licences for the exploration and extraction of oil and gas are granted for identified geographical blocks. There are currently 11 licenced blocks coincident with the Hornsea Three array area operated by Centrica, INEOS and Shell, and five unlicensed blocks. There are currently eight licenced blocks coincident with the offshore cable corridor, operated by Shell, INEOS, Independent and ConocoPhillips, with two of these blocks operated by Independent Oil and Gas coinciding with the offshore HVAC booster station search area, and 15 unlicensed blocks, with six of these coinciding with the offshore HVAC booster station search area.

6.12.1.7 A number of potential impacts on infrastructure and other users, associated with the construction, operation and maintenance, and decommissioning of Hornsea Three, were identified. These included displacement of recreational craft and recreational fishing vessels, restriction of access to cables and pipelines, change in aggregate resource, and disruption to oil and gas operations (including restriction on seismic survey activity, restrictions on drilling and the placement of infrastructure, and interference with Radar Early Warning Systems (REWS) on gas platforms). With the proposed mitigation measures in place, there will be no significant effects arising from the development of Hornsea Three in isolation during the construction, operation and maintenance, or decommissioning phases on recreational users and recreational fishing and aggregate extraction, cables and pipelines receptors, with these impacts resulting in effects of either negligible or **minor adverse** significance (not significant in EIA terms).

6.12.1.8 With the proposed mitigation measures in place, there will be no significant effects arising from the development of Hornsea Three in isolation during the construction, operation and maintenance, or decommissioning phases on oil and gas receptors, with the exception of the impact on REWS during the operation and maintenance phase. The presence of turbines in previously open sea areas may cause interference with the performance of the REWS located on the J6A platform operated by Centrica, which was assessed as **moderate adverse** significance (significant in EIA terms). There are mitigation measures available to reduce the significance of effect on the REWS on the J6A platform. Hornsea Three proposes that further consultation with Centrica and the proprietor of the REWS shall be undertaken to ascertain suitable options. Following the implementation of mitigation measures it is anticipated that the residual effect will be not significant in EIA terms.

6.12.1.9 In regard to other potential impacts to oil and gas operators, the significance of effect has not been assessed for Centrica licence blocks. Hornsea Three are in discussions with Centrica and there is not enough certainty in relation to future plans to assign sensitivity to their licence blocks at this stage. These assessments will be included in the Environmental Statement which will be submitted in Quarter 2 of 2018.

- 6.12.1.10 Cumulative impacts from aggregate extraction activities, other offshore wind farm developments and cables and pipelines were assessed and predicted to result in effects of either **negligible** or **minor adverse** significance (not significant in EIA terms) upon recreational users and recreational fishing and aggregate extraction, cables and pipelines receptors. The potential cumulative effect arising from Hornsea Three during the operational and maintenance phase, alongside other projects/plans, on the Saturn platform REWS, operated by ConocoPhillips, has been considered within the assessment. Consultation regarding the Saturn REWS is ongoing and it has not been possible to conclude this assessment until this consultation has progressed further. This assessment will be updated for the Environmental Statement.
- 6.12.1.11 Transboundary effects relate to effects of Hornsea Three in isolation on the J6A platform REWS operated by Centrica Netherlands and located within Dutch territorial waters. The effect is predicted to be of **moderate adverse** significance (significant in EIA terms). Hornsea Three proposes that further consultation with the platform operator shall be undertaken as discussed above.

### 6.13 Inter-Related Effects (Offshore)

- 6.13.1.1 The EIA for Hornsea Three has also assessed the potential for inter-related effects to arise. Inter-related effects are defined as multiple effects upon the same receptor arising from Hornsea Three. These occur either where a single effect acts upon a receptor over time to produce a potential additive effect or where a number of separate effects interact to affect a single receptor, for example the combination of noise and habitat loss on marine mammals.
- 6.13.1.2 Potential inter-related effects have been identified based on the detailed assessments undertaken in the individual PEIR chapters for example, habitat loss/disturbance/alteration, increased suspended sediment concentrations and associated sediment deposition on benthic ecology. However, given the temporary and small scale nature of effects, availability of alternative habitats, and also factoring in proposed measures adopted as part of the project, the overall significance of any inter-related effects was not judged to increase the individual effects assessed in the topic-specific chapters.

## 7. Potential Environmental Impacts (Onshore)

### 7.1 Introduction

- 7.1.1.1 The Non-Technical Summary outlines how the EIA process to date has assessed the potential for the construction, operation and maintenance, and decommissioning of the onshore elements of Hornsea Three offshore wind farm to create impacts upon the onshore environment, as characterised by the review and analysis of site-specific data, peer reviewed papers, desk based studies and modelling of specific parameters. The onshore elements of Hornsea Three include the Hornsea Three landfall, the onshore cable corridor search area, the onshore HVAC booster station, onshore HVDC converter/HVAC substation, and the interconnection with the Norwich Main Nation Grid substation. Further information is provided at chapter three of the NTS. This section of the NTS provides a non-technical summary of the onshore assessments undertaken to date for Hornsea Three. Further information on the assessments undertaken to date can be found in each of the topic chapters in volume 3 of the PEIR.
- 7.1.1.2 The assessment of environmental effects has been informed by Nationally Policy, local planning policy, relevant legislation and guidance, as well as consultation with relevant stakeholders.

### 7.2 Geology and Ground Conditions

- 7.2.1.1 Geology is the study of the origin, history and structure of the earth and geological materials (i.e. the bedrock and other below ground materials (other than soils)). The assessment of ground conditions focuses on the potential for disturbance by the development of existing land contamination, for example waste disposal sites or former industrial sites, and the potential for impacts on groundwater.
- 7.2.1.2 The geology and ground conditions study area comprises of a 1 km buffer around the onshore elements of Hornsea Three. The baseline information was collated from various sources, which included a desktop study of existing studies and datasets and the compilation of all designated sites within the geology and ground conditions study area that could be affected by Hornsea Three. There are three geological Sites of Special Scientific Interest (SSSI) within the Hornsea Three onshore cable corridor search area: Weybourne Cliffs, Weybourne Town Pit, Kelling Heath. There are also several Mineral Safeguarded Areas (sand and gravel) which are areas of known mineral resource of sufficient economic or conservation value to warrant protection for future generations.

- 7.2.1.3 The bedrock of the Hornsea Three landfall area and central part of the onshore cable corridor search area are split between the Lewes Nodular Chalk of the White Chalk Subgroup (in the west) and the Wroxham Crag Formation (in the east). The rest of the Hornsea Three onshore cable corridor search area and the onshore HVDC converter/HVAC substation are underlain by Lewes Nodular Chalk of the White Chalk Subgroup. Superficial deposits include higher ground underlain by geological deposits in the valley floors. The majority of the superficial deposits within the Hornsea Three onshore cable corridor search area are underlain by different glacial deposits.
- 7.2.1.4 The Chalk bedrock is a principal aquifer and there are also a number of secondary aquifers in more permeable parts of the superficial drift materials which are crossed by the landfall and cable route corridor. There are public water supplies from the Chalk aquifer which are, regulated by the Water Framework Directive (WFD), protected by Source Protection Zones (SPZs) together with several private abstractions from the Chalk along the cable route corridor. The WFD sets environmental standards for the protected areas which should be adhered to. The Chalk aquifer is also regulated by the WFD.
- 7.2.1.5 There are a number of filled ponds, substations and former storage tanks (particularly fuel storage tanks) located within the Hornsea Three onshore cable corridor search area which may have potentially caused localised ground contamination. However, there are no sites recorded as contaminated land under Part 11A of the Environmental Protection Act 1990 within 500 m of the Hornsea Three onshore cable corridor search area.
- 7.2.1.6 The effects of the development on designated sites of geological or geomorphological interest were assessed to be of **negligible to minor adverse** significance (not significant in EIA terms) with inclusion of measures adopted as part of the project such as, risk assessments and a minimum standoff of 2 m above the chalk aquifer.
- 7.2.1.7 The impacts of construction may result in the loss of mineral resources within the Mineral Safeguarded Areas was assessed to be of **minor adverse** significance (not significant in EIA terms). The area of the Mineral Safeguarded Area occupied by Hornsea Three is likely to reduce following the refinement of the Hornsea Three onshore export cable. Hornsea Three will continue to work with Norfolk County Council regarding the Mineral Safeguarded Area to agree how to minimise the impacts on mineral resources as the project progresses.
- 7.2.1.8 A number of potential impacts on geology and ground conditions associated with Hornsea Three were identified. These included impacts on the groundwater quality of secondary and primary aquifers including in SPZs resulting from ground disturbance or contamination, the creation of pathways whereby surface water may hydraulically connect with groundwater aquifers and possibly affecting the WFD status of the groundwater. With the proposed mitigation measures adopted as part of the project in place, all of these impacts result in effects of either **negligible** or **minor adverse** significance (not significant in EIA terms).

- 7.2.1.9 The operation and maintenance of the onshore export cable may affect the groundwater quality from thermal effects of the power cables, which may affect the WFD status of the groundwater. With inclusion of mitigation measures adopted as part of the project the significance of thermal effects was considered to be **minor adverse** (not significant in EIA terms).
- 7.2.1.10 There are a number of possible cumulative impacts of Hornsea Three and other developments related to the disturbance or contamination of aquifers and associated surface waters which may affect WFD status, depletion of mineral resources within the Mineral Safeguarded Areas, and thermal effects of underground power cables. However, the significance of the effects of these impacts was only assessed to be **minor adverse** (not significant in EIA terms) assuming extraction before construction is feasible.
- 7.2.1.11 It was considered that there was no potential for significant transboundary effects with regard to onshore geology and ground conditions from Hornsea Three upon the interests of other EEA States.

### 7.3 Hydrology and Flood risk

- 7.3.1.1 Hydrology is the study of the movement, distribution and quality of water above ground, including the hydrological cycle, water resources and in addition to flood risk. The assessment of hydrology and flood risk focuses on the potential for increased flooding and watercourse disturbance as a result of the development.
- 7.3.1.2 The hydrology and flood risk study area comprises the onshore elements of Hornsea Three plus a 1 km buffer around the proposed onshore HVAC booster station and onshore HVDC converter/HVAC substation, and a 250 m buffer around the Hornsea Three landfall area and onshore cable corridor search area. Baseline data on the hydrological resources and flood risk within the hydrology and flood risk study area has primarily been collected using a desktop study of publicly available information. This information has also been supplemented by information requested from the Environment Agency, Norfolk Rivers Internal Drainage Board, Norfolk County Council, North Norfolk District Council, Broadlands District Council and South Norfolk Council.
- 7.3.1.3 The Hornsea Three hydrology and flood risk study area includes a number of catchments and associated surface watercourses. These include the River Yare, River Tud, River Wensum, River Bure, River Glaven (Gunthorpe Stream), Spring Beck, Intwood Stream, Swannington Beck and Blackwater Drain. All of these watercourses are classified as having moderate water quality under the Water Framework Directive, with the exception of the River Bure which is classified as poor.
- 7.3.1.4 Environment Agency mapping indicates the proposed Hornsea Three development includes small areas located within Flood Zone 3 in the vicinity of near Salle, Blackwater Drain, Swannington Beck, River Wensum, River Tud, River Yare, unnamed tributary of the River Yare at Lille Melton and Intwood Stream; which means that there is less than 1% chance of flood in those locations. The rest of the proposed development is in Flood Zone 1 which has less 0.1% chance of flooding.

- 7.3.1.5 The impacts of construction onshore elements of Hornsea Three may affect tidal and surface water flood risk. Onshore construction may also impact existing drainage pipelines, field drainage and irrigation. However, with the inclusion of specific measures that will be included as part of the final project, the effects of these impacts have been assessed to be of **minor adverse** significance (not significant in EIA terms).
- 7.3.1.6 The potential use of open cut trenching, Horizontal Directional Drilling (HDD) and other site activities, may impact surface water quality due to increases in turbid (murky) run-off, spillages/leaks of fuel, oil etc. and an alteration in surface water flow pathways. With the inclusion of designed mitigation measures, such as the use of HDD at the Hornsea Three Landfall the effects of these impacts have been assessed to be of **minor adverse** significance (not significant in EIA terms).
- 7.3.1.7 The operation of the proposed onshore HVAC booster station and onshore HVDC converter/HVAC substation may impact on flood risk due to an increase in runoff rate. However, with the inclusion of the mitigation measures adopted as part of the design the effect of this impact is considered to be **negligible** (not significant in EIA terms).
- 7.3.1.8 The operation and maintenance of the proposed onshore HVAC booster station and onshore HVDC converter/HVAC substation may result in the unintentional spillage of substances, such as transformer oil which could impact the water quality of surface watercourse. Taking into account the measures integrated as part of the project the effect of this impact is considered to be of **minor adverse** significance (not significant in EIA terms).
- 7.3.1.9 The effects of impacts of Hornsea Three decommissioning pertaining to temporary flood risk and surface water courses are considered to be of **minor** significance (not significant in EIA terms).
- 7.3.1.10 The effects of the cumulative impacts on surface water quality, flood risk, drainage pipeline infrastructure, field drainage and irrigation during construction, and operation and maintenance were assessed to be of **negligible to minor adverse** significance (not significant in EIA terms).
- 7.3.1.11 It was considered that there was no potential for significant transboundary effects with regard to onshore hydrology and flood risk from Hornsea Three upon the interests of other EEA States.

## 7.4 Ecology and Nature Conservation

- 7.4.1.1 The ecology and nature conservation chapter focuses on any impacts of Hornsea Three on the communities of animals and plants, and the interaction between these species and the physical environment. The ecology and nature conservation chapter covers those aspects of Hornsea Three which are onshore, namely the Hornsea Three landfall area, the onshore cable corridor search area, the onshore HVAC booster station, the onshore HVDC converter/HVAC substation and the interconnection with the Norwich Main Nation Grid substation.

- 7.4.1.2 The ecology and nature conservation study area includes a buffer of up to 250 m for field data collection either side of the onshore elements of Hornsea Three. In addition, a 2 km study area was used for the data search and desk study and 5 km data search area specifically for bats and ornithology were also incorporated. Baseline information relating to ecology and nature conservation has been collated through a combination of a desk top study and site specific surveys, as well as a collation of data for designated sites within the 2 km search area extending from the Hornsea Three development.
- 7.4.1.3 Twenty statutory designated sites, including SSSIs, SACs and Ramsar sites, were identified within 2 km of Hornsea Three development, with 126 non-statutory designated sites also identified. The desktop study and site specific surveys indicated the presence of protected or otherwise notable species including bluebell, holly-leaved naiad, sandy stiltball, white-clawed crayfish, whorl snail species, common lizard, great crested newt (Figure 7.1), grass snake, slow worm, breeding birds, wintering birds, migratory birds, badger, otter, bats and water vole.



Figure 7.1: Great crested newts and survey sampling equipment.

- 7.4.1.4 There are a number of possible impacts on onshore habitats and species associated with the open cut trenching required to install the export cable. The impacts include potential habitat loss, for example in designated sites, hedgerows and sensitive water courses, as well as possible disturbance of notable species. The significance of the effects of these impacts is assessed to range from **moderate** to **major adverse** (significant in EIA terms). Hornsea Three will continue to refine the onshore project design, and as part of that work there will be opportunities to mitigate some of these effects. Potential impacts on ecology and nature conservation may be avoided through the detailed cable route alignment, avoiding designated sites and sensitive habitats, through the timing of works in some locations to avoid interaction with protected species, and through the selection of cable installation methodologies in key locations. These actions would mitigate the effects of impacts on potentially sensitive habitats and species. Therefore, with the proposed mitigation in place the significance of the effects of these impacts would be reduced to **negligible** and **minor adverse** (not significant in EIA terms).
- 7.4.1.5 In most cases it is expected that the potential for the construction and decommissioning of cables to affect species would be of **minor adverse** significance, a **moderate adverse** effect (significant in EIA terms) is predicted for wintering pink-footed goose populations at the coastal end of the cable and a **minor adverse** effect (not significant in EIA terms) in most other cases. However, it is anticipated that with appropriate mitigation measures the residual effect would be of **minor adverse** significance (not significant in EIA terms).
- 7.4.1.6 Cumulative impacts from other schemes were also assessed. Other schemes were included in the assessment based upon data confidence, effect-receptor pathways and the spatial/temporal scales involved. None of the effects of the potential impacts identified were considered significant in EIA terms.
- 7.4.1.7 It was considered that there was no potential for significant transboundary effects with regard to onshore ecology and nature conservation from Hornsea Three upon the interests of other EEA States.

## 7.5 Landscape and Visual Resources

- 7.5.1.1 Landscape and visual resources refers to the physical elements of the landscape, landscape character, areas designated for their scenic or landscape-related qualities and views from various locations such as settlements, transport routes, high areas of land and other sensitive locations.
- 7.5.1.2 The impact assessment for the construction, operation and maintenance, and decommissioning phases of the onshore elements of Hornsea Three. At PEIR stage the assessment focuses on only the likely significant effects, and the effects presented in this PEIR chapter are limited to those that have been assessed as being major adverse and above. This is based on the scheme definition currently available. A high level summary of all potential landscape and visual effects (including impacts which are not considered significant), is presented with the PEIR as an annex. The potential impacts reported are preliminary and will be revisited and expanded upon (where relevant) in the ES when the design of Hornsea Three has been further defined.

- 7.5.1.3 As details of the onshore cable route are still yet to be defined, the visual impact assessment for this phase of the development is designed to highlight the likely impact that the type of receptors within the onshore cable route 1 km study area will witness, detailing their sensitivity and indicating the likely significance of effect for the receptor type rather than specific visual receptors. Similarly, the likely visual impact for visual receptors within 1 km of each of the three main construction compounds, the type of impact that they will witness and their sensitivities are set out, with an indication of the likely significance of effect. As the maximum height and type of development for the HVAC booster station and the HVDC converter/HVAC substation are known, the individually identified visual receptors within the 5 km study areas that are likely to witness significant effects as a result of each, are set out in terms of the likely magnitude of impact, sensitivity of receptors and significance of effect.
- 7.5.1.4 Once the project has been fully defined, a more detailed assessment of the effects that are likely to arise as a result of the onshore infrastructure will be undertaken and submitted as part of the ES. The ES will also include specific elements of mitigation that will be identified in order to alleviate significant adverse effects where they are likely to arise. The mitigation measures will be set out within the outline Landscape Scheme and Management Plan (LSMP) and will be agreed with the LPAs. Similarly, a detailed assessment of night time effects will be provided for submission as part of the ES once a lighting strategy has been agreed with the LPAs.
- 7.5.1.5 A number of potential impacts on landscape and visual resources associated with Hornsea Three were identified in the PEIR assessment. These included effects on designated and undesignated landscape and seascape resources as well as effects on visual receptors within the study areas.
- 7.5.1.6 The effects of the impact of construction of the onshore elements of Hornsea Three on landscape resources and receptors were mainly assessed to be not significant. However, the temporary effects of construction of the onshore elements of Hornsea Three on a number of local character areas, was assessed to have a **major adverse** significance (significant in EIA terms).
- 7.5.1.7 Similarly, the majority of the effects of the construction of the onshore elements of Hornsea Three on visual receptors were considered to be not significant. However, the temporary effects of construction of the onshore elements of Hornsea Three on a number of visual receptors at residential properties and public rights of way are expected to have a **major adverse** significance (significant in EIA terms).
- 7.5.1.8 The long term effects of the operation and maintenance of the onshore HVAC booster station and the onshore HVDC converter/HVAC substation on landscape resources and receptors were considered to be not significant. The operation and maintenance of the onshore HVAC booster station and the onshore HVDC converter/HVAC substation on visual receptors were in the main assessed to be not significant. However, long term effects of the impact of the operation and maintenance of the onshore HVAC booster station and the onshore HVDC converter/HVAC substation on visual receptors at a number of residential properties and public rights of way were considered to have a **major adverse** significance (significant in EIA terms).

- 7.5.1.9 The effects of the impact of decommissioning the HVAC booster station and the onshore HVDC converter/HVAC substation, and the majority of the effects of the impact of decommissioning the onshore cable on landscape resources and receptors were assessed to be not significant. However, the temporary effects of the impacts of decommissioning of the onshore cable on the character area Coastal Towns and Villages was assessed to have a **major adverse** significance (significant in EIA terms).
- 7.5.1.10 Likewise, the majority of the effects of the decommissioning of the onshore elements of Hornsea Three on visual receptors were considered to be not significant. However, the temporary effects of impact of decommissioning of the onshore HVDC converter/HVAC substation on a number of residential properties were considered to have a **major adverse** significance (significant in EIA terms).
- 7.5.1.11 When considered in combination with other plans and projects, the onshore cable, onshore HVAC booster station and onshore HVDC converter/HVAC substation of Hornsea Three, are thought to have a significant cumulative effect of **major adverse** significance) on the nationally designated landscapes Norfolk Coast AONB, Salle Park RPaG, and Intwood Hall RPaG during construction, operation and decommissioning. In addition, the effect of the cumulative impact of the onshore elements of Hornsea Three with other plans and projects local character areas and visual receptors is considered to have a **major adverse** significance (significant in EIA terms).
- 7.5.1.12 It was considered that there was no potential for significant transboundary effects with regard to onshore Landscape and Visual Resources from Hornsea Three upon the interests of other EEA States.

## 7.6 Historic Environment

- 7.6.1.1 The historic environment assessment considers the potential effects of onshore elements of Hornsea Three on the historic environment including effects on buried archaeological remains together with consideration of the effects on the settings of nearby heritage assets and the historic landscapes.
- 7.6.1.2 The historic environment study area covers an area of up to 1 km on either side of the Hornsea Three onshore cable corridor search area, with a focus on a core study area of 250 m either side of the Hornsea Three onshore cable corridor search area. The baseline environment of the study area was established through a desk top review of historic and geological mapping, existing studies and datasets, site visits and walkover surveys, and finally, designated sites were identified through consultation with stakeholders, in particular Historic England and the local planning authorities.

7.6.1.3 Within 1 km of the Hornsea Three onshore cable corridor search area there are:

- 13 scheduled monuments, whose settings may be affected by the proposals.
- 167 listed buildings. Of these, seven are listed at Grade I, 23 at Grade II\* and 137 at Grade II.
- 4 Registered Parks and Gardens. Three of which are the Grade II\* listed: Heydon Hall located 380 m east of the Hornsea Three onshore cable corridor search area; Intwood Hall, located 180 m north of the Hornsea Three onshore cable corridor search area; and Sheringham Hall, located 800 m east of the Hornsea Three onshore cable corridor search area. Salle Park, located 110 m east of the Hornsea Three onshore cable corridor search area at its nearest point is registered at Grade II.
- 11 Conservation Areas, which are: Weybourne, Hempstead, Mulbarton, Heydon, Upper Sheringham, Glaven Valley, Baconsthorpe (Figure 7.2), Reepham, Bawburgh, Keswick Mill and Stoke Holy Cross Mill. These conservation areas contain many of the listed buildings in the area.



Figure 7.2: Exterior view of Baconsthorpe Castle.

Source: English Heritage, <http://www.english-heritage.org.uk/visit/places/baconsthorpe-castle/>

- 7.6.1.4 Construction works at the site of the Hornsea Three landfall area, along the onshore cable corridor (including compounds and construction side accesses), onshore HVAC booster station and onshore HVDC converter/HVAC substation could potentially result in temporary impacts on the settings of heritage assets including Scheduled Monuments, Listed Buildings, Conservation Areas and Registered Parks and Gardens. The significance of the effects of these impacts were considered to be **moderate adverse** (significant in EIA terms).
- 7.6.1.5 The effect of the impacts caused by operation and maintenance of the onshore HVAC booster station and onshore HVDC converter/HVAC substation could result in long-term but reversible impacts on the settings of the heritage assets mentioned above (paragraph 7.6.1.4) as well as long-term impacts on the overall historic landscape; both were considered to be of **moderate adverse** significance (significant in EIA terms).
- 7.6.1.6 The effects of decommissioning the onshore cable, onshore HVAC booster station and HVDC converter/HVAC substation is considered to be of **moderate beneficial** (significant in EIA terms) in relation to buried archaeological remains and the settings of heritage assets, and **minor beneficial** (not significant in EIA terms) in relation to impacts on the overall historic landscape.
- 7.6.1.7 Cumulative impacts with other developments include construction works at the landfall, along the cable route and at the site of onshore HVAC booster station and HVDC converter/HVAC substation could result in cumulative permanent loss of or damage to, buried archaeological remains. The significance of the effect of this impact was considered to be **minor to moderate adverse** (not significant to significant in EIA terms).
- 7.6.1.8 In addition, construction works at the site of onshore HVAC booster station and HVDC converter/HVAC substation could potentially result in temporary cumulative impacts on the settings of heritage assets including Scheduled Monuments, Listed Buildings, Conservation Areas and Registered Parks and Gardens. The significance of the effect of this impact was considered to be **minor to moderate adverse** (not significant to significant in EIA terms).
- 7.6.1.9 It was considered that there was no potential for significant transboundary effects with regard to onshore historic environment from Hornsea Three upon the interests of other EEA States.

## 7.7 Land Use and Recreation

- 7.7.1.1 The land use and recreation assessment considers the potential impacts of Hornsea Three on user groups that may be affected by the project, including farmers, recreational users, and others.
- 7.7.1.2 The land use and recreation study area comprises the area required for the onshore infrastructure including construction working areas and construction access routes, together with the land and recreational resources immediate proximate to, or linking to these onshore elements. For the purpose of the PEIR, the Hornsea Three land use and recreation study area is the Hornsea Three onshore cable corridor search area, which also includes the sites for the onshore HVAC booster station and onshore HVDC converter/HVAC substation.
- 7.7.1.3 The baseline conditions in land use and recreation were determined through a detailed desktop review of existing studies and datasets. The desktop review identified the known soil types and patterns, agricultural land quality, farm holdings, designated sites, and recreational resources including public rights of way (i.e. public footpaths, bridleways and restricted byways). In addition to a walkover survey of public rights of way, consultation has also been undertaken with the relevant local authorities to confirm the existing public right of way network.
- 7.7.1.4 The Hornsea Three onshore cable corridor search area crosses four landscape regions of Norfolk: the Coastal Plain; Cromer Ridge and Sand-Loam Uplands; the Boulder Clay Plateau; and the river valleys of the Glaven, Bure, Wensum and Yare and their main tributaries. The four landscape regions contain different soils that may be graded using Agricultural Land Classification. This places land into one of five grades, with Grade 1 being the best and Grade 5 the worst, according to the degree to which its physical characteristics impose long term limitations on its agricultural use.
- 7.7.1.5 The Coastal Plain landscape region is underlain by Marly Drift and the soils are generally graded as 3a. Similarly, in the Cromer Ridge and Sand-Loam Uplands landscape region areas where soil developed in glaciofluvial sands and gravels they are generally graded 3a/4. However, in areas where glaciofluvial sands and gravels are overlain by aeolian drift higher grades of 2/3a occur. In the vicinity of Boulder Clay Plateau landscape region substantial areas of Grade 2 and Subgrade 3a with only minor amounts of Subgrade 3b are prevalent. Lastly, in landscape region of the river valleys of the Glaven, Bure, Wensum and Yare, and their main tributaries, land is generally no better than Grade 4. In terms of farming, the Local Authority areas within which the Hornsea Three onshore cable corridor search area is situated are mainly employed for cereal cropping in farms that are generally (33%) greater than 100 ha.

7.7.1.6 The land use and recreation study area includes a variety of recreation resources. Noted for fishing, the shingle beach at Weybourne can be accessed by anglers and other visitors from a beach side car park (Figure 7.3). The rivers Wensum and Yare are also popular with anglers, as well as for other water based activities. The land use and recreation study area also encompasses a camping site west of Weybourne, as well as Kelling Heath Holiday Park. Kelling Heath SSSI and Booton Common SSSI are also included in the study area along with other recreational resources such as Baconsthorpe Castle (Figure 7.2), Salle Park, North Norfolk Railway and the Muckleburgh Military Collection. The land use and recreation study area also crosses, or runs close to, two National Trails, a number of public rights of way, a National Cycle Network Route, other cycle routes and informal paths.



Figure 7.3: Shingle beach near the Hornsea Three landfall area.

7.7.1.7 The construction of the onshore cable, HVAC booster station and HVDC converter/HVAC substation may affect farm holdings and the Agricultural Land Classification. The onshore cable may cause temporary severance within a number of farm holdings and temporarily affect areas of Grades 2 and 3a land. The loss of the land required for the onshore HVAC booster station and HVDC converter/HVAC substation may also affect the workability of individual holdings, as well as resulting in the permanent loss of the best and most versatile land. The temporary effect of these impacts on Agricultural Land Classification is considered to be **major adverse** (significant in EIA terms), as a result of the loss of agricultural land as a result of the construction of the HVAC booster station and HVDC converter/HVAC substation, and the temporary loss of agricultural land during the construction of the onshore cable, while the effect on farm holdings during construction is **moderate adverse** (significant in EIA terms). Hornsea Three will develop and implement a Soils management Strategy to manage the excavation, storage and reinstatement of agricultural land on the onshore cable route, to minimise any loss in its quality.

7.7.1.8 The construction of the onshore elements may also impact the use of public rights of way, in particular the two National Trails, Peddars Way and Norfolk Coast Path National Trail. The temporary effect of the impact of the development is assessed to be **major adverse** (significant in EIA terms) for the National Trails and **minor adverse** (not significant in EIA terms) for other public rights of way. The temporary effect of the impact of construction on other linear routes is considered to be of **moderate adverse** significance (significant in EIA terms) and for the National Cycle Network Route and **minor adverse** (not significant in EIA terms) for other routes. These will be mitigated through the agreement and implementation of temporary footpath management measures, and discussion about the timing of the works, which will be progressed with Norfolk County Council.

7.7.1.9 Construction activities on the onshore elements of Hornsea Three may fall during the summer months when many of the recreational resources in the land use and recreation study are operating at maximum capacity. Therefore, the effect of this impact is assessed to be of **moderate adverse** significance (significant in EIA terms).

7.7.1.10 Other impacts of the construction of the Hornsea Three onshore elements include impacts on the public use of the coast at Weybourne, as well as access to land such as Kelling Heath. However, as public access of these resources is likely to only be slightly impeded the effect of these impacts is concluded to be of **minor adverse** significance (not significant in EIA terms).

7.7.1.11 During operation and maintenance the effects of the impacts due to the permanent loss of the best and most versatile land and on farm holdings associated with the onshore HVAC booster station and HVDC converter/HVAC substation is assessed to be **minor adverse** and **negligible** to **minor adverse** respectively (not significant in EIA terms). The impacts of the onshore cable during the operation and maintenance phase will be **minor adverse** (not significant in EIA terms).

- 7.7.1.12 The cumulative impact of the construction of onshore elements of Hornsea Three and other plans and projects (within 1km buffer around the Hornsea Three onshore cable corridor search area) may affect Agricultural Land Classification and the workability of farm holdings. The effect of these impacts on Agricultural Land Classification is considered to be **major adverse** (significant in EIA terms), while the effect on farm holdings is **minor adverse** (not significant in EIA terms).
- 7.7.1.13 The effects of the cumulative temporary impact on access land, recreational resources, public rights of way and other linear routes has assessed to be of **minor adverse** significance (not significant in EIA terms).
- 7.7.1.14 It was considered that there was no potential for significant transboundary effects with regard to onshore land use and recreation from Hornsea Three upon the interests of other EEA States.

## 7.8 Traffic and Transport

- 7.8.1.1 The Hornsea Three traffic and transport chapter relates to the traffic movements associated with the project, these being the movement of construction workers, equipment, materials, abnormal loads and traffic movements associated with operation, maintenance and decommissioning of the onshore infrastructure. Baseline data have been obtained from existing data sets and studies site visits and site specific surveys including traffic surveys and personal injury accident data.
- 7.8.1.2 The traffic and transport study area in relation to transport includes all highways, rights of way, private accesses and railways in the vicinity of the Hornsea Three onshore cable corridor search area and the onshore HVDC converter/HVAC substation that are anticipated to be used by construction, operational and decommissioning traffic. The traffic and transport study area also includes parts of the wider transport networks that provide links between the Hornsea Three onshore cable corridor search area and onshore HVDC converter/HVAC substation site and the strategic transport networks, rail terminals and port facilities.
- 7.8.1.3 The existing environmental baseline has been established from analysis and consultation and the inclusion of information presented to date has been agreed with the Local Highways Authority (Norfolk County Council) in discussion in February 2017. Predicted heavy goods vehicle use has been calculated for 71 potential access points to the onshore cable route during construction. However, the effect of the temporary impacts of these vehicles on driver delay, severance of routes, pedestrian delay, fear and intimidation, accidents and road safety, and hazardous, dangerous and abnormal loads during construction works has not yet been assessed. Potential access routes for the 71 access points have also been considered.

- 7.8.1.4 An impact assessment has not been undertaken within this PEIR; its purpose is to consult on the access route and location options. Responses to the PEIR will be considered to identify the preferred routes for the construction of the onshore cable. The impact assessments will be undertaken once responses to the PEIR, combined with site-specific surveys which will be undertaken, have been acquired at which point Hornsea Three will consult with the relevant consultees before the DCO application is submitted. Hornsea Three will prepare a draft Construction Traffic Management Plan (CTMP) in consultation with stakeholders, which will be submitted as part of the final DCO application. A final CTMP will be required to be agreed prior to any works starting on site.
- 7.8.1.5 The level of vehicles generated during the operation and maintenance phase will be very low and irregular, with only a few vehicle movements anticipated per week (typically in the order of 1 a week). As such, the effect of impacts arising from traffic associated with the operation of the onshore cable and HVDC converter/HVAC substation are considered to be **negligible to minor adverse** (not significant in EIA terms).
- 7.8.1.6 Traffic and transport impacts during the decommissioning phase will be lower than those the construction phase. The assessments undertaken for the construction assessment will therefore cover the decommissioning phase together with the mitigation measures identified.
- 7.8.1.7 It was considered that there was no potential for significant transboundary effects with regard to onshore traffic and transport from Hornsea Three upon the interests of other EEA States.

## 7.9 Noise and Vibration

- 7.9.1.1 Noise and vibration considers the potential effects from noise and vibration generated during the construction, operation and decommissioning of the onshore elements of Hornsea Three. Site specific surveys (Figure 7.4) were used to establish the baseline sound levels at locations representative of the noise sensitive receptors potentially most affected by the proposed onshore HVAC booster station and the HVDC converter/HVAC substation.
- 7.9.1.2 For construction and decommissioning, the noise and vibration study area considers noise and vibration sensitive receptors and Public Rights of Way within approximately 300 m of the onshore HVDC converter/HVAC substation and HVAC booster station; and the Hornsea Three onshore cable corridor search area. For the operational assessment, the noise and vibration study area is 1 km from the onshore HVDC converter/HVAC substation and HVAC booster station has been considered.



Figure 7.4: Noise monitoring equipment.

7.9.1.3 Hornsea Three will develop measures to control construction noise and vibration impacts during the construction phase. This will include consideration of selection of quieter plant and equipment, acoustic barriers around noisy equipment, if necessary, and controlled construction hours. All of these measures will be developed in consultation with the relevant stakeholders. Taking these measures into account the results of the noise and vibration assessment indicate that the significance of temporary noise and vibration effects from the temporary impacts of construction of the cable route construction accesses and the installation of the cable were assessed as **negligible to moderate adverse** significance (not significant to significant in EIA terms), while the temporary impacts of cable installation by HDD and construction of onshore HVAC booster station and the onshore HVDC converter/HVAC substation were assessed as **negligible to major adverse** significance (not significant to significant in EIA terms). The range in the level of significance depends on the proximity of noise sensitive receptors to the development. Partial or full enclosure of some or all plant and/or the selection/specification of quieter plant to reduce relevant construction effects to non-significant levels could be employed by the project.

7.9.1.4 The effect of the operational impact of an onshore HVDC converter/HVAC substation was considered to be of **moderate to major adverse** significance (significant in EIA terms), while the onshore HVAC booster station was thought to be of **moderate** significance (significant in EIA terms). Hornsea Three will continue to work on the site design for the HVAC Booster Station and HVDC converter/HVAC substation. This will include the design of acoustic attenuation measures, and site layout options to mitigate noise impacts. These will be developed in consultation with stakeholders, including the relevant local planning authorities.

7.9.1.5 During decommissioning, the equipment and activities used are likely to be broadly similar to those used during construction, apart from the decommissioning of the onshore cable for which it is anticipated that the cable ends would be cut and sealed. Therefore, the effect of the temporary impacts of onshore HVDC converter/HVAC substation booster station during decommissioning is considered to be of **negligible to minor adverse** significance (not significant in EIA terms), and the effect of temporary impacts of cable decommissioning is considered to be of **negligible** significance (not significant in EIA terms).

7.9.1.6 The effects of all cumulative impacts identified to date are considered to be of **negligible** significance (not significant in EIA terms).

7.9.1.7 It was considered that there was no potential for significant transboundary effects with regard to onshore land use and recreation from Hornsea Three upon the interests of other EEA States.

## 7.10 Air Quality

7.10.1.1 The air quality chapter considers the potential changes in air quality as a result of the construction, operation and maintenance, and decommissioning of the onshore elements of Hornsea Three. The onshore elements include the onshore cable, the onshore HVAC Booster Station, onshore HVDC converter/HVAC substation and the interconnection with the Norwich Main National Grid substation.

7.10.1.2 The study area for the air quality construction dust assessment comprises the onshore elements of Hornsea Three comprising of the landfall area, the onshore cable corridor search area, the onshore HVAC booster station, the onshore HVDC converter/HVAC substation and the interconnection with the Norwich Main National Grid substation, plus a 350 m buffer. The baseline air quality was investigated in relation to exhaust emissions, larger dust particles (less than 10 µm in diameter) and smaller dust particles (less than 2.5 µm in diameter). The concentrations were found to be well below the objectives set by the National Air Quality Strategy to protect health. A risk based assessment approach has been used for impacts on air quality caused by Hornsea Three.

- 7.10.1.3 It is anticipated that temporary impacts of construction at the Hornsea Three landfall, the cable route and construction site access and the onshore HVAC booster station and HVDC converter/HVAC substation may affect receptors sensitive to dust (human and ecological). However, it is expected that the effect of dust on air quality in terms of dust soiling, impact on human health and ecological receptors will not be significant with the IAQM recommended dust controls in place. Proposed control measures include fully enclosing site or specific operations where there is a high potential for dust production and the site is active for an extended period; covering, seeding or fencing stockpiles to prevent wind whipping; and avoiding bonfires and burning of waste materials.
- 7.10.1.4 It is also anticipated that the temporary impacts of decommissioning of the onshore cable, onshore HVAC booster station and HVDC converter/HVAC substation may affect receptors sensitive to dust. The impact, which would affect receptors directly, is considered to be potentially high, before dust controls; however, with the application of controls, the risk of impacts would be expected to be reduced such that the effect is not significant.
- 7.10.1.5 In the event that the construction programmes for other schemes overlap with Hornsea Three, the temporary impacts of the construction at the Hornsea Three landfall, onshore cable side accesses, of the onshore HVAC booster station and HVDC converter/HVAC substation may affect receptors sensitive to dust. The most significant issue in relation to local air quality effects is likely to be temporary nuisance caused by the deposition of dust during the construction phase. However, provided that the cumulative developments use the recommended IAQM dust controls, the effect will be not significant.
- 7.10.1.6 Any air quality impacts on onshore receptors arising from the construction, operation and maintenance and decommissioning of Hornsea Three will be confined to a localised area within, or in close proximity to (<350 m), the footprint of the Hornsea Three onshore cable corridor search area (and a localised area of the UK road infrastructure). There is no pathway by which direct or indirect effects arising from Hornsea Three could significantly affect onshore receptors of another member state.

## 7.11 Socio-economics

- 7.11.1.1 The socio-economic chapter presents the considerations for the assessment of socio-economic impacts, which will be included in the Environmental Statement submitted as part of the DCO application. The update of the work is expected to reflect the increased involvement of UK suppliers in the offshore wind supply chain. Regeneris Consulting Limited is currently working with DONG Energy to reflect their insight into the sector, and will use the most up-to-date evidence in the assessment of impacts. Therefore, the assessment of Hornsea Three on main socio-economic receptors is not presented at this stage, as is limited to the assessment of effects on tourism activity.
- 7.11.1.2 The final assessment will draw on an economic model which quantifies the additional economic activity and employment which could arise across the UK and in areas local to the development as a result of the construction, operation and decommissioning activity. This will be achieved by considering the effect of the Hornsea Three development on the following socio-economic indicators against current baseline conditions: economic activity as measured through gross value added; employment creation; business sectors affected by the construction, operation and maintenance, and decommissioning of the wind farm (i.e. the supply chain); the volume and value of tourism activity; and measures of community vitality and viability (e.g. changes in demand for local housing, accommodation and services). The assessment considers the impact of both the onshore and offshore elements of Hornsea Three.
- 7.11.1.3 In light of the uncertainty that currently exists in relation to the selection of construction and operation and maintenance ports, the assessment will include two separate impact areas for employment and Gross Value Added (GVA) related effects. The socio-economics study area includes New Anglia Local Enterprise Partnership (LEP) area, covering 14 separate local authority districts in Norfolk and Suffolk, and Humber LEP area which includes Hull, East Riding, North Lincolnshire and North East Lincolnshire. The baselines in the study areas were assessed through a desktop study of various data sources, in particular the Office of National Statistics. LEPs are partnerships set up between local authorities and businesses, in order to help drive and encourage collaborative working between business and Government, to deliver economic priorities and lead economic growth and job creation.
- 7.11.1.4 The New Anglia LEP has a relatively large impact area, comprising of 14 local authority districts. It has a historic energy presence, with the offshore gas production and the emerging renewables sector. The proportion of the New Anglia population which is of working age of 60% is slightly lower than the national level of 63%. However, of the population that is of working age, 80% are economically active and 77% are employed, which is higher than the national figures of 78% and 74% respectively. This is reflected by the fact that 3.5% of the population is unemployed with 1.3% claiming out of work benefits, which are lower than the national averages of 5% and 1.9% respectively. Although these employment figures for the New Anglia LEP area are above the national average, residents and workers generally earn less than is typical nationally. This is echoed by a lower number of level 4 qualifications, a higher number of people with no qualifications, and that lower skill professions are overrepresented. Some local areas like Great Yarmouth and North Norfolk consistently underperform, illustrating a lack of opportunity in these areas. However, some of these areas, particularly Great Yarmouth, have the greatest potential to benefit from the proposed development given their supply chain capacity and capability. For example the LEP area has seen a series of planned investments in the offshore wind locally: Statoil's Operations Centre for Dungeness Offshore Wind Farm in Great Yarmouth, Lowestoft will be used as the construction base for Galloper Wind Farm, and Siemens have set up a base in Great Yarmouth. New Anglia is also home to one of six Centres for Offshore Renewables Engineering in Great Yarmouth and Lowestoft which are designed to attract investment in wind farm assembly and manufacturing.

- 7.11.1.5 Humber LEP area is a built-up area with an industrial heritage. Historically, it suffers from socio-economic challenges but with a strong and growing renewable energy sector and significant investments in recent years to develop its offshore wind sector and which has enhanced its potential to benefit from Hornsea Three. All of the labour market indicators for Humber LEP area are lower than the national averages despite 62% of the population being working age of, only slightly lower than the national level of 63%. This is exemplified by the low employment density of 651 jobs per 1,000 working age residents, which is 61 jobs per 1,000 residents lower than the national average. The unemployment rate of 6.3% is slightly above the national average of 5.0%, although there are parts of the LEP area where the rate is higher. Residents and workers in the Humber LEP area earn less than the UK average, which reflects the focus of the employment base on activities which generate lower levels of value added and wealth. However, Humber LEP area has benefitted from several offshore wind developments in recent years, building on its existing industry strengths and further capabilities. These include: Siemens and its blade manufacturing facility in Hull; REDS Maritime providing cable remediation and support services; GEV Wind Power – a turbine maintenance company, and other key energy players such as Centrica, Total and BP. In addition, pre-existing sectors within the Humber LEP (e.g. manufacturing) could benefit from construction, and operation and management of Hornsea Three.
- 7.11.1.6 There are several possible impact scenarios which will be assessed in the Environmental Statement. The impact scenarios will vary assumptions in the amounts of goods and services sourced from the LEP areas or the UK as a whole. The research on the nature and strengths of offshore supply chains in the UK is ongoing with the assistance of DONG Energy and other stakeholders, and so the assessment of Hornsea Three on main economic and labour market receptors is not presented in this chapter, as is limited to the assessment of effects on tourism activity.
- 7.11.1.7 The chapter has provided the assessment of effects of Hornsea Three on tourism volume and value, which will not be dependent on the UK content evidence. The assessment identified potential adverse impacts on tourism activity, however, these impacts are not expected to be significant in EIA terms.

## 7.12 Inter-related Effects (Onshore)

- 7.12.1.1 The EIA for Hornsea Three has also assessed the potential for inter-related effects to arise. Inter-related effects are defined as multiple effects upon the same receptor arising from Hornsea Three. These occur either where a single effect acts upon a receptor over time to produce a potential additive effect or where a number of separate effects interact to affect a single receptor, for example noise and vibration, visual effects and traffic related impacts for people living in dwellings within 350 m of the Hornsea Three offshore cable corridor during the construction phase.
- 7.12.1.2 Potential inter-related effects have been identified based on the detailed assessments undertaken in the individual PEIR chapters, for example, disruption, visual effects and noise on Public Right of Way (PRoW) users. However, given the temporary and small scale nature of effects, and also factoring in proposed measures adopted as part of the project, the overall significance of any inter-related effects was not judged to increase the individual effects assessed in the topic-specific chapters.

## 8. References

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