



Hornsea Offshore Wind Farm Project One

Environmental Statement

Non-Technical Summary

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SMart Wind Limited

**Hornsea Offshore Wind Farm
Project One – Environmental Statement**

Non-Technical Summary

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1 INTRODUCTION

1.1 Purpose of this Document

- 1.1.1 SMart Wind Ltd (hereinafter referred to as SMart Wind) is promoting the development of Project One, comprising up to three offshore wind farms in the Round 3 Hornsea Zone located in the southern North Sea. The joint applicants for the Development Consent Order (DCO) for Project One are Heron Wind Limited, Njord Limited and Vi Aura Limited (jointly referred to as 'the Developer'). These companies are owned jointly by Mainstream, Siemens and DONG Energy.
- 1.1.2 Project One will have a maximum generating capacity of 1,200 megawatts (MW). Project One will therefore, be an offshore generating station with a capacity of more than 100 MW and will be a Nationally Significant Infrastructure Project (NSIP). As such, there is a requirement to submit an application for development consent to the Planning Inspectorate (PINS) (in order to obtain a DCO).
- 1.1.3 This document provides a Non-Technical Summary (NTS) of the Environmental Statement prepared for Project One within the Round 3 Hornsea Zone (the Hornsea Zone). The NTS provides details of Project One, as well as a description of the existing environment in and around Project One. The NTS also presents the key conclusions of the Environmental Impact Assessment (EIA) undertaken for Project One.
- 1.1.4 This NTS is intended to act as a stand-alone document that will provide sufficient information on the environmental effects of the proposed development without having to refer to the Environmental Statement. However, for more detailed information, the full Environmental Statement should be referred to.

1.2 Project One

- 1.2.1 Project One is the first proposed development within the Hornsea Zone (see Figure 1.1). Project One will constitute up to three offshore wind generating stations with a total capacity of up to 1,200 MW and will include all associated offshore and onshore infrastructure.
- 1.2.2 For the purposes of the assessment, the area within the Hornsea Zone in which turbines and inter-array cabling, as well as associated infrastructure for Project One will be placed, has been labelled 'Subzone 1'. Subzone 1 is located in the centre of the Hornsea Zone, 103 km from the coast of the East Riding of Yorkshire and 43.6 km from the median line between United Kingdom (UK) and Dutch Waters. Power will be transferred onshore via an export cable, along which there may be a need for an offshore High Voltage Alternating Current (HVAC) reactive compensation substation depending on the final project design.

- 1.2.3 Further details of the project are provided under the "Project Details" sub-heading below.

1.3 The Developer

- 1.3.1 The promoter of Project One is SMart Wind, which is a 50/50 joint venture between International Mainstream Renewable Power (Offshore) Limited (IMRPOL) and Siemens Project Ventures GmbH (SPV).
- 1.3.2 IMRPOL is a group company of Mainstream Renewable Power Limited (Mainstream). Mainstream is a leading developer of large scale renewable energy projects that accelerate global progress towards a sustainable future. Siemens Project Ventures is a group company of Siemens Financial Services GmbH. Siemens is a global powerhouse in electronics and electrical engineering, operating in the industry, energy, healthcare and infrastructure sectors.
- 1.3.3 SMart Wind was established specifically for promoting the development of the Hornsea Zone, within which Project One is located.
- 1.3.4 In December 2011, SMart Wind entered into a partnership with DONG Energy, whereby DONG Energy acquired a 33.3% stake in Project One. DONG Energy is one of the leading energy groups in Northern Europe, having invested £3 billion in UK renewables since 2005. They operate a number of offshore wind farms in the UK, including the current largest offshore wind farm in the world, London Array. DONG Energy's business is based on procuring, producing, distributing and trading in energy and related products in Northern Europe.
- 1.3.5 The joint applicants for the DCO for Project One are Heron Wind Limited, Njord Limited and Vi Aura Limited (hereafter jointly referred to as 'the Developer'). These companies are owned jointly by Mainstream, Siemens and DONG Energy. The application for development consent for Project One has been compiled and consulted on by SMart Wind on behalf of 'the Developer'.

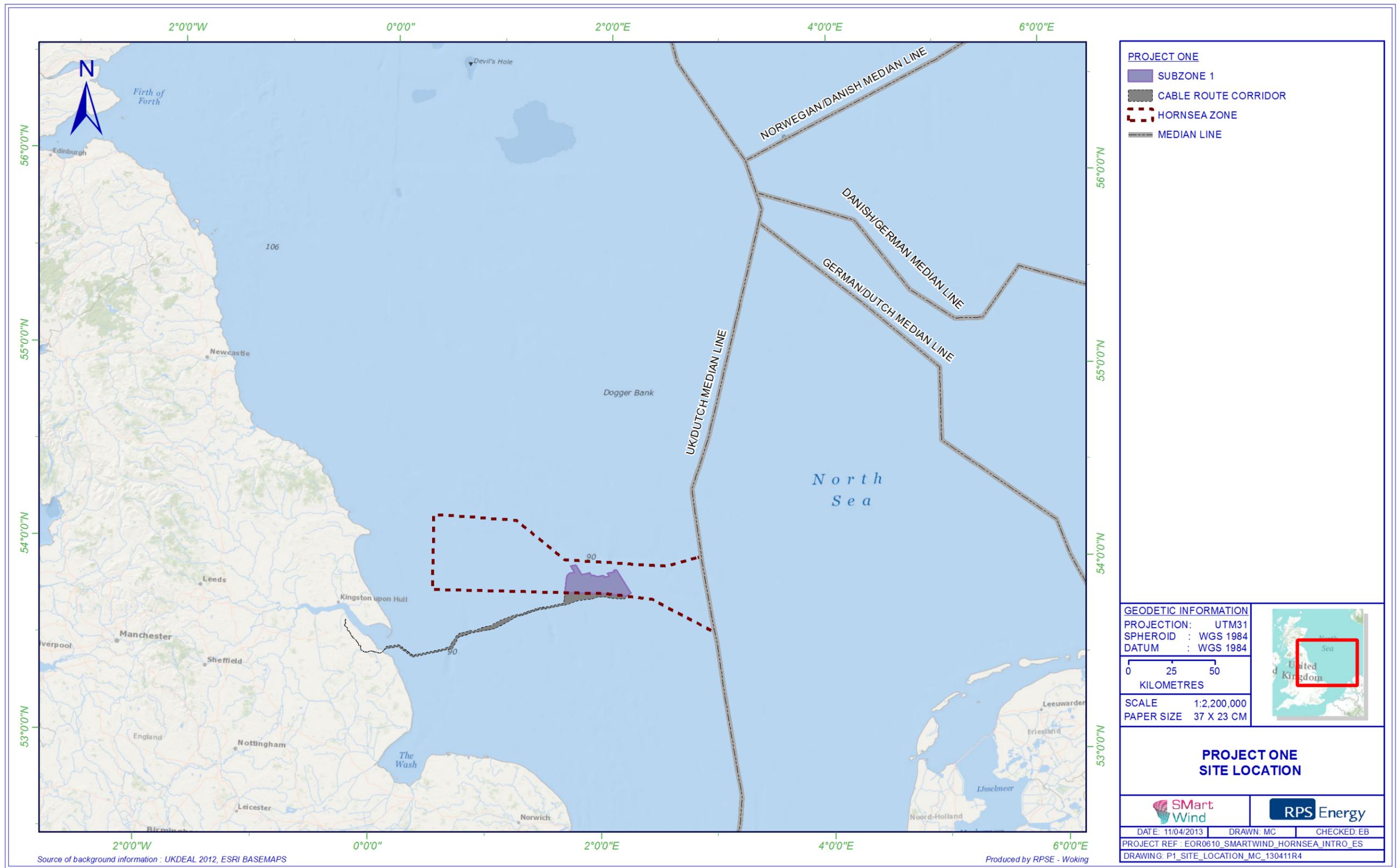


Figure 1.1 Overview of location of Project One (offshore and onshore project boundaries).

2 NEED FOR PROJECT ONE AND POLICY FRAMEWORK

- 2.1.1 The UK has been set a mandatory national target of achieving 15% of energy consumption to be sourced from renewable energy by 2020, through the European Council Directive 2009/28/EC on the promotion and use of energy from renewable energy sources (Renewable Energy Directive).
- 2.1.2 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, July 2010;
 - UK Renewable Energy Strategy (RES; DECC, 2009a);
 - UK Low Carbon Transition Plan (DECC, 2009b);
 - The Renewable Energy Roadmap (DECC, 2012); and
 - The UK Carbon Plan (DECC, 2011a).
- 2.1.3 The central objective of the Government's 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.
- 2.1.4 The need for this infrastructure is fully recognised in many areas of Government policy. On 29 November 2012, the Energy Bill was also introduced to the House of Commons. The Energy Bill 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.
- 2.1.5 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).
- 2.1.6 NPS EN-3 and NPS EN-5 identify certain environmental topic-specific policy considerations. Where relevant, these are outlined within the Environmental Statement chapters.

3 CONSENTING

- 3.1.1 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 infrastructure. Project One is defined as an NSIP, as it will be an offshore generating station with a capacity of greater than 100 MW.
- 3.1.2 Permission to build and operate an NSIP is given in a DCO, granted by PINS in accordance with the policy framework provided in the NPSs. The application will cover all offshore and onshore works. A draft deemed Marine Licence has been included in the draft DCO, which has been developed via consultation with statutory bodies including the Marine Management Organisation (MMO).
- 3.1.3 The draft DCO for Project One also includes provisions related to a number of additional consents, for example, works near watercourses, street work licences, traffic regulation orders, compulsory powers for acquisition of land and rights, removal of hedgerows and the Humber Conservancy Act 1905. In addition to the DCO, a number of additional consents may be required by the Developer to enable the full development of Project One.
- 3.1.4 Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (EIA Directive) 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 2009 (EIA Regulations) implement the EIA Directive for consent applications made under the Planning Act 2008. However, 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 has therefore, been undertaken for Project One and an Environmental Statement produced, of which this NTS forms a part.

4 CONSULTATION PROCESS

- 4.1.1 Under the Planning Act 2008, it is the responsibility of the developer to ensure that pre-application consultation fully accords with the requirements of the Planning Act 2008 and associated regulations (including the EIA Regulations) and guidance.
- 4.1.2 Consultation with statutory consultees has been undertaken on a regular basis throughout the development of proposals for Project One, with a four-stage statutory consultation programme devised following guidance from the Department for Communities and Local Government (DCLG). This phased approach allowed for an iterative design process, in which consultees were able to observe the project changes in response to their feedback.
- 4.1.3 As well as statutory consultation, informal consultation also took place throughout the pre-application period, which included detailed discussions with a number of technical consultees with specialist knowledge of certain topic areas.
- 4.1.4 In summary, the following key phases of consultation have been undertaken by the Developer for Project One, with each phase lasting 42 days:
- Phase 1 Consultation (March to April 2011) – consultation on the overall project and broad onshore cable route corridors. Involved consultation with prescribed bodies and 11 consultation events attended by over 200 people (Figure 4.1);
 - Phase 2 Consultation (November to December 2011) – consultation events were organised at eight of the venues used for Phase 1, based on their location along the refined onshore cable route corridor. Feedback from Phase 2 enabled the Developer to select a preferred site for the onshore High Voltage Direct Current (HVDC) converter station and HVAC substation from four options proposed;
 - Phase 3 Consultation (August to September 2012) – by correspondence only, to the prescribed bodies consulted during Phases 1 and 2. A Preliminary Environmental Information Report (PEIR) detailing EIA works completed to that point was issued to all stakeholders for review and comment; and
 - Phase 4 Consultation (January to March 2013) – final stage of consultation for Project One. Final drafts of the main documents and reports that would accompany the application for a DCO, including a Draft Environmental Statement, were issued to all prescribed bodies. A series of consultation events were held in February 2013, at the same locations used for Phase 2 Consultation.
- 4.1.5 Further detail on the consultation that has been undertaken to date, is set out in a separate Consultation Report which has been submitted alongside the final Environmental Statement as part of the DCO application.

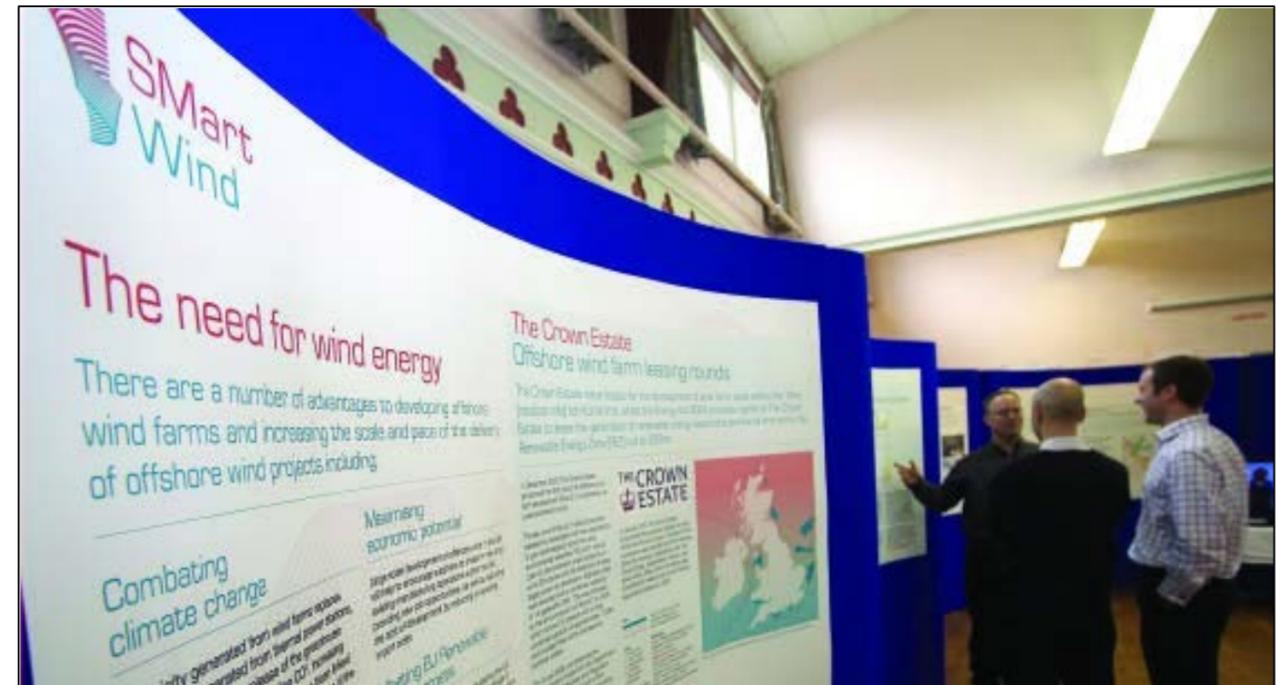


Figure 4.1 Project One Phase 1 consultation event.

5 SITE SELECTION AND ALTERNATIVES

- 5.1.1 The site selection process for Project One was a detailed exercise, involving a wide range of stakeholders and relying on feedback from the formal consultation stages outlined above in Section 4.
- 5.1.2 For Project One, 16 discrete stages were involved in the site selection, starting with the overall identification of the Hornsea Zone by The Crown Estate, which itself drew upon the findings of the Offshore Energy Strategic Environmental Assessment undertaken by Department for Energy and Climate Change (DECC) in 2009 (DECC, 2009c).
- 5.1.3 The identification of individual projects, including Subzone 1 (area in which turbines and inter-array cabling, as well as associated infrastructure for Project One will be placed), within the Hornsea Zone was undertaken by the process of Zone Appraisal and Planning (ZAP) which is a non-statutory strategic planning process recommended by The Crown Estate specifically for Round 3. SMart Wind carried out a ZAP to optimise the use of the Hornsea Zone and to ensure that all proposed works were delivered safely, efficiently and with minimum impact for stakeholders and the environment.
- 5.1.4 The offshore boundary to delineate the location of offshore wind turbines, within Subzone 1, for Project One was identified by SMart Wind through an analysis of engineering, environmental, economic and consenting risks and constraints. Key factors considered at this stage of the site selection process involved water depth, distance from shore, human constraints (such as existing subsea infrastructure, surface structures commercial fishing, military, aviation and nature conservation designations and shipping densities) and biological constraints.
- 5.1.5 Subsequent stages in the site selection process for Project One involved the identification of individual areas within Subzone 1 (for up to three offshore wind farms), the onshore grid connection point, a cable route corridor for the onshore and offshore export cable (and associated landfall) and a location for either an onshore HVDC converter station or HVAC substation (depending upon the electrical transmission option chosen, see paragraph 6.1.7 to 6.1.10 for further information).
- 5.1.6 Constraints analysis and engineering appraisals informed the location of potential landfall locations, from which options for offshore and onshore cable route corridors were identified. Based on the outcomes of the commercial, technical and environmental appraisals and early stakeholder consultation, three offshore and onshore cable route corridor options were defined.
- 5.1.7 A final broad cable route corridor was then selected following a review of data from onshore ecological surveys, further engineering and environmental appraisals and feedback from the consultation process (Figure 5.1).
- 5.1.8 The potential locations identified for the onshore HVDC converter station or HVAC substation were also informed by feedback received during the Project One consultation, in addition to consideration of technical, environmental and planning issues and also discussions with landowners. A short-list of four sites were identified with the final decision on the preferred location based on commercial, environmental, planning and engineering/technical criteria (Figure 5.1).

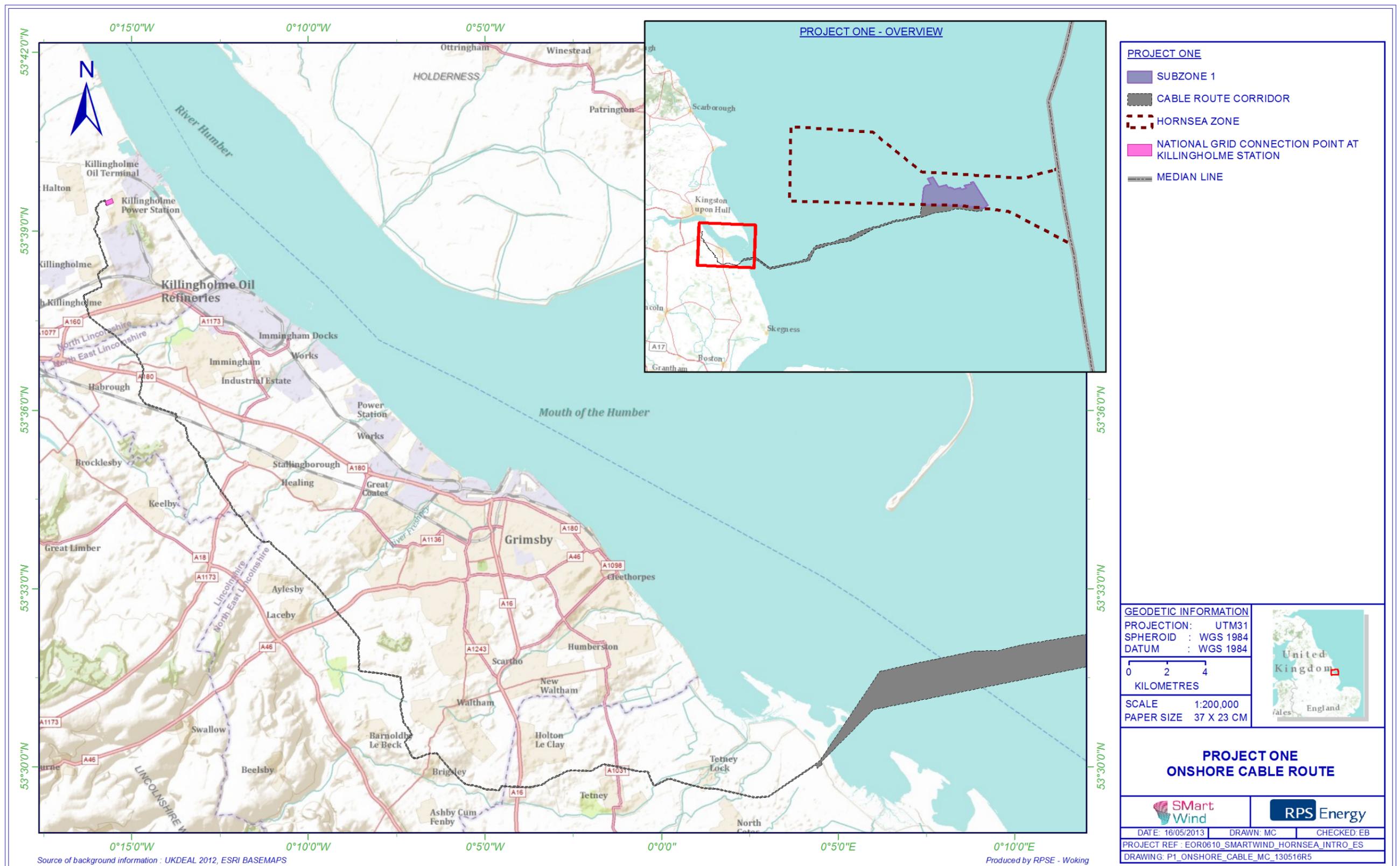


Figure 5.1 Project One onshore cable route and HVDC converter/HVAC substation.

6 PROJECT DETAILS

- 6.1.1 Project One will constitute up to three offshore wind generating stations with a total capacity of up to 1,200 MW and will include all associated offshore and onshore infrastructure.
- 6.1.2 For the purposes of Project One, the area within the Hornsea Zone in which turbines and inter-array cabling, as well as associated infrastructure such as offshore HVAC collector substations, offshore HVDC converter stations and offshore accommodation platforms will be placed, has been labelled 'Subzone 1'. Subzone 1 is located in the centre of the Hornsea Zone and has a total area of 407 km².
- 6.1.3 Key components of the proposed Project One include:
- Wind turbine generators (hereinafter referred to as 'turbines');
 - Turbine foundations;
 - Offshore cabling (comprising inter-array, export and platform interconnecting cables);
 - Offshore accommodation platforms;
 - Onshore cabling; and
 - HVAC or HVDC infrastructure (see paragraph 6.1.8 to 6.1.10 for further information).
- 6.1.4 The Design Envelope for Project One includes up to 332 wind turbine generators with capacities ranging from 3.6 MW up to 8 MW. Maximum blade tip heights of 200 m above Mean High Water Springs (MHWS) have been assessed along with a maximum rotor diameter of 178 m (see Figure 6.1).
- 6.1.5 Given the range of wind turbine generators under consideration, it has not been possible to specify a single layout within the application. However, a number of turbine layout principles have been provided which govern the different permutations of spacing and layout arrangements of turbines that have been assessed within the Environmental Statement.

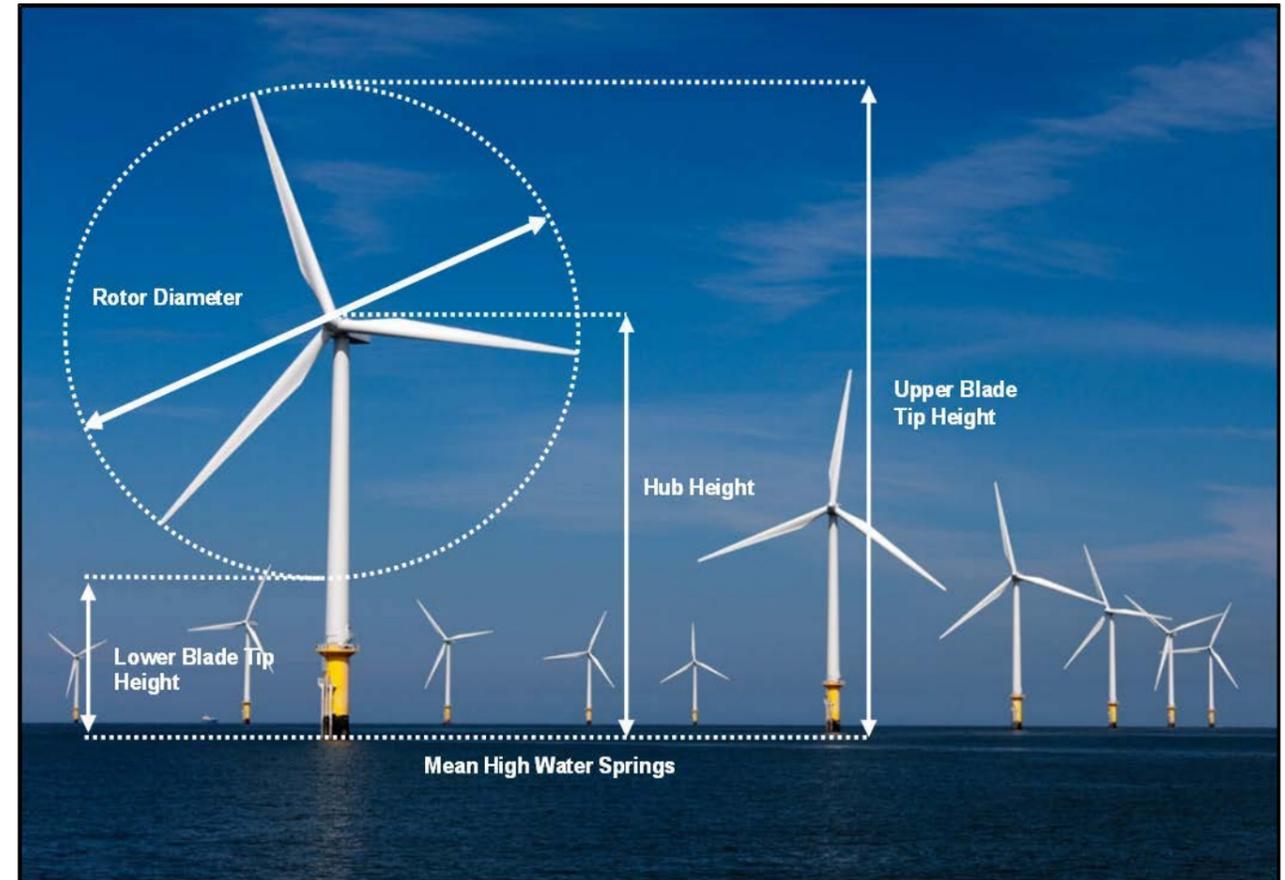


Figure 6.1 Wind turbine parameter terminology.

- 6.1.6 The offshore cable route corridor for Project One extends from the proposed landfall at Horseshoe Point in Lincolnshire, offshore in a north-easterly direction to the southern boundary of Subzone 1. The corridor is approximately 150 km in length.
- 6.1.7 From the proposed landfall point at Horseshoe Point, onshore cables will connect the offshore wind farms to the onshore HVAC substation/HVDC converter station which will in turn, connect to the existing National Grid substation at North Killingholme in North Lincolnshire district, a distance of approximately 40 km.
- 6.1.8 The Developer is proposing to transmit the electricity generated either via buried, High Voltage (HV) cables using either Direct Current (DC) or Alternating current (AC). As a consequence, depending on the option selected, the proposed project will have slightly different key components in addition to those listed above (Figure 6.2).

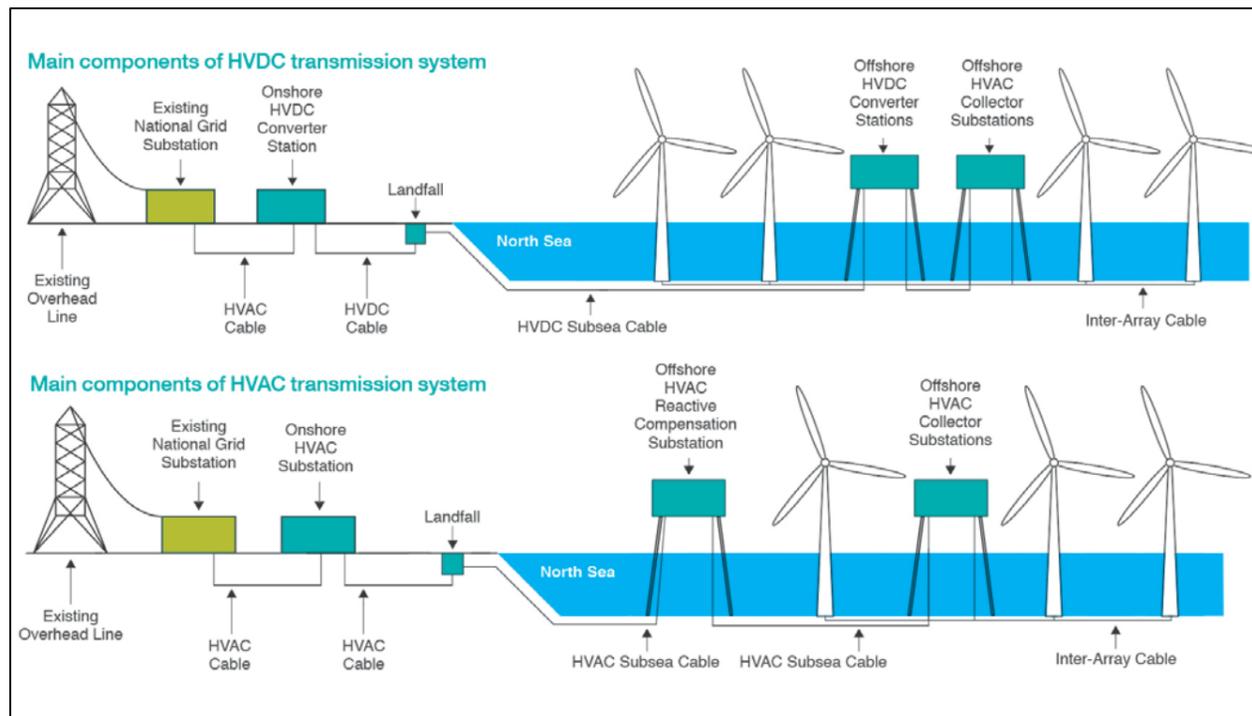


Figure 6.2 Main components of HVDC and HVAC transmission options for Project One.

6.1.9 Where the HVDC project design is taken forward, the key components will also include;

- Offshore HVAC collector substations (Figure 6.3);
- Offshore HVDC converter station(s); and
- Onshore HVDC converter station (Figure 6.4).

6.1.10 Where the HVAC option is taken forward, the key components will also include:

- Offshore HVAC collector substation(s);
- Offshore HVAC reactive compensation substation; and
- Onshore HVAC substation (Figure 6.4).

6.1.11 If the application for development consent is successful, construction is proposed to commence in 2015 and may be undertaken in either a single or multiple (up to three) phases. Onshore construction is anticipated to take up to 36 months, delivered over one, two or three phases, over a period of five years.

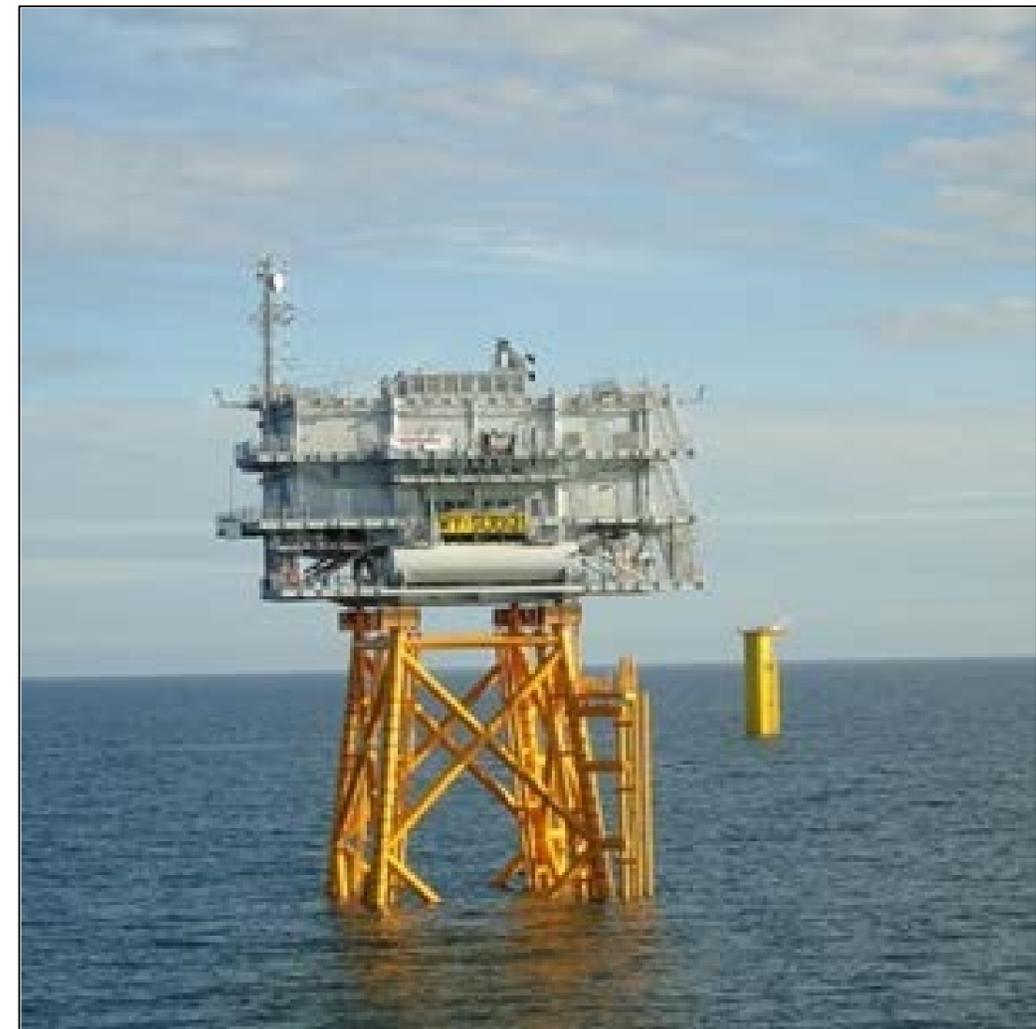


Figure 6.3 Typical offshore HVAC collector substation.

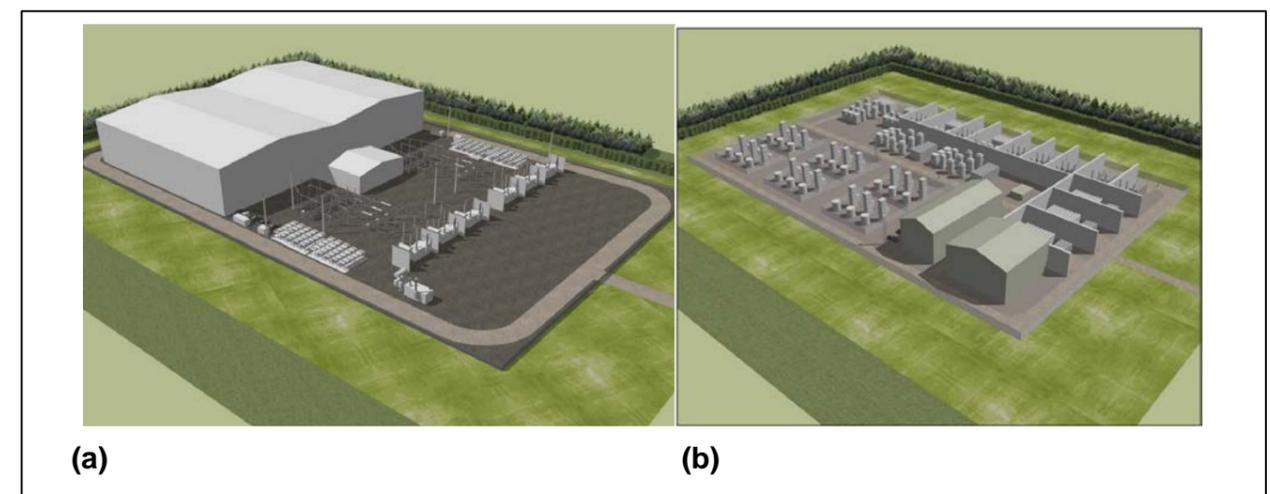


Figure 6.4 Visual representation of an indicative worst case (a) onshore HVDC converter station and (b) onshore HVAC substation.

7 ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY

7.1 Introduction

- 7.1.1 The EIA required to accompany the DCO application for Project One has been undertaken by SMart Wind, as promoter of Project One, in accordance with all appropriate legislation and guidance.
- 7.1.2 A Scoping Request, supported by a Scoping Report (SMart Wind, 2010), for Project One was submitted in November 2010 with a Scoping Opinion provided in December 2010 (IPC, 2010). A Second Scoping Opinion was provided by PINS in May 2012 (PINS, 2012) following the submission of a Scoping Report Addendum by SMart Wind (SMart Wind, 2012). Advice and information provided in these formal Scoping Opinions was used to inform the EIA for Project One.
- 7.1.3 The EIA for Project One describes the likely effects on the environment arising from the construction, operation and decommissioning of the project and, where significant impacts are predicted, where possible it identifies mitigation to reduce the significance of these impacts.

7.2 Design Envelope

- 7.2.1 In order to ensure that the full range of potential development options being considered (i.e., the Design Envelope) are fully assessed within the EIA, the worst-case scenario for every project component (foundations, turbines, cables etc.) was assessed for each impact assessment (see Section 6 for details of the Design Envelope considered for Project One). This is intended to allow meaningful assessments of Project One to proceed, whilst still allowing reasonable flexibility for future project design parameters.
- 7.2.2 The use of the Design Envelope approach has been recognised in 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.

7.3 Environmental Baseline Conditions

- 7.3.1 The EIA was informed by a number of project-specific data collection surveys and studies intended to characterise the site. This allows the existing environment to be fully described so that potential impacts on this environment could be considered.
- 7.3.2 Key offshore surveys undertaken include geophysical surveys of Subzone 1 and the export cable route corridor to gather data on seabed conditions and sediments, oceanographic surveys to gather data on wave and tidal conditions, marine ecological surveys to identify key seabed communities and surveys of fish, birds and marine mammals.
- 7.3.3 Onshore surveys include ecological surveys (bird, bat, and reptile), archaeological surveys, and landscape and visual assessments.

7.4 Measures Adopted as Part of the Project

- 7.4.1 SMart Wind has elected to undertake the Project One assessment using 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 Project One design.
- 7.4.2 The iterative approach to EIA employed in this Environmental Statement, as outlined in Figure 7.1, 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 then made to relevant project parameters in order to reduce the magnitude of that impact.
- 7.4.3 In select cases, additional mitigation measures have been outlined within the topic chapters. This includes mitigation measures where:
- The threshold of significance of effect has been reached (i.e., where an impact is significant in EIA terms) when including designed in mitigation measures, but there are additional mitigation measures available to reduce the level of effect; or
 - Mitigation has been proposed but has not yet been confirmed (i.e., awaiting sign-off from regulators, stakeholders etc.) as agreed mitigation.

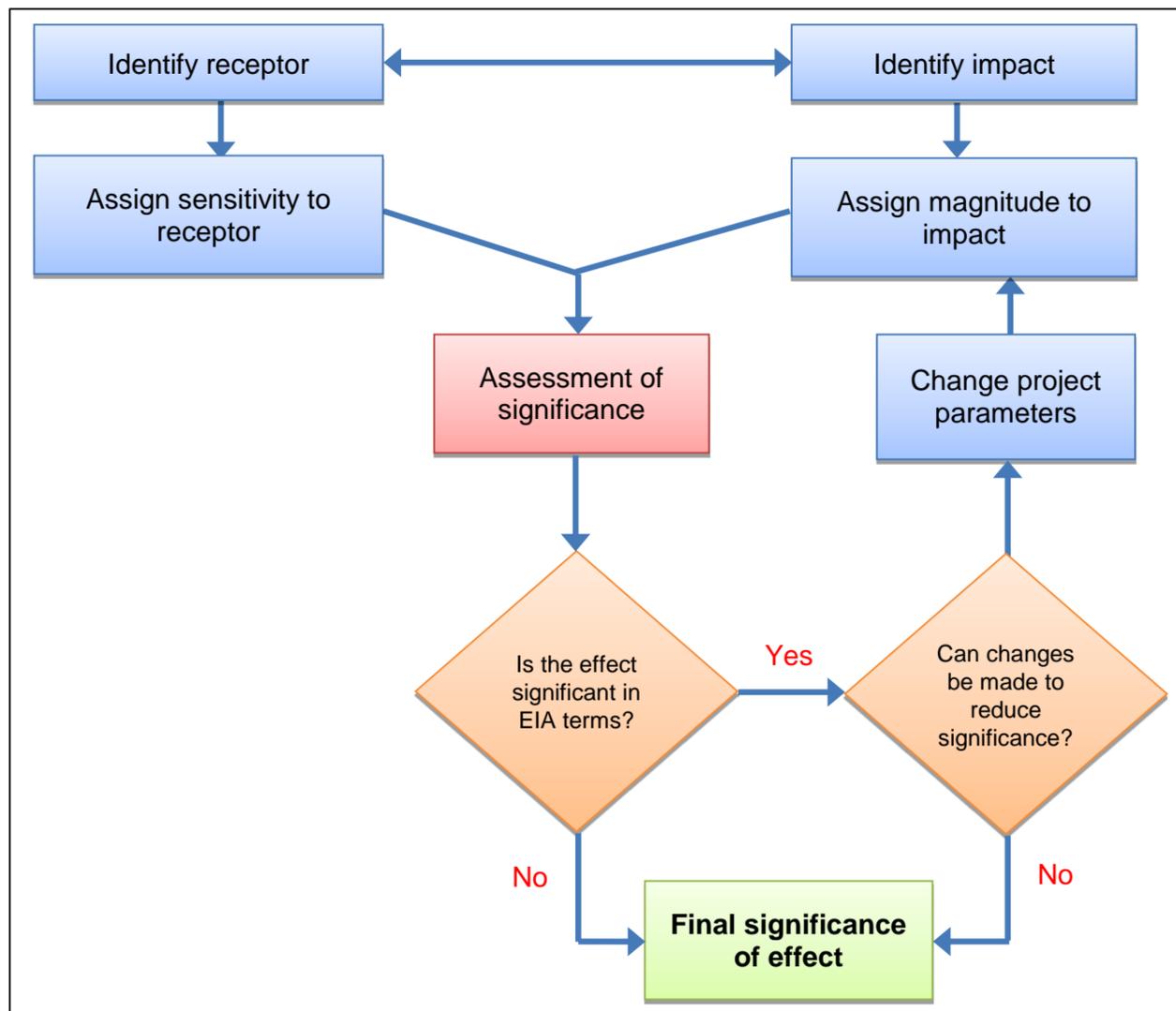


Figure 7.1 Iterative approach to mitigation within the Project One EIA.

7.5 Assessment of Effects

7.5.1 Data from project-specific surveys and studies was used to inform the impact assessment stage of the EIA so that site-specific issues were identified and addressed. The magnitude of each impact, defined by the spatial extent, duration, frequency and reversibility of the impact was identified. The sensitivity of receptors was then determined, based on the vulnerability, recoverability and value/importance of each receptor. The overall significance of effect was 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 7.1 below. Where a differing methodology is required in a specific topic assessment, the methodology has been explained within the Environmental Statement chapter.

7.5.2 The Environmental Statement 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 were considered 'significant' in EIA terms (where this differs for specific assessments, this is explained within the appropriate Environmental Statement chapters). Where impacts are considered significant in EIA terms, this will normally trigger additional analysis, consultation and possibly further mitigation measures, where possible. When the 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.

7.5.3 The EIA also included a full consideration of potential cumulative, transboundary and inter-related effects. With respect to cumulative impacts, the potential for Project One to interact with other developments in the southern North Sea (including other wind farm projects) was assessed and the significance of any effects identified. The significance of transboundary impacts were also defined using the matrix approach outlined above. The significance of inter-related effects was not assigned; rather the scope for the significance of existing individual effects to be increased via inter-related effects was assessed.

Table 7.1 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 may be important, but are not likely to be key decision-making factors. 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.

7.6 Environmental Statement

7.6.1 The outcomes of the EIA for Project One are presented within the Environmental Statement, of which this NTS forms a part. The Project One Environmental Statement includes a description of the project, the main alternatives studied by the applicant and an indication of the main reasons for site selection, a description of aspects of the environment likely to be significantly affected and any inter-relationships between different environmental parameters. The likely significant effects of the development on the environment are also included in the Project One Environmental Statement together with a description of the measures envisaged to prevent, reduce and, where possible, offset any significant adverse effects.

8 POTENTIAL ENVIRONMENTAL IMPACTS (OFFSHORE)

8.1 Introduction

8.1.1 The EIA process has assessed the potential for the construction, operation and decommissioning of Project One to create impacts upon the offshore environment, as characterised by the review and analysis of site-specific data collected from the surveys outlined above (see Section 7.3), peer reviewed papers, desk based studies and modelling of specific parameters.

8.2 Marine Processes

8.2.1 Marine processes is a collective term for:

- Marine and seabed physical processes;
- Geology and geomorphology (physical features on the surface of the earth);
- Hydrodynamics (the mechanical properties of fluids);
- Seabed sediments;
- Bathymetry (the measurement of water depths); and
- Tides and waves.

8.2.2 Marine processes were characterised by a review of relevant past projects and publicly available information, and a metocean campaign which collected monitoring data on tidal heights, currents, waves, suspended sediment concentrations and meteorological parameters.

8.2.3 Water flows across Subzone 1 and the cable route corridor are tidally dominated. On the east coast, as in many other parts of the UK, westerly and south-westerly winds are the most frequent; however, during the winter and spring, winds from the northeast and east sectors are common. The wave regime is highly episodic and exhibits strong seasonal variation. In deep water, waves will move across the sea surface without major modification, but as they move into shallower water, refraction, shoaling (wave steepening) and eventually wave breaking will occur. Across the many shallow banks of the southern North Sea, maximum wave heights are also likely to become 'depth limited' with shoaling and wave breaking occurring, especially around low tide.

8.2.4 Depths within Subzone 1 and the survey area range from approximately 20 to 57 m below lowest astronomical tide. The majority of the water depths within Subzone 1 are shallow with depths of less than 30 m. From the landfall at Horseshoe Point, water depths gradually increase to around 30 m, peaking at 63 m where the cable route crosses the northern extent of Silver Pit. Within Subzone 1 the dominant

sediment types identified are sand, gravelly sand and sandy gravel. The thickness of the surficial sediments along the cable route corridor is generally less than 1 m and in places only tens of centimetres. This veneer of surficial sediments predominantly comprises sand, gravelly sand and sandy gravel, often with shell fragments present. Values of suspended sediment in the summer are generally low in offshore areas – typically 0 to 10 mg/l, although background turbidity levels during winter in the southern North Sea can reach over 30 mg/l. Closer to the shore within areas like The Wash and the Humber, background suspended sediment concentrations are generally higher (e.g., > 300 mg/l in the Humber Estuary).

- 8.2.5 In carrying out an impact assessment, marine processes are not in themselves receptors in all cases, but changes to these processes may have an impact on sensitive receptors. Therefore, the impact assessment within this subject describes the potential changes to marine processes due to Project One, but does not provide a significance level in all cases.
- 8.2.6 A number of potential effects on marine processes, associated with the construction, operation and decommissioning of Project One, were identified. These included increased suspended sediment concentrations and deposition, changes to seabed morphology and hydrodynamics, and changes to the wave regime.
- 8.2.7 The installation of WTGs will temporarily increase suspended sediment concentrations and will result in temporary deposition of fine material on the seabed. During seabed preparation for gravity base foundations and drilling of monopiles, increases in suspended sediment concentrations were predicted to increase by up to 20 mg/l above background levels for a period of up to 24 hours which, in the context of background levels, is considered to be a short-term and small scale effect. Predicted levels of associated sediment deposition are very low (less than 20 mm).
- 8.2.8 Effects of the presence of WTGs and associated offshore infrastructure on the wave regime during operation have been investigated to predict associated potential impacts along adjacent shorelines. The greatest magnitude of impact occurs when waves are coming from a northerly direction. However, as the impact is of limited spatial and temporal extent, the magnitude is considered to be negligible. As the effects of Project One on the wave climate are considered to be of negligible magnitude, the effects on the shoreline will be of **negligible** significance (not significant in EIA terms).
- 8.2.9 The installation of the export cable route at the landfall has the potential to affect the beach morphology, hydrodynamics and sediment transport (littoral drift). The effects of the installation of the cable route at the landfall are considered to be of low magnitude and the effects on the shoreline will be of **negligible** significance (not significant in EIA terms).

- 8.2.10 Cumulative effects from aggregate extraction activities and other offshore wind farm developments were assessed and predicted to result in minimal effects on marine processes. Potential cumulative effects of changes to the wave regime resulting from the operational presence of Project One and Project Two are predicted to result in small-scale changes to drift rates at the coast. The effects on the shoreline will be of **minor adverse** significance (not significant in EIA terms).
- 8.2.11 Transboundary effects with respect to tidal currents, wave regime and sediment regime are considered to be of **negligible** significance (not significant in EIA terms).

8.3 Benthic Subtidal and Intertidal Ecology

- 8.3.1 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 the Project One site was characterised via a series of site-specific surveys using grab sampling, underwater video and fish trawls.
- 8.3.2 These surveys indicated that the seabed within Project One 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 sediment supporting a range of species such as catworms, sea urchins and amphipods, as well as deeper, fine sand habitats characterised by marine worms. 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 8.1).

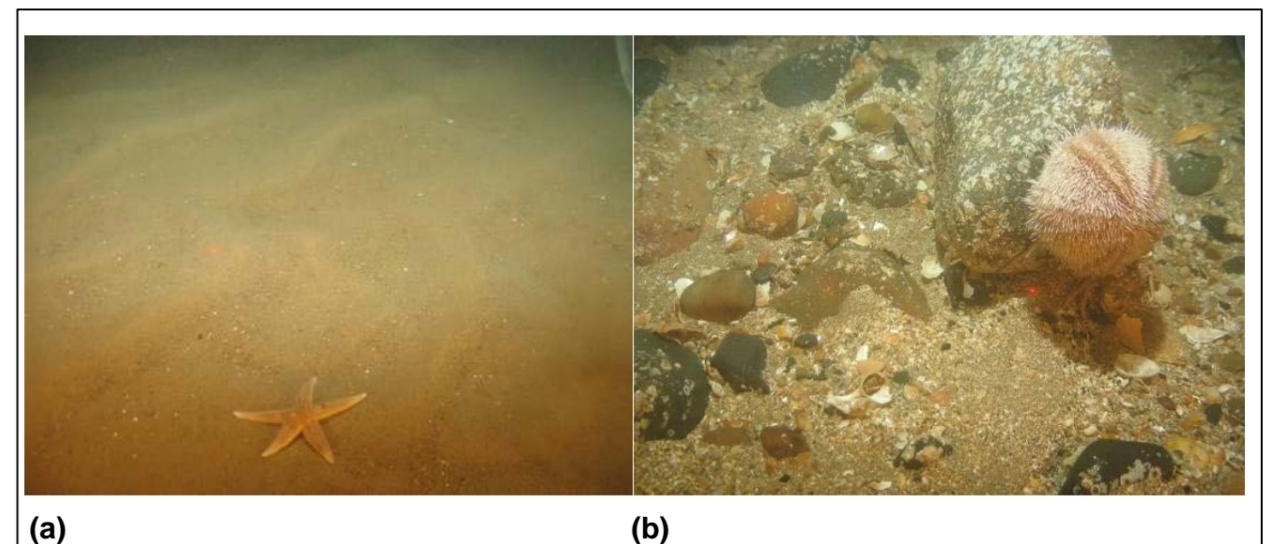


Figure 8.1 Species recorded during the underwater video survey of the Project One site included (a) common starfish and (b) edible sea urchin.

- 8.3.3 The majority of the intertidal site, where the offshore export cables will make landfall, contained habitats that are all features of the Humber Estuary Special Area of Conservation (SAC).
- 8.3.4 A number of potential impacts on benthic subtidal and intertidal communities/species, associated with the construction, operation and decommissioning of Project One, were identified. These included increased suspended sediment concentrations and deposition and temporary habitat disturbance, and long term habitat loss, introduction of new habitat and habitat disturbance via scour and vessel activities during operation. With the proposed mitigation measures in place, the majority of these impacts result in effects of either **negligible, minor adverse** or **minor beneficial** significance (not significant in EIA terms).
- 8.3.5 Temporary and long term habitat loss/disturbance was deemed to be of **minor adverse** significance (not significant in EIA terms) to benthic receptors in the benthic ecology study area, as the proportion of habitat lost is predicted to be small in the context of available habitats in the southern North Sea.
- 8.3.6 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 within Project One, on the assumption that mitigation to avoid direct impacts to these features will be implemented. The majority of the effects on intertidal Annex I habitats in the Humber Estuary SAC area, including the effects of increased suspended sediment concentrations, deposition and associated contaminant resuspension, were assessed as being of **minor adverse** significance (not significant in EIA terms).
- 8.3.7 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.
- 8.3.8 No transboundary effects with regard to benthic subtidal and intertidal ecology from Project One on the interests of other EEA States were predicted.

8.4 Fish and Shellfish Ecology

- 8.4.1 The fish and shellfish ecology of the Project One site was characterised via a desktop study and a series of site-specific fish trawl surveys (such as otter trawls, see Figure 8.2), in the subtidal and intertidal parts of Project One, as well as shellfish surveys along the export cable route corridor.

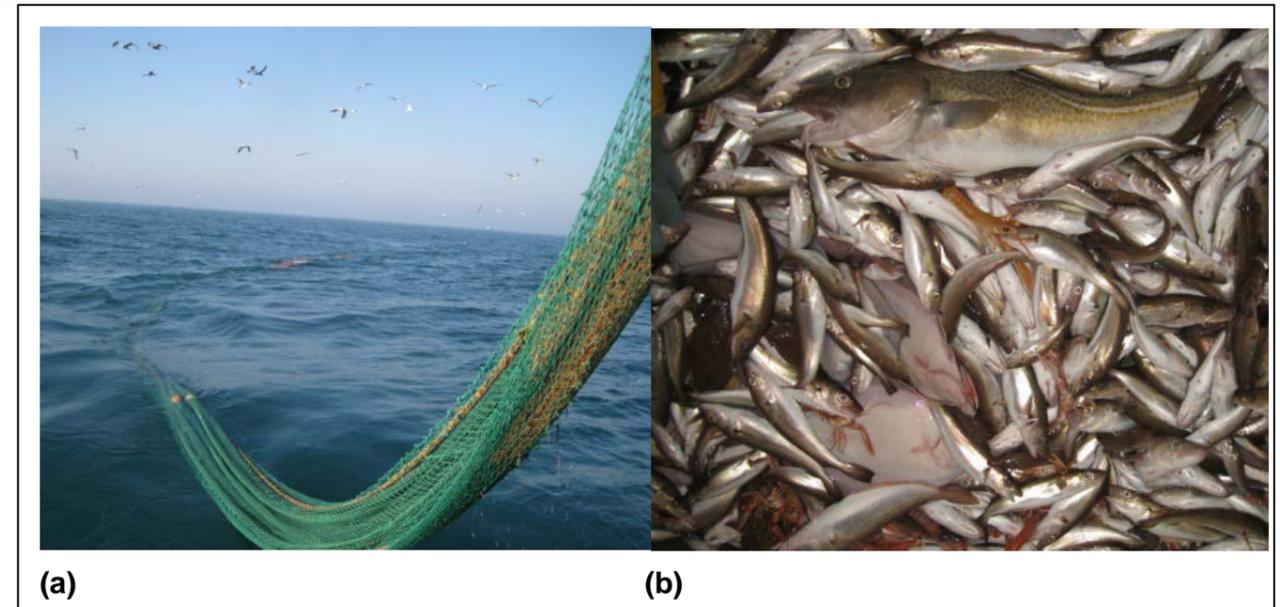


Figure 8.2 (a) Commercial otter trawl being deployed for fish surveys and (b) typical catch from otter trawl survey.

- 8.4.2 These surveys indicated that the fish and shellfish communities recorded within Project One are typical of the southern North Sea. Some of the key species recorded in abundance in the offshore parts of Project One included whiting, dab, plaice, gurnard and solenette. At the landfall site, the communities were dominated by juvenile fish, and in particular sandeels.
- 8.4.3 Spawning and nursery habitats were identified for a range of species including herring, plaice, lemon sole, dab, common sole, cod, whiting, sandeel, sprat, brown crab, European lobster and *Nephrops*. The Humber Estuary represents a particularly important nursery habitat for many of these species. The Humber Estuary was also identified as being important for migratory fish species including sea and river lamprey, Atlantic salmon, sea trout, allis and twaite shad, European smelt and European eel.
- 8.4.4 A number of potential impacts on fish and shellfish communities, associated with the construction, operation and decommissioning phases of Project One, were identified. These included underwater noise, increased suspended sediment concentrations, sediment deposition, temporary habitat disturbance, long term habitat loss, electric and magnetic field emissions from subsea cables, introduction of new habitat and potential for reduced fishing pressure during operation. With the proposed mitigation measures in place, the majority of these impacts result in effects of either **negligible, minor adverse** or **minor beneficial** significance (not significant in EIA terms).

- 8.4.5 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 Project One to lead to barrier effects on migratory fish species when transiting to/from spawning grounds in estuarine environments.
- 8.4.6 Temporary and long term habitat loss/disturbance was deemed to be of **minor adverse** significance (not significant in EIA terms) to fish and shellfish receptors, as the proportion of habitat lost was predicted to be small in the context of available habitats in the southern North Sea.
- 8.4.7 Effects associated with electric and magnetic field emissions from subsea cables was predicted to be of **minor adverse** significance (not significant in EIA terms), due to the localised spatial extent of the effects and the fact that they are not anticipated to create a barrier to migratory species.
- 8.4.8 Cumulative impacts from aggregate extraction activities, other offshore wind farms and oil and gas operations were assessed and predicted to result in effects of **negligible** to **minor adverse** significance (not significant in EIA terms) upon fish and shellfish communities.
- 8.4.9 Transboundary effects, with regards to fish and shellfish ecology, on the interests of other EEA States were predicted from Project One. 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. This has been assessed to be of **negligible** to **minor adverse** significance (not significant in EIA terms).

8.5 Marine Mammals

- 8.5.1 Site-specific boat based survey data were combined with a desktop review to describe the distribution, abundance and density of marine mammals in the Project One marine mammal study area.
- 8.5.2 These surveys identified that Project One lies within an important area for marine mammals. Harbour porpoise are the most frequently occurring species of marine mammals in Project One, with minke whale (Figure 8.3a), white-beaked dolphin, grey seal (Figure 8.3b) and harbour seal also being common. All other species of cetacean were considered rare or occasional visitors and were not taken forward in the assessment.
- 8.5.3 A number of potential impacts on marine mammals, associated with the construction, operation and decommissioning of Project One, were identified. These included underwater noise, increased vessel traffic, increased suspended sediments, changes to prey resources, accidental release of contaminants and electric and magnetic effects from subsea cables. With the proposed Marine Mammal Mitigation Protocol

(MMMP) in place (including, but not limited to, soft start for all piling activities, a 500 m buffer within which marine mammals must be absent for 30 minutes prior to commencement of piling and codes of conduct for vessel operators), these impacts, with the exception of underwater noise, were predicted to result in effects of either **negligible**, **minor adverse** or **minor beneficial** significance (not significant in EIA terms).

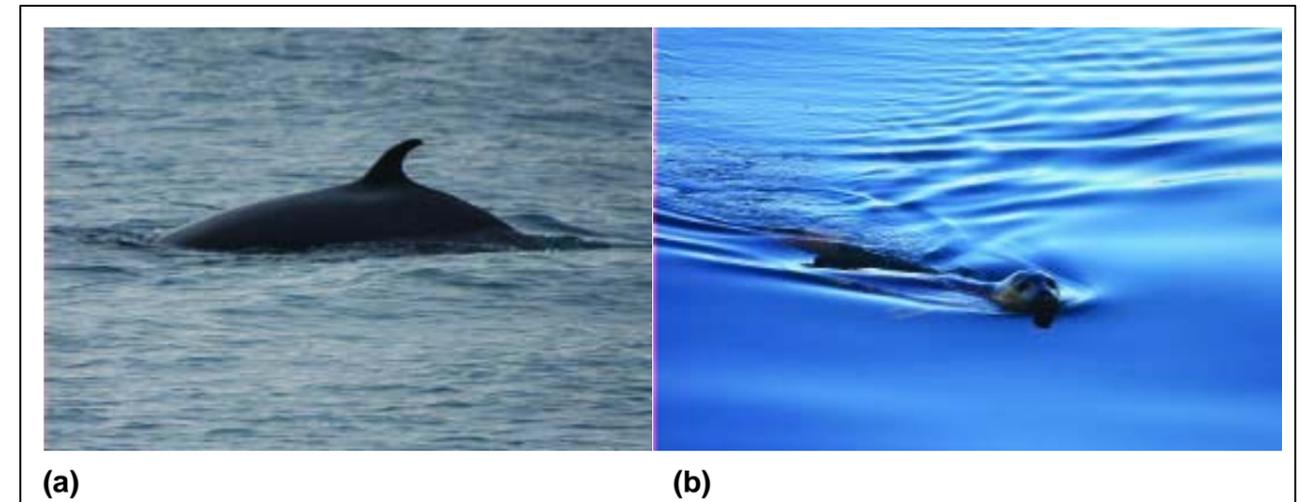


Figure 8.3 (a) Minke whale and (b) grey seal recorded during Project One marine mammal surveys.

- 8.5.4 The key impact of piling noise relates to the potential for hearing injury and/or behavioural disturbance (such as displacement from a feeding area) on marine mammals during the piling activity. Assuming a soft start at 600 kJ hammer energy is employed, the risk of causing hearing injury to marine mammals will be localised to within 200 m of the piling and will be mitigated further using marine mammal observers and passive acoustic monitoring to ensure no marine mammal are present within the buffer prior to piling. Behavioural disturbance, leading to possible displacement of animals, was predicted to occur over much larger scales for both harbour porpoise and minke whale and would last for 18 to 36 months depending upon whether single or concurrent piling was employed. Underwater noise over the short to medium-term was deemed to be of **moderate adverse** significance (significant in EIA terms) for harbour porpoise and minke whale, with the potential for recovery to baseline levels over the long-term. It is important to note that there is considerable uncertainty as to the consequence of temporary displacement of marine mammals and therefore, the assessment has taken a very precautionary approach in concluding moderate adverse effects. In recognition of this uncertainty a commitment is made to construction phase monitoring to validate predictions made and increase the knowledge base on this topic. For all other marine mammals underwater noise was deemed to be of **minor adverse** significance (not significant in EIA terms).

- 8.5.5 Increased vessel traffic during construction and the associated disturbance and collision risk to marine mammals, in particular lethal injury to seals from collision with propellers, was deemed to be of **minor adverse** significance (not significant in EIA terms) due to the tolerance of most dolphins and porpoise to vessel activity, as well as the distance between construction activities and seal pupping and haul-out sites.
- 8.5.6 Cumulative impacts from aggregate extraction activities, other offshore wind farm developments and, oil and gas installations were assessed. They were predicted to result in effects of **negligible, minor adverse** significance (not significant in EIA terms) or **moderate adverse** significance (significant in EIA terms) upon marine mammal receptors within the southern North Sea. The assessment concluded that there is the potential for significant effects on harbour porpoise, minke whale, grey seal and harbour seal due to cumulative disturbance from pile driving noise in the southern North Sea. For grey and harbour seal, the potential for significant cumulative effects of piling noise was considered only likely to occur if concurrent pile-driving took place at the majority of offshore wind farms within the area of potential impact for seals (southern North Sea) and which were scheduled for construction at similar times. As for Project One alone, uncertainties were addressed by adopting a precautionary approach throughout the assessment. Commitment to construction monitoring has been made in order to address any knowledge gaps and to allow future projects to present more realistic and informed assessment predictions. Significant impacts are not anticipated upon white beaked dolphin as a result of underwater noise.
- 8.5.7 There is also potential for effects of **moderate adverse** significance (significant in EIA terms) upon gray seal and harbour seal due to the cumulative increase in collision risk arising from an increase in vessel traffic in the North Sea. However, it is assumed that mitigation measures recommended by JNCC will be adopted by other offshore wind farms where the magnitude is **high** or **medium** (i.e., not Project One where the magnitude is **low**). As a result, the significance level will be reduced to **minor adverse** and therefore, will not be significant in EIA terms.
- 8.5.8 Transboundary effects, with regards to marine mammals, on the interests of other EEA States were predicted from Project One. Potential exists for transboundary effects for white-beaked dolphin, grey seal as a result of direct physical injury and/or behavioural disturbance as a result of underwater noise from construction piling and vessels and increased risk of vessel collision (all phases of Project One), and indirect disturbance due to changes in prey (fish) species distribution and/or abundance. This has been assessed to be of **minor adverse** significance (which is not significant in EIA terms). Potential exists for transboundary effects for harbour porpoise and minke whale as a result of direct disturbance as a result of underwater noise from construction piling. This has been assessed to be of **moderate adverse** significance in the short to medium term, although with the potential for recovery to baseline levels in the long-term, (which is significant in EIA terms).

8.6 Ornithology

- 8.6.1 Offshore ornithology describes the abundance, spatial and temporal distribution, and behaviour of the bird assemblage present within the Project One ornithology study area (including Subzone 1 and the offshore export cable route corridor up to the near-shore environment). The offshore bird assemblage was characterised via a series of site-specific boat-based surveys, and contextualised through studies of the wider area published in the scientific literature.
- 8.6.2 Results from boat-based baseline surveys indicate that the bird assemblage present is typical of that in the offshore environment of the central/eastern North Sea. 'True' seabird species dominate. Also present are some species which spend part of their annual life cycle at sea (e.g., divers and seaducks), and in small numbers a range of other species on migration both to and from the UK and continental Europe, such as waterfowl, waders and passerines. In both survey years; guillemot, kittiwake and razorbill were the three most frequently encountered species, accounting for around 75% of all records. These species were recorded in nationally-important numbers.



Figure 8.4 Fulmar (species recorded during boat-based bird surveys of Project One).

- 8.6.3 Abundances of the most frequently recorded species tended to peak during late summer and the post-breeding dispersal period (roughly August to November), which is likely to be reflective of birds from a wide variety of breeding locations moving through the site towards wintering areas. This seasonal peak also pertained to species breeding within the Flamborough Head and Bempton Cliffs Special Protection Area (SPA), including gannet, fulmar, kittiwake, and auk species (guillemot, razorbill and puffin). Migratory species (skuas, terns and little gull) peaked during autumn, with the latter recorded in potentially internationally important numbers. A number of potential impacts on the offshore ornithological assemblage, associated with the construction, operation and decommissioning of Project One, 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 (including, but not limited to, Health, Safety and Environment procedures and a Code of Common Practice during the construction period, as well as minimal lighting of turbines during the operational phase), the majority of these impacts result in effects of either **negligible**, **minor adverse**, or **minor or moderate adverse** significance (not significant in EIA terms).
- 8.6.4 Disturbance to seabird species during the construction phase was deemed to be of no more than **minor adverse** significance (not significant in EIA terms) for all receptors. Although there are relatively high peak abundances for some species within the survey area compared to regional populations, it is likely that only birds in close proximity to construction activities will be affected over a short-term period. This is particularly the case for gulls, fulmar and gannet, where evidence shows that generally individuals are unperturbed by human presence, and may even be attracted to it. Although auk species may be more sensitive, the impact is unlikely to be significant at a population level (e.g., by a reduction in survival or productivity).
- 8.6.5 Operational displacement effects caused mainly by the presence of turbines are also species-specific, with gulls in particular likely remaining unaffected. However, evidence from another study suggests that some species (e.g., auks) can be at least partially displaced from a wind farm. To assess the effect, the proportion of birds displaced, the distance of displacement from the wind farm, and the resulting seasonal additional mortality rate were determined for each receptor, using available scientific evidence, and mean peak population estimates. For gulls, fulmar and gannet, an effect of **negligible** or **minor adverse** significance (not significant in EIA terms) was predicted. Effects of **minor adverse** significance (not significant in EIA terms) were predicted for guillemot and razorbill in relation to the large reference populations, and also puffin, as it is very likely that birds from larger colonies further north are present throughout the year, thereby spreading impact across these populations.

- 8.6.6 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. Results predicted an effect of **negligible** or **minor adverse** significance (not significant in EIA terms) for most receptors, with the exception of herring gull and lesser black-backed gull which are considered to be of higher vulnerability to collisions. For these species, an effect of **minor or moderate adverse** significance (may be significant in EIA terms) was predicted, due to the higher overall sensitivity rating of the species and relatively small regional breeding populations.
- 8.6.7 The main cumulative impacts identified for offshore ornithology were operational displacement and collision mortality. A seasonal approach considered impacts on the breeding and non-breeding season populations of each receptor, based on presented values from Project One and other offshore projects' Environmental Statements within foraging range (breeding season) and along the east coast of Britain (non-breeding season). Additional mortality as a result of collisions and/or displacement reached an effect of at most **minor or moderate adverse** significance for receptors, which with additional evidence (e.g., population modelling of the regional breeding populations of key species) showed that this would not be significant to the populations. It was also noted that in the majority of these cases, Project One would contribute only a small proportion of overall mortality.
- 8.6.8 Transboundary effects of Project One on offshore ornithological receptors were considered based on potential connectivity with continental SPAs or other important bird areas such as Dogger Bank and Brown Ridge in the breeding and non-breeding seasons. No important sites were considered to be within regular foraging range of Project One 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 Project One being of lesser importance, and any impacts being short-term. No transboundary effects with regard to offshore ornithology from Project One on the interests of other EEA States were therefore predicted.

8.7 Nature Conservation

- 8.7.1 Nature conservation refers to internationally, nationally, regionally and locally designated sites with marine habitats and/or species. The offshore Nature Conservation assessment identified the sites present in the study area through a desktop review and considered the effects of Project One on these sites which included: eight UK, Dutch and German Special Areas of Conservation; 38 Special Protection Areas, of which seven are also Ramsar sites; and seven Sites of Special Scientific Interest.

- 8.7.2 All European designated sites are assessed within the Habitats Regulations Assessment under a separate process and with a separate method to the EIA, so were not assessed in the Nature Conservation chapter. The construction, operation, and decommissioning phases of Project One are predicted to result in no significant effects on any UK designated sites with benthic ecology, fish and shellfish, marine mammal or ornithological features.
- 8.7.3 Similarly, cumulative impacts from aggregate extraction activities, other offshore wind farm developments and oil and gas activities were assessed and predicted to result in no significant effects on any UK designated sites with benthic ecology, fish and shellfish, marine mammal or ornithological features.
- 8.7.4 Transboundary effects on non-UK European designated sites are considered within the Habitats Regulations Assessment (HRA). No transboundary effects on non-UK national and/or local sites outside of European designated site boundaries have been identified.

8.8 Commercial Fisheries

- 8.8.1 The commercial fisheries assessment considered the potential impacts on all the UK and European fleets that operate in the Project One study area. Extensive consultation with the relevant fleets was undertaken and available data on the landings and activities of these fleets over an 11 year period (to account for variations in activity in recent years) to establish the baseline environment.
- 8.8.2 Within Subzone 1, UK and Dutch beam trawl vessels dominate the fishery, targeting plaice and sole (Figure 8.5). There is also a distinct sandeel ground, which is historically important to Danish trawlers. A small number of UK potting vessels also target Subzone 1 as part of an offshore brown crab fishery. Other nationalities that fish across Subzone 1 to a lesser extent include Belgian, French, German and Norwegian vessels trawling for various species of fish. Fishing grounds north of Subzone 1 are fished by UK trawlers that target *Nephrops*. Fishing operations within Subzone 1 occur throughout the year.
- 8.8.3 Across the offshore export cable route corridor, UK potting vessels dominate in a brown crab and lobster targeted fishery. The export cable avoids the inner Silver Pit area, which is targeted by a range of fleets from other countries.
- 8.8.4 Potential impacts include exclusion from fishing grounds, displacement, gear snagging and ecological effects upon targets species. On the basis that the continuation of fishing activities within the array is likely, the overall effects from construction, operation and decommissioning are assessed as being of **minor adverse** significance (not significant in EIA terms) on the majority of fleets in the commercial fishing sector.
- 8.8.5 A key impact is reduced access to, or the potential exclusion from, established fishing grounds, which is a particular consideration for UK and European trawler fleets in Subzone 1. With the specified spacing between turbines and up to 10% of inter-array cables requiring rock protection, it is likely that fishing within the array would continue. This results in an effect of **minor adverse** significance (not significant in EIA terms) from reduced access. Similarly for the UK potting fleet fishing along the offshore export cable corridor, reduced access would be limited in scale and extent leading to an effect of **minor adverse** significance (not significant in EIA terms).
- 8.8.6 A knock-on effect of exclusion is the displacement of vessels onto other fishing grounds, which can cause conflict with other fishing gears. The UK potting fleet operates across large areas inshore from Subzone 1 and is considered to be sensitive to gear conflict interactions since gear is left unattended on the seabed. As displacement from construction and decommissioning is short-term and considered unlikely during operation, displacement is assessed as having an effect of **minor adverse** significance (not significant in EIA terms).
- 8.8.7 The cumulative impact assessment for commercial fisheries focused on displacement effects on UK and European commercial fishing fleets arising from Project One in combination with other projects within 100 km of Project One. The continuation of fishing within Project One and within the other offshore wind farm developments results in a cumulative effect that is of **minor adverse** significance (not significant in EIA terms).
- 8.8.8 Transboundary effects outside UK waters are limited to the potential displacement of effort from Project One into non-UK waters. Based on the established fishing grounds targeted by the fleets under assessment, it is not anticipated that displacement effects into non-UK waters would be significant.

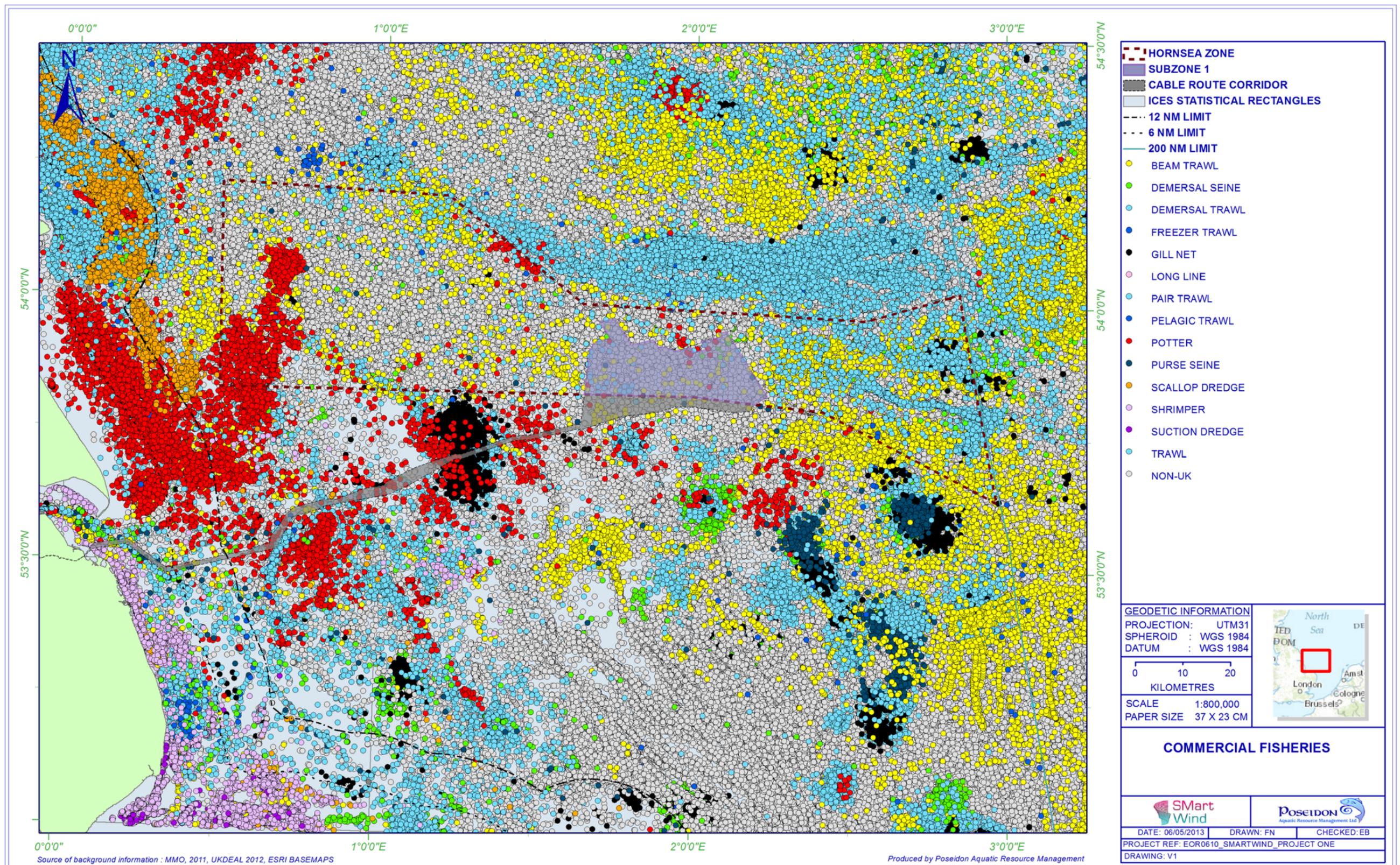


Figure 8.5 Vessel Monitoring System (VMS) data for vessels (≥ 15 m) from 2006 to 2010, presenting actively fishing vessels by gear type (source: MMO, 2011).

8.9 Shipping and Navigation

8.9.1 The navigational activity (i.e., the passage) of vessels (Figure 8.6) within a 10 NM buffer around Subzone 1 and a 5 NM buffer along the export cable route corridor was characterised via a review of existing data and project-specific studies. Key data included a total of 56 days of Automatic Identification System (AIS) and radar survey data collated from working vessels within the Hornsea Zone, supplemented with an additional 25 days of validation data (2011 and 2012), fishing surveillance satellite data and observation data (2005 to 2009), maritime incident data, marine aggregates dredging data, recreational sailing data and information on the location of oil and gas platforms in the study area.



Figure 8.6 Vessel recorded within Subzone 1.

8.9.2 The 56 days of site-specific data indicated that there were an average of up to 30 unique vessels per day passing within 10 NM of Subzone 1, with an average of 13 per day actually intersecting Subzone 1. The majority of these vessels were cargo vessels, followed by tankers.

8.9.3 The baseline review identified that there were no International Maritime Organisation (IMO) routing measures in close proximity to Subzone 1 although the proposed offshore cable route corridor does enter the Humber near the Humber Traffic Separation Scheme (TSS). The cable route corridor passes through the MOD exercise area, Donna Nook. There are no Marine Environment High Risk Areas (MEHRA) within Subzone 1 or the cable route corridor.

8.9.4 Formal Navigation Risk Assessments (NRA) of the project were undertaken in accordance with the requirements of Marine Guidance Note 371 (one for Subzone 1 and the export cable route corridor and a second for the offshore HVAC reactive compensation substation). The findings of the NRAs were used to inform the overall impact assessment for shipping and navigation, which considered vessel to vessel collision risk, vessel to structure allision risk, anchor and gear snagging risk and the effect upon both emergency response and pollution and salvage response capabilities. With the standard industry measures adopted as part of the project, the majority of these impacts result in effects of either **negligible** or **minor adverse** significance (not significant in EIA terms), with the exception of vessel to vessel collision risk and vessel to structure allision risk during the operational and maintenance phase, which were predicted to be of **moderate** and **major adverse** significance (significant in EIA terms), respectively.

8.9.5 The physical presence of the Project One offshore infrastructure may displace commercial shipping, fishing vessels and recreational vessels leading to an increased vessel to vessel collision risk. The significance of effect has been assessed as of **moderate adverse** significance (significant in EIA terms). Once the final layout has been designed, further consultation with the MMO in conjunction with the Maritime and Coastguard Agency (MCA) and Trinity House Light Service (THLS) will identify additional aids to navigation that may be required to ensure any risk to vessel safety can be reduced to acceptable levels. In addition, the use of Notice to Mariners and charting of the wind turbines will reduce this effect to **minor adverse** significance (not significant in EIA terms).

8.9.6 The physical presence of the Project One offshore infrastructure may cause additional vessel to structure (wind farm components) allision risk for commercial vessels, recreational users, commercial fishing vessels and wind farm operators. Due to the irregular boundary shape of the worst case layout used for this impact assessment and the inclusion of potentially extreme peripheral wind turbines, the effect has been assessed as of **major adverse** significance (significant in EIA terms). However, in compiling with the conditions of the marine licence, further consultation will be had with MMO in conjunction with the MCA and THLS, which will inform the final layout of Project One and the appropriate level of aids to navigation. Particular attention and consideration will be given to the navigational safety requirements of peripheral structures. This will ensure that the significance of the impact is reduced to as low as reasonably practicable, resulting in a residual effect that is expected to be of **minor adverse** significance (not significant in EIA terms).

8.9.7 Cumulative impacts from oil and gas activity, aggregate extraction activities and other offshore wind farm developments were assessed and predicted to result in effects of **negligible** to **minor adverse** significance (not significant in EIA terms) or **moderate adverse** significance (significant in EIA terms) upon shipping and navigation. The cumulative impact of vessel to vessel collision risk and vessel to structure (wind farm components) allision risk from Project One and Hornsea Project Two was assessed

as **moderate adverse** significance (significant in EIA terms). A separate NRA shall be undertaken for Project Two which, when considering the layout for Subzone 2, shall take into consideration the alignment of turbines within Subzone 1 and how the two arrangements sit side by side, considering minimising risks to navigation safety. Consultation with the MCA and THLS will then enable the appropriate aids to navigation to be implemented to ensure that any risk to navigation from the combined projects can be reduced to acceptable levels.

8.9.8 No transboundary effects with regard to shipping and navigation from Project One on the interests of other EEA States were predicted.

8.10 Aviation, Military and Communications

8.10.1 The potential effects on aviation, military and communications interests arising from Project One have been assessed. Existing activities were identified from desk studies, offshore surveys and consultation. The factors considered for assessment included the physical obstructions of airspace and the potential interference with radar and communication systems. Potential effects have been considered on the interests of CAA airspace policy, NATS En-Route Ltd (NATS), the MOD, Search and Rescue (SAR) and helicopter support operations to the offshore oil and gas industry, and sea-based vessels (from a communications perspective).

8.10.2 There are a number of aviation, military and communications related interests in the vicinity of Subzone 1 and offshore cable route corridor. This includes MOD Managed Danger Areas (MDAs), Military Low Flying Areas, and the Donna Nook Danger Area (D307). In addition, two Helicopter Main Routes (HMRs) cross Subzone 1 and its boundary extends into the 9 NM consultation zones surrounding the Mimas, Saturn and Schooner A offshore gas platforms.

8.10.3 Subzone 1 is located within the operational range of the NATS Claxby and Cromer Primary Surveillance Radars (PSRs), and is also within the operational range of the MOD's Air Surveillance and Control Systems (ASACS) Air Defence PSRs located at Staxton Wold and Trimingham. There are networks of microwave links in the vicinity of Subzone 1; however no permanent structures from Project One will obscure the line of sight of any existing links.

8.10.4 The construction, operation and decommissioning of Project One has the potential to cause direct and indirect impacts upon aviation, military and communications receptors. Potential impacts identified and considered within the assessment include interference with operations within MOD Danger Areas, disruption to HMRs, disruption to cross-zone transit helicopter traffic, and disruption of instrument approach procedures and Missed Approach Procedures (MAPs) to and from, offshore oil and gas platforms. Other impacts include disruption to civil and military radar cover, obstruction to SAR helicopter operations, and interference with microwave and other communication links. Taking into account the designed in

mitigation, (referred to as 'measures adopted as part of the project') these impacts result in effects of **no, negligible** or **minor adverse** significance (not significant in EIA terms).

8.10.5 The physical presence of Project One offshore infrastructure in helicopter operational airspace may disrupt the use of HMR 3 and HMR 12 in instrument meteorological conditions (IMS) and when the weather dictates flying at less than 2,000 ft. is required. In such instances helicopters would have to deviate around Subzone 1. An obstacle free route is available as a deviation around Subzone 1 and the ability of the helicopter operator to make the intended journey safely is therefore not affected as concluded through consultation with aviation stakeholders. The effect of the presence of Project One is considered to be of **minor adverse** significance (not significant in EIA terms).

8.10.6 The physical presence of Project One offshore infrastructure infringes on the 9 NM consultation zones around the Mimas, Saturn and Schooner A gas platforms. In certain wind directions, instrument approach procedures to these platforms will be restricted. From an analysis of the wind data, an assessment of the amount of flights restricted per month was made. Consultation was also had with the operators of the platforms with regard to the operational requirements of these platforms. The results of the assessment and consultation response identified that there is an effect of **minor adverse** significance (not significant in EIA terms) to the three platforms.

8.10.7 Subzone 1 is within the operational range of the NATS Claxby and Cromer PSRs. However, radar line of site modelling has demonstrated that Subzone 1 would almost always be undetectable. As the radar are at their limit of operational range, this was assessed as no impact, which was confirmed through consultation with NATS. Subzone 1 is within the operational range of the military Air Defence Radars (ADRs) located at Staxton Wold and Trimingham. Radar line of sight modelling for the Staxton Wold ADR showed that a candidate turbine at the closest point to the Staxton Wold radar is highly unlikely to be detected. The line of sight modelling for Trimingham ADR showed that the majority of the development would not be detected, although intermittent detection of turbines in the southwest of Subzone 1 may be possible in certain conditions. The overall effect is assessed to be of **negligible** significance (not significant in EIA terms), which has been confirmed through consultation with the MOD.

8.10.8 The cumulative effect of Project One alongside that of other wind farm projects and oil and gas operations has been considered on aviation, military and communications. No cumulative impacts were assessed to be of significant effect (in EIA terms).

8.10.9 No transboundary effects with regard to aviation, military and communications from Project One upon the interests of other EEA States have been identified.

8.11 Marine Archaeology and Ordnance

- 8.11.1 An assessment has been completed of the potential effects of Project One on marine archaeology: the physical remains of past human activity on and beneath the seabed. Baseline assessment of the marine archaeology of the Project One site was characterised through a variety of desk-based sources, including national wreck databases, and archaeological analysis of site-specific surveys, including geophysical and geotechnical surveys of Subzone 1 and the offshore cable route corridor, and walkover surveys of the intertidal cable route corridor.
- 8.11.2 With regards to the geoarchaeology of seafloor sediments, a number of palaeochannels (historic river channels) were identified within Subzone 1. An extensive system of Early Holocene channels, already documented in the Southern North Sea by recent research, was identified in many parts of the development area, particularly Subzone 1, where a series of large former river valleys drain northwards into the depression now known as Outer Silver Pit. These channels vary from 50 m to 2 km wide and are up to 50 m deep. The palaeochannels are likely to contain preserved ancient land surfaces, covered and protected by fluvial alluvium deposited in the Early Holocene period. Fewer of these channels were identified within the cable route corridor, although a second group were identified draining into Inner Silver Pit from the west and east. Finally, a large geoarchaeological feature was identified extending 5 km seawards from the landfall at Horseshoe Point. This is believed to be the remains of later Mesolithic/Neolithic wetland associated with the prehistoric course of the Humber.
- 8.11.3 In terms of maritime and aviation wrecks (e.g., Figure 8.7), records suggest that these become much more common within 60 km of the coast. Particularly high numbers of World War I and II wrecks are recorded in this area, many of which had been sunk by mines. Substantial numbers of aircraft, mostly Beaufighters, are recorded as having being lost during World War II close to the strategically important World War II airfield at North Cotes, beside the cable landfall, and it is possible that some of these may lie within the offshore export cable route corridor. In total, 32 confirmed (A1) anomalies, 17 recorded but unconfirmed (A3) anomalies and 975 unconfirmed (A2) anomalies were identified within Subzone 1 and the offshore export cable route corridor.

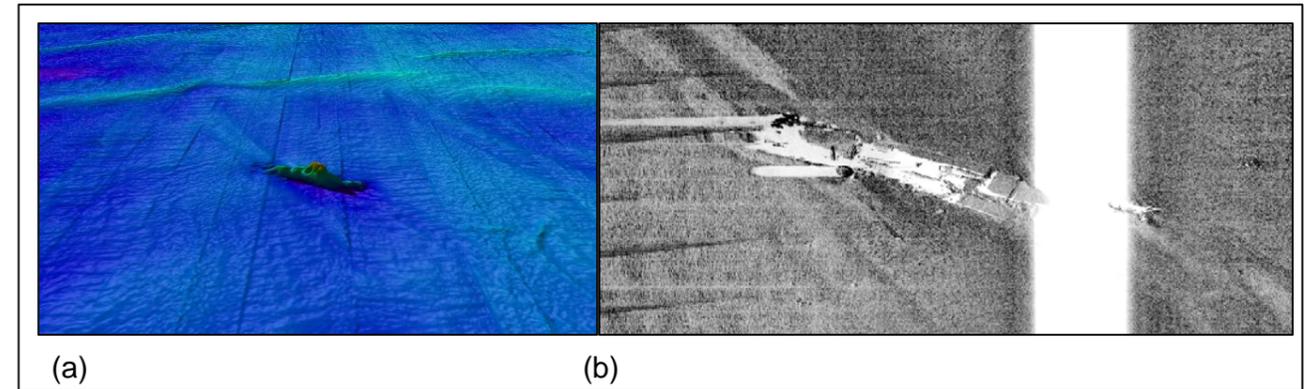


Figure 8.7 Wreck located within the offshore cable route corridor, (a) is a multibeam bathymetry image and (b) a sidescan sonar image.

- 8.11.4 A number of potential impacts on marine archaeology, associated with the construction, operation and decommissioning of Project One, were identified. These concerned either removal or disturbance of sediments of geoarchaeological significance or the disturbance or destruction of wrecks and/or crashed aircraft. With the proposed draft Written Scheme of Investigation in place, which is intended to i) identify archaeologically sensitive remains encountered during the development, ii) to avoid them wherever possible via the use of Archaeological Exclusion Zones and iii) to enable recording of any remains that are directly affected, the impacts were predicted to result in effects of either **negligible** or **minor adverse** significance (which is not significant in EIA terms).
- 8.11.5 The impact assessment for geoarchaeology considered the impacts of both gravity based turbines and wind turbines with monopile foundations. This concluded that gravity based foundations are likely to have the greatest effect on buried Early Holocene sediments, given their relatively shallow depth (gravity based foundations will penetrate to a maximum depth of 5 m). However, it was also concluded that monopiles are likely to have the greatest impact on the deeper Pleistocene sediments, with potential to contain remains of Palaeolithic archaeology. Given the localised nature of the impacts and the high value but very considerable extent of sediments of geoarchaeological potential, the effect was considered to be of **minor adverse** significance (not significant in EIA terms).
- 8.11.6 In considering the impact of Project One on shipwrecks and aircraft wrecks, gravity base foundations were considered due to the greater surface area that they will affect, compared to monopiles. The impact assessment concluded that, with the proposed draft Written Scheme of Investigation in place (avoidance of known wrecks combined with the chance finds procedures) the effect was considered to be of **minor adverse** significance (not significant in EIA terms).

- 8.11.7 The results of the assessment work carried out in support of the Environmental Statement, as well as the proposed archaeological mitigation, will also have a beneficial effect through improved understanding of human history and prehistory in the marine archaeology study area.
- 8.11.8 Cumulative impacts from aggregate extraction activities and other offshore wind farm developments were assessed and predicted to result in effects of **minor adverse** significance (not significant in EIA terms) upon marine archaeology receptors within the Humber Estuary Regional Environmental Characterisation (REC) area.
- 8.11.9 No transboundary effects with regard to marine archaeology from Project One on the interests of other EEA States were predicted.

8.12 Seascape and Visual Resources

- 8.12.1 The seascape and visual resources assessment considers the effects of Project One on present day seascape character and on the Historic Seascape Character (HSC). The present day seascape and HSC were characterised by site-specific surveys from viewpoint locations, as well as a desktop study.
- 8.12.2 The visual characteristics of Subzone 1 and the offshore export cable route corridor are relatively homogenous, with a lack of visibility to coastal areas, due to the distance from the shore. The offshore area is generally open, with occasional views of offshore structures such as gas platforms, and regular patterns of use by sea-going vessels for a variety of purposes (e.g., recreational cruising, commercial ferry routes, commercial fishing activity etc.). Air combat training takes place over the majority of the study area. There are no national or regional seascape designations within the seascape and visual resources study area.
- 8.12.3 Subzone 1 lies within two broad HSC types; Navigation and Offshore Industry. Similarly the offshore export cable route corridor passes largely through areas with Navigation or Offshore Industry broad character designations. The only exceptions to this, is close to the shore, which is identified as Military and Coastal Industry.
- 8.12.4 A number of potential impacts on seascape and visual resources, associated with the construction, operation and decommissioning of Project One, were identified. These include a change to the existing present day seascape character and HSC, as well as a change to the current visual and night-time scenario experienced by visual receptors. For the purpose of the seascape and visual resources assessment, effects of **major** significance or above were considered significant in EIA terms. None of the impacts from Project One were predicted to result in a significant (in EIA terms) effect upon seascape and visual resources.
- 8.12.5 As the wind turbines are located 103 km from the East Riding of Yorkshire coast, they will not be visible from shore. Subzone 1 will however, form a new wind farm Character Area within the Dogger Deep Water Channel present day seascape character area. It will provide a large scale visual focus and an orientation feature for marine users. It will have an effect of **minor adverse** significance (not significant in EIA terms) on the Dogger Deep Water Channel seascape character area.
- 8.12.6 With regards to the HSC, the Project One wind farm will turn a substantial part of the Well Bank area, historically used for fishing and navigation, into an area dominated by offshore wind turbines and their associated infrastructure. Given the mitigation in paragraph 8.11.4, the effect was deemed to be of **minor adverse** significance (not significant in EIA terms).
- 8.12.7 The Well Hole area is characterised as an area of offshore industry. The impact of Project One will therefore, be generally in keeping with the existing HSC. The effect was therefore, deemed to be **minor adverse** significance (not significant in EIA terms).
- 8.12.8 The seascape assessment concluded that Project One offshore infrastructure will have a small impact upon sea based observers, given the temporary duration of the impact on moving observers, such as fishing and commercial vessels. The effect was predicted to be **negligible** to **moderate adverse** significance (not significant in EIA terms).
- 8.12.9 Cumulative impacts from oil and gas activities and other offshore wind farms were assessed and predicted to result in effects of **negligible** to **moderate adverse** significance (not significant in EIA terms) upon seascape and visual resources.
- 8.12.10 Transboundary effects, with regards to seascape and visual resources, from Project One on the interests of other EEA States were predicted where Project One is visible beyond the international boundary. Given the distance between Subzone 1 and the small area that Subzone 1 may be visible in beyond the international boundary, the significance of visual effects on marine users and the effect upon present day seascape character were both predicted to be **negligible** (not significant in EIA terms).

8.13 Infrastructure and Other Users

- 8.13.1 Infrastructure and other users considers the impact of Project One on the following receptors: recreational sailing and motor cruising, kite surfing, surfing, windsurfing, sea/surf kayaking and canoeing, diving, recreational fishing, other offshore wind farms, offshore telecommunications cables, Carbon Capture and Storage (CCS), Underground Coal Gasification (UCG), disposal sites, aggregate extraction and oil and gas operations (including pipelines).

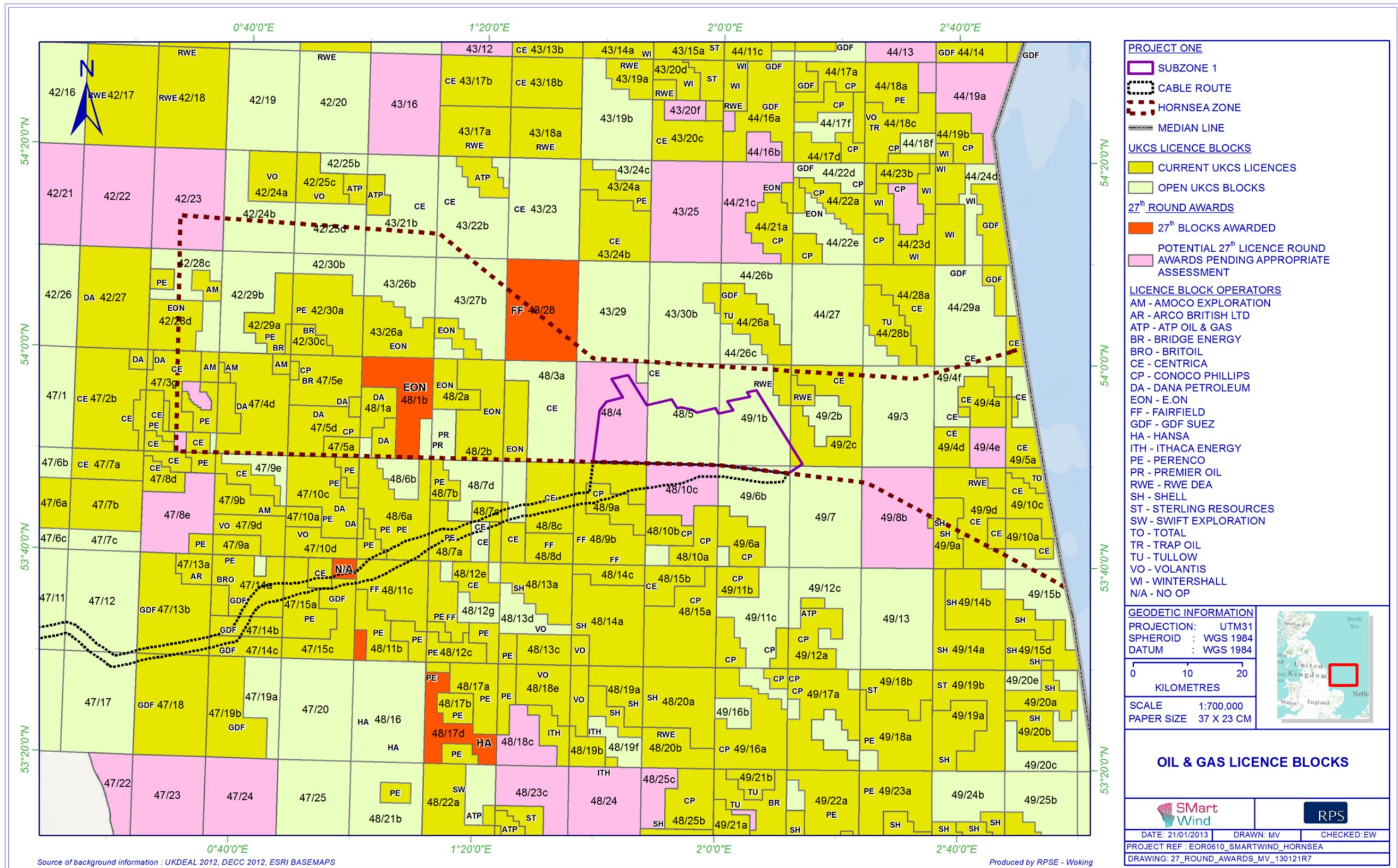


Figure 8.8 Oil and gas licence blocks within the Project One infrastructure and other users study area.

- 8.13.2 A number of potential impacts on infrastructure and other users, associated with the construction, operation and decommissioning of Project One, were identified. These included displacement of recreational vessels, disturbance to cables and pipelines and aggregate areas, disruption to oil and gas operations including the interference with Radar Early Warning Systems (REWS) on gas platforms, and an increase in airborne noise. With the proposed mitigation measures in place, these impacts identified, with the exception of the potential disruption to oil and gas seismic surveys, result in effects of **negligible to minor adverse** significance (not significant in EIA terms).
- 8.13.3 Recommended precautionary areas around Subzone 1 during construction activities will restrict the potential for conventional towed streamer seismic surveys in the area. In the event that blocks 48/4b and 48/10c are licenced, an effect of **moderate adverse** significance (significant in EIA terms) is predicted. This licencing of these blocks is dependent on the outcome of the 27th round Appropriate Assessment and will not be known until potentially the second quarter of 2013. SMart Wind shall continue to consult with the potential licence holders of these blocks, through the planning process, in order to ensure that any potential impacts are reduced and to maximise mutually beneficial coexistence between the two parties.
- 8.13.4 REWS are used on oil and gas platforms as part of their vessel anti-collision safety systems. The REWS system on the Saturn platform (operated by ConocoPhillips) was identified as being the closest to Subzone 1 and therefore, having the greatest potential for effect from Project One. The results of the radar modelling showed that considering the potential effects of the radar, such as direct returns, multipath returns, shadow effects and fluctuating returns, the effect would be of **minor adverse** significance (not significant in EIA terms).
- 8.13.5 Cumulative impacts from oil and gas activities and other offshore wind farm developments were assessed and predicted to result in effects of **negligible, minor adverse** significance (not significant in EIA terms) or **moderate adverse** significance (significant in EIA terms) upon infrastructure and other users. The cumulative impact of Project One and Project Two during construction may restrict oil and gas conventional towed streamer seismic exploration activities due to safety zones. This effect is of **moderate adverse** significance (significant in EIA terms). The agreement for lease development site, designated area and dredging restriction zones may exclude drilling and the placement of infrastructure within 235 m either side of the order for lease for the offshore export cable route, restricting oil and gas or carbon capture and storage projects. The cumulative effect with Project Two is of **moderate adverse** significance (significant in EIA terms). For both impacts the use of alternative technology and programme consideration have the potential to reduce this impact. On-going consultation with DECC and oil and gas operators will promote and maximise cooperation between parties and minimise both spatial and temporal interactions between conflicting activities. Open dialogue and further provision of

information may reduce the potential cumulative effects to **minor adverse** significance (not significant in EIA terms).

- 8.13.6 No transboundary effects with regard to infrastructure and other users from Project One on the interests of other EEA States were predicted.

8.14 Air Quality and Waste Management

- 8.14.1 A number of existing and commissioned studies were used to inform the air quality and waste assessment. Examples of publically available information include DEFRA's UK-AIR (data from the monitoring station in Hull Freetown) and meteorological data from the Royal Air Force (RAF) Donna Nook monitoring station. In addition to this, SMart Wind commissioned a Carbon Life Cycle Analysis (CLCA) to determine the potential carbon emissions and savings resulting from the construction and operation of Project One.
- 8.14.2 Baseline air quality data has been derived from the DEFRA UK ship emissions inventory using shipping movements within waters surrounding the UK. This information has been used to determine the annual mass of NO_x, SO₂, and CO₂ emissions from the UK ship emissions inventory that corresponds to Project One and the surrounding area. Background NO₂ and SO₂ data has also been taken from the Hull Freetown Automatic Urban Monitoring Network (AURN) monitoring site.
- 8.14.3 A number of potential impacts upon air quality and waste, associated with the construction, operation and decommissioning of Project One, were identified. These included the release of atmospheric contaminants, the accidental release of non-hazardous and hazardous materials, and an increase in pressure upon onshore waste receiving facilities. These impacts were predicted to result in effects of **negligible to minor adverse** significance (not significant in EIA terms).
- 8.14.4 Atmospheric emissions have been estimated from the predicted fuel consumption for Project One. Given the dispersive nature of the environment and the mobile source of emissions, local elevated concentrations of emissions will be short lived, are unlikely to be detectable except at a short distance away from any of the activities and will quickly return to background levels as a vessel moves on. The effect of atmospheric emissions was therefore, assessed as being of **minor adverse** significance (not significant in EIA terms).
- 8.14.5 Total quantities of hazardous and non-hazardous materials were estimated including those that that will be used in construction and decommissioning vessels and equipment and those stored offshore for maintenance during operations. The assessment of the accidental release of hazardous and non-hazardous material upon receptors was undertaken in the relevant receptor chapters and is summarised above in the summaries for Benthic Subtidal and Intertidal Ecology, Fish and Shellfish Ecology, Ornithology and Marine Mammals.

- 8.14.6 Waste quantities have been estimated for all phases of Project One, using the project description and CLCA report. The level of waste generated by the various offshore vessels have been drawn from Environmental and Emissions Monitoring System (EEMS) submissions for offshore oil and gas exploration and production operations on the UK Continental Shelf. The management of waste has been detailed in the Site Waste Management Plan (SWMP). The effect upon onshore waste receiving facilities was predicted to be of **negligible** to **minor adverse** significance during the construction, operation and decommissioning phases (not significant in EIA terms).
- 8.14.7 Cumulative impacts from oil and gas activities and other offshore wind farm developments were assessed and predicted to result in effects of **minor adverse** significance (not significant in EIA terms) upon air quality receptors and onshore landfall facilities.
- 8.14.8 No transboundary effects with regard to air quality and waste from Project One on the interests of other EEA States were predicted.

8.15 Inter-Related Effects (Offshore)

- 8.15.1 The EIA for Project One 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 Project One. 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.
- 8.15.2 Potential inter-related effects have been identified based on the detailed assessments undertaken in the individual Environmental Statement chapters. However, given the low sensitivity of receptors, temporary and small scale nature of effects, availability of alternative habitats, and also factoring in proposed mitigation 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.

9 POTENTIAL ENVIRONMENTAL IMPACTS (ONSHORE)

9.1 Geology and Ground Conditions

- 9.1.1 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. The baseline geology and ground conditions of the Project One onshore development was characterised by desktop study of published sources of information, dedicated onshore surveys and by consultation.
- 9.1.2 The geology of the landfall area at Horseshoe Point comprises superficial deposits of beach and tidal flat deposits, and marine/estuarine alluvium which extends inland for approximately 150 m. Underlying these materials is glacial till, with Chalk bedrock possibly at 40-50 m below ground level. Inland, the geology of the cable route corridor and the HVDC converter/HVAC substation site is dominated by marine or glacial deposits up to approximately 20 m thick overlying the Chalk bedrock.
- 9.1.3 The Chalk bedrock is a principal aquifer and there are also a number of secondary perched aquifers in more permeable parts of the superficial drift materials that are crossed by the landfall and cable route corridor. There are public water supplies from the Chalk aquifer protected by Source Protection Zones (SPZ) together with several private abstractions from the Chalk along the cable route corridor.
- 9.1.4 There are two historic landfills within 250 m of the cable route corridor but no sites registered as contaminated land. There are no designated areas with geological or geomorphological interest within 1.8 km of the onshore development. There are a number of Environmental Permits (formerly IPPC or IPC permits) relating to combustion and power generation within 250 m or 500 m of the development.
- 9.1.5 A number of potential impacts on geology and ground conditions associated with Project One were identified. These included impacts on the groundwater quality of secondary and primary aquifers including in SPZs resulting from ground disturbance or contamination and the creation of pathways whereby surface water may hydraulically connect with groundwater aquifers. With the proposed mitigation measures in place, the majority of these impacts result in effects of either **negligible** or **minor adverse** significance (not significant in EIA terms).
- 9.1.6 The effects of the development on designated sites of geological or geomorphological interest were assessed to be of **negligible** significance (not significant in EIA terms) as there are no such designated sites within 1.8 km of the development.

- 9.1.7 The construction impacts of deep Horizontal Direct Drilling (HDD) on the groundwater quality of the Chalk Principal Aquifer including within an SPZ used for public supply were considered. There is the potential for hydraulic connections to be established between the surface and groundwater aquifer leading to potential ingress of contaminated surface water, and also potential disturbance of the Chalk itself. With mitigation measures, including hydrogeological risk assessments in agreement with the Environment Agency (EA) and an appropriate standoff distance above the aquifer bedrock and below the surface feature, the effect was deemed to be of **minor adverse** significance (not significant in EIA terms).
- 9.1.8 The thermal impacts of heat transfer from the operational high voltage cable to the surrounding ground, including to groundwater, were assessed via a review of recent research. This research concluded that there was an undetectable impact on ground temperatures at distances of more than 1200 mm in any plane from properly constructed thermally conductive layers around the cables. Although largely continuous during operation and therefore long term, the effect was deemed to be of **negligible** to **minor adverse** significance (not significant in EIA terms).
- 9.1.9 Cumulative impacts from other onshore developments likely to involve ground disturbance and potential impacts on the principal groundwater aquifer in particular were assessed are predicted. No increase in cumulative effects on the principal aquifer as all developments will be constructed under the same regulations as Project One.
- 9.1.10 No transboundary effects with regard to onshore geology and ground conditions from Project One on the interests of other EEA States are predicted.

9.2 Hydrology and Flood Risk

- 9.2.1 Hydrology is the study of the movement, distribution, and quality of water, including the hydrological cycle, water resources and environmental watershed sustainability. The assessment of hydrology and flood risk focuses on the potential for increased flooding and watercourse disturbance as a consequence of the development. The baseline hydrology and flood risk was characterised by desk-top study of published sources of information, dedicated onshore surveys and by consultation.
- 9.2.2 EA mapping (Figure 9.1) shows that the majority of the proposed development is located within Flood Zone 1, meaning that there is less than a 1 in 1,000 annual probability of river or sea flooding. A number of localised areas; namely at the landfall and where the cable route corridor comes into close proximity to main rivers, are located within Flood Zones 2/3 with a 1 in 100 or greater annual probability of river flooding or a 1 in 200 or greater annual probability of flooding from the sea in any year.

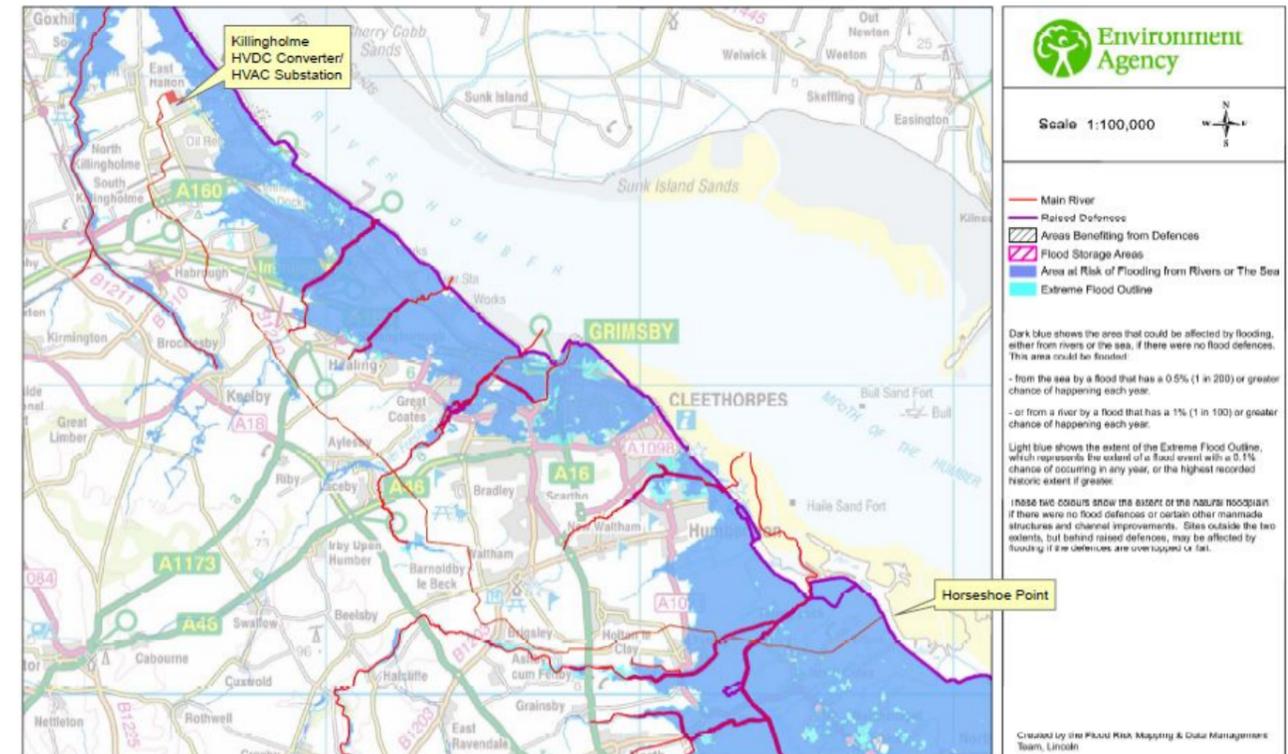


Figure 9.1 Environment Agency Flood Zone Map.

- 9.2.3 The proposed development is located within the Humber River Basin Management Plan (2009) study area, which has classified watercourses in close proximity to Project One as having a poor to moderate water quality based on Water Framework Directive definitions.
- 9.2.4 Potential impacts on hydrology and flood risk include an increase in temporary and permanent flood risk, impacts on flood defences, drainage pipelines, field drainage and irrigation and watercourses from HDD and open-cut cable route crossings. With the proposed mitigation measures in place effects would be temporary and are anticipated to be of **negligible** or **minor adverse** significance (not significant in EIA terms).
- 9.2.5 The proposed technique for crossing the tidal flood defence at Horseshoe Point is predicted to have an effect of **negligible** significance (not significant in EIA terms), as the method will be designed to ensure the cable is taken to an approximate 30 m depth below surface level to ensure that the flood defence structure is not compromised.
- 9.2.6 A range of cable route crossing techniques for main and minor water courses have been assessed and determined to have an effect of **minor adverse** significance (not significant in EIA terms). There are unlikely to be any significant effects on hydrological conditions during the construction phase. Activities on site would be controlled through best practice site management practices.

- 9.2.7 Increases in flood risk associated with the construction of low permeability areas will be managed through the design and implementation of an appropriate drainage strategy, restricting offsite surface-water flows to the 1 in 2 year pre-development rate and is predicted to result in an effect of **negligible** significance (not significant in EIA terms).
- 9.2.8 Cumulative impacts from other schemes within 250 m of Project One were assessed. No significant cumulative impacts of water resources and flood risk were identified.
- 9.2.9 No transboundary effects with regard to hydrology and flood risk from Project One on the interests of other EEA States are predicted.

9.3 Ecology and Nature Conservation

- 9.3.1 Onshore ecology refers to communities of animals and plants which are located on, or utilise habitats on land and the inter-relationships between these species and the physical environment.
- 9.3.2 To inform the impact assessment a consultation was undertaken with relevant stakeholders including the Joint Nature Conservation Committee (JNCC), Natural England (NE), the EA, Lincolnshire County Council and relevant District Councils, the Royal Society for the Protection of Birds (RSPB) and the Wildlife Trust.
- 9.3.3 Baseline data relating to sites, habitats, species and populations of ecology and nature conservation interest were collated through an ecology desk study and a series of field surveys.
- 9.3.4 Findings of the desk study and field surveys reported the presence of habitats with the potential to support protected or otherwise notable species including great crested newts, water voles, otters, badgers, bats, breeding birds, wintering birds and migratory birds. Eight statutory designated sites were identified within 5 km of the cable route corridor: the Humber Estuary, which is designated as a Ramsar site, SPA, SAC and SSSI; Donna Nook NNR; North Killingholme Pits SSSI; Tetney Blow Wells SSSI; Bradley Wood LNR and several non-statutory designated sites were identified including Tetney Marshes reserve and the River Freshney Headwaters Local Wildlife Site.
- 9.3.5 A number of potential impacts on onshore ecology species and habitats, associated with Project One, were identified. These included temporary habitat loss and habitat and species disturbance. With the proposed mitigation measures in place, the majority of these impacts result in effects of either **negligible** or **minor adverse** significance (not significant in EIA terms).
- 9.3.6 Findings of this assessment reported that installation of the onshore cable at the landfall by HDD will likely result in an effect on sand dunes and nearby coastal lagoons of **minor adverse** significance (not significant in EIA terms).

- 9.3.7 The impact on the SPA qualifying winter and migratory bird populations due to potential disturbance, displacement and habitat loss or disturbance is predicted to result in an effect of **minor adverse** significance (not significant in EIA terms) in the medium term. The significance of this effect has been reduced through designed in mitigation, namely the restricted timing of works (April to September inclusive) when fewer birds are present, the restricted extent of working areas and the availability of alternative suitable habitat in the wider Humber Estuary.
- 9.3.8 HDD installation will be undertaken beneath major watercourses along the cable route corridor in order to minimise the expected level of disturbance to the habitat and species present, including water voles. HDD works will have an effect of **negligible to minor adverse** significance (not significant in EIA terms).
- 9.3.9 Cable installation and the construction of the HVDC converter/HVAC substation will result in the temporary loss of a considerable number of hedgerow sections. However, mitigation proposals will include replacement planting and the enhancement of hedgerows in a 100 m wide corridor along the full length of the cable route corridor. Therefore, in the medium to long term, works will result in a positive effect on hedgerow habitat.
- 9.3.10 Cumulative impacts from other schemes within 4 km of the cable route corridor and 5 km of the landfall and HVDC converter/HVAC substation site were assessed. No likely significant ecological or nature conservation impacts were identified.
- 9.3.11 No transboundary effects with regard to onshore ecology from Project One on the interests of other EEA States are predicted.

9.4 Landscape and Visual Resources

- 9.4.1 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. A series of field surveys have been carried out alongside a desk-based assessment reviewing the local, regional and national character types and designations. This information has been collated to give an accurate picture of the baseline conditions, from which the assessment of sensitivity of the landscape and visual resources, the impact of Project One and the resultant effects can be made.
- 9.4.2 The land use for the majority of the cable route corridor is agricultural. The land cover is predominantly arable, with some areas of pasture closer to villages. In the south, close to the Humber Estuary, field boundaries are often ditches. Hedgerows around arable fields are often degraded or missing, particularly around the larger arable fields. The baseline data showed that the landfall is located within National Character Area 'Lincolnshire Coast and Marshes', regional character area 'Coastal Saltmarshes

and Mudflats' and local Landscape Character Area 'Donna Nook to Gibraltar Point Naturalistic Coast'. The cable route falls within the 'Lincolnshire Coast and Marshes' national landscape character area, but also within the 'Humber Estuary' national character area. It crosses several regional and local landscape character areas, on its route north. The onshore HVDC converter/HVAC substation site lies within National character area 'Humber Estuary', regional character area 'The Humber Estuary' and local landscape character area 'The Humber Estuary – Open Undulating Farmland'.

- 9.4.3 The landscapes in which the cable route corridor and onshore HVDC converter/HVAC substation are proposed are undesignated. In general they are considered to be of a low sensitivity to the proposed development. However, there are a few places where they are thought to be more sensitive including: the intertidal area at the landfall; the area of small fields with mature hedgerows to the north-east of Laceby and an area of small fields and mature hedgerows to the east of East Halton.
- 9.4.4 A number of potential impacts on landscape and visual resources associated with Project One were identified. These included effects on designated and undesignated landscape and seascape resources, effects on close, medium and long range visual receptors.
- 9.4.5 The significance of temporary effects as a result of the construction of the landfall and cable route varies between **no impact** to **substantial** (not significant to significant in EIA terms), where the cable route corridor construction temporarily crosses a public right of way (PRoW) or comes close to residential properties. The significance of temporary effects as a result of the construction of the onshore HVDC converter/HVAC substation varies from **none** to **substantial** (not significant to significant in EIA terms), where PRoWs or residential properties are close to the construction site.
- 9.4.6 The significance of effects on receptors of the landfall and cable route corridor during the operational phase would be **negligible** to **minor adverse** (not significant in EIA terms). The significance of effects as a result of the onshore HVDC converter/HVAC substation during the operational phase varies from **none** to **major adverse** significance, major for one residential receptor, and for the closest PRoWs (not significant to significant in EIA terms).
- 9.4.7 Cumulative impacts from other onshore infrastructure upon onshore landscape and visual resources within 1 km of the landfall and cable route and within 15 km of the onshore HVDC converter/HVAC substation site were assessed. There are several cumulative schemes that lie to the east of the North Killingholme refinery, between woodland of Burkinshaw's Covert and the Humber. While it is unlikely that there will be significant combined effects on the landscape resources and visual receptors, there may be significant sequential visual effects on people using PRoW in the area. The proposed developments located to the north of the Killingholme refinery would

permanently change the landscape character in this area. These proposed developments will bring the built development closer to the village of East Halton and the size of the proposed development would impede views towards the Humber Estuary. The cumulative effects on landscape resources and visual receptors in this area may be significant depending upon which schemes are actually constructed. The Project One proposal would not tip the balance from a non-significant to a significant effect, however, it would add slightly to the impact on landscape resources and visual receptors.

- 9.4.8 There are no transboundary effects with regard to landscape and visual resources from Hornsea Project One.

9.5 Historic Environment

- 9.5.1 The effects of the onshore cable route corridor on the historic environment of the area, including buried archaeological and geoarchaeological remains together with consideration of the effects of the proposed onshore HVDC converter/HVAC substation at North Killingholme on the settings of nearby heritage assets and the historic landscape have been assessed.
- 9.5.2 The buried archaeology along the cable route and at the proposed onshore HVDC converter/HVAC substation sites has been evaluated through an aerial photographic assessment, field walking, a geophysical survey and trial trenching. These surveys have revealed a number of sites, including a large area of medieval settlement between North and South Killingholme, a Roman settlement north of North Beck Drain, a large Roman settlement south of Holton le Clay and an extensive landscape of salterns, apparently of medieval date, east of Tetney.
- 9.5.3 There are six Scheduled Monuments (SM) within 5 km of the proposed onshore HVDC converter/HVAC substation. There are 36 listed buildings, of which eight are Grade I, two are Grade II* and 26 are Grade II, within 5 km of the proposed onshore HVDC converter/HVAC substation. There is one Registered Park and Garden within 5 km of the proposed onshore HVDC converter/HVAC substation.
- 9.5.4 Designated assets include Thornton Abbey and Goxhill Hall, located some 2.8 km west and 3.9 km northwest of the proposed onshore HVDC converter/HVAC substation respectively. Project One would have an effect of **no** significance (not significant in EIA terms) on either asset.
- 9.5.5 A number of potential impacts on heritage assets, associated with Project One were identified. These included effects on undesignated assets which would range from **none** to **moderate adverse** significance (not significant to significant in EIA terms). Effects on designated heritage assets will range from **none** to **minor adverse** significance (not significant in EIA terms). Screening on designated heritage assets of the highest significance to a radius of 10 km of the proposed onshore HVDC

converter/HVAC substation has been undertaken and effects of **no** significance (not significant in EIA terms) were predicted. Similarly, the onshore cable route corridor will have effects of **no** significance (not significant in EIA terms) on the settings of any designated historic assets.

- 9.5.6 A moated site is located between North and South Killingholme. The full extent of the asset has not been determined through trial trenching, because this stage of evaluation has taken place largely within the cable route corridor. However, the geophysical survey covered a larger area and the site can be seen to cover a relatively wide area, much of it outside the cable route corridor and to its south. Construction would only impact upon part of the site. The effect will be of **moderate adverse** significance, which is significant in EIA terms.
- 9.5.7 A moated site at Baysgarth Farm is located approximately 750 m southwest of the proposed HVDC converter/HVAC substation and is the closest designated heritage asset. Given that the area comprising the setting of the SM is relatively small, the effect will be of **no** significance (not significant in EIA terms).
- 9.5.8 The parish church of St Peter at East Halton is located approximately 1.05 km southwest of the proposed HVDC converter/HVAC substation and is listed at Grade I. The church itself is a relatively low structure and does not form a prominent feature of local views within the village. The proposed HVDC converter/HVAC substation is not inter-visible with the church. The setting of the building is confined to the churchyard and to a small part of the village. The impact is predicted to be of local spatial extent, medium term and as such, an effect of **no** significance is predicted (not significant in EIA terms).
- 9.5.9 Cumulative impacts from developments within 1 km of the boundary of the Project One cable route corridor have been assessed, as have those from tall developments within 15 km of the proposed onshore HVDC converter/HVAC substation. No significant cumulative effects upon the historic environment are predicted.
- 9.5.10 No transboundary effects with regard to the historic environment from Project One on the interests of other EEA States were predicted.

9.6 Land Use, Agriculture and Recreation

- 9.6.1 The existing land use, agricultural and recreational baseline conditions were identified during a desk based review of available published information and through site surveys. This provided information on soil types and patterns, agricultural land quality, farm holdings and recreational resources including PRoW (i.e., public footpaths, bridleways and restricted byways). Consultation has also been undertaken with the relevant local authorities to confirm the existing PRoW network.

9.6.2 The onshore elements of Project One are located within the predominantly open, agricultural landscape of the flat coastal plain, with sparse woodland and hedgerow cover. The land gradually rises towards the foot of the Lincolnshire Wolds to the west and is crossed by irregular ditches, streams and dykes. The area has a dispersed pattern of small settlements with larger settlements towards the coast. The proposed development is located away from these settlements wherever possible and therefore away from the key areas of tourist accommodation and the more formal recreational and tourist resources.

9.6.3 The agricultural soils within the area are developed in two types of drift material, marine and estuarine alluvium, which is generally calcareous in nature and glacial till. The quality of agricultural land is assessed by applying the Agricultural Land Classification system. 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. The published information and survey work undertaken indicates that the agricultural quality of the soil developed in the alluvium are generally of higher quality, grade 1 or 2 whereas the soils developed in glacial till, are mainly grade 3a land with smaller areas of grade 3b. The detailed survey of the onshore HVDC converter/HVAC substation site identified the land affected to comprise grade 3a quality land. The farming of the majority of the land affected by the proposals is typical of the pattern across the districts affected, dominated by large, predominantly arable farming enterprises, typically comprising in excess of 100 ha of land.

9.6.4 At the landfall site, located in the vicinity of Horseshoe Point, there are broad sand and mud banks above mean low water accessible from the public car park. A permissive path runs on the top of the sea defences at this location and the Humber Wildfowling Club has shooting rights over two ponds to the north of the landfall. To the south lies Donna Nook National Nature Reserve, a popular visitor attraction. From the landfall site, the cable route corridor runs to the south of the grass air strip at North Coates Airfield which provides a base for non-commercial aviators. The cable route corridor crosses, or runs close to, a number of public footpaths and bridleways, some of which form locally valued circular routes. They include the Wanderlust Way promoted path. Some of the bridleways have good links to local riding school facilities, none of which are located within the cable route corridor. The cable also comes close to other recreational assets, including fishing at Tetney Lock on the Louth Canal and various holiday accommodations. The route will cross a small section of the driving range at Laceby Manor Golf Club.

9.6.5 There is a small area of predominantly grade 3a land at the proposed onshore HVDC converter/HVAC substation site with small areas of grade 2 land (medium sensitivity) at transition jointing bay locations along the cable route corridor that would be permanently lost as a result of the project. This permanent loss of agricultural land quality is considered to have an effect of **minor adverse** significance (not significant in EIA terms).

- 9.6.6 There would also be a temporary loss of a larger area of grades 2 and 3a 'best and most versatile' land to the cable route during the construction period. This loss is considered to be of temporary nature and an effect of **moderate adverse** significance (significant in EIA terms) is predicted.
- 9.6.7 There would be a permanent loss of land from a single farm holding arising from the development of the onshore HVDC converter/HVAC substation development, together with losses of small areas of land from a large number of arable holdings arising from the construction of the transition joint bays and cable jointing pits. These effects, based predominantly on the loss of the land for the onshore HVDC converter/HVAC substation site are assessed to be of **minor adverse** significance (not significant in EIA terms).
- 9.6.8 There would also be a temporary loss of land from a number of predominantly large arable farming enterprises and other potential short term effects on the local farming framework during the construction period, which is considered to be of **minor adverse** significance (not significant in EIA terms).
- 9.6.9 There are assessed to be minor temporary effects on wildfowling at the landfall location and the Laceby Manor Golf Driving Range during the construction phase but no significant effects on the recreational use of the grass air strip at North Coates Airfield. There would be no significant permanent effects on these receptors as a result of the operation of Project One.
- 9.6.10 There will be temporary effects of **minor adverse** significance for footpath users (not significant in EIA terms) and temporary effects of **moderate adverse** significance (significant in EIA terms) for bridleway users but no significant permanent effects on these receptors. Proposals for temporary diversions of some PRoW and the use of management measures have been incorporated into the project to minimise the disruption to walkers, horse riders and cyclists.
- 9.6.11 No significant cumulative effects on agricultural land use arising from other developments in the area have been identified, although should Project Two be constructed after Project One there would be greater potential for cumulative impacts on the structure of farm holdings, with fields, farm access routes and drainage systems being severed for longer periods of time compared to a scenario of simultaneous construction of Project One with Project Two.
- 9.6.12 There may be some cumulative effects on the permissive route along the sea defences at the landfall point arising from the construction of the Phillips66 replacement pipeline and additional traffic management measures may be required should they be constructed simultaneously. If Project Two is constructed after Project One, there would be a cumulative effect on PRoW resources since they would be required to be stopped up and, where practical, diverted for an additional period of time.

- 9.6.13 There is no potential for transboundary effects with regard to land use, agriculture and recreation from Project One on the interests of other EEA States.

9.7 Traffic and Transport

- 9.7.1 Project One traffic and transport 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. The assessment is based on baseline studies and site surveys, consultation with relevant highway authorities and relevant policy and guidance. The study area in relation to transport includes all highways, PRoW, private accesses and railways in the vicinity of the onshore infrastructure that are anticipated to be used or affected by construction, operational and decommissioning traffic. The study area also includes parts of the wider transport networks that provide links between the Project One onshore site and the strategic transport networks, rail terminals and port facilities.
- 9.7.2 Baseline data have been obtained from site visits, existing traffic flow data supplemented with new surveys undertaken in 2011 and 2012, records of personal injury accidents and information relating to public transport services.
- 9.7.3 The level of vehicular trip generation associated with the construction phase of the project is based on information provided by Sinclair Knight Merz (SKM) and is derived from assumptions about the anticipated construction methods that influence quantities of materials and types of equipment to be transported to and from sites and staffing levels. The level of vehicle trip generation during the operational phase of development is expected to result in an effect of **negligible** significance (not significant in EIA terms) in relation to the cable route corridor and very low in relation to the operation of the HVDC converter/HVAC substation.
- 9.7.4 Vehicle trips have been distributed onto the highway network using existing patterns of commuter movement in relation to staff and in accordance with the expected routing of Heavy Goods Vehicles (HGVs). The main route for HGVs is assumed to be via the M180 and A180 and either via the A160 for the northern part of the cable route corridor and the HVDC converter/HVAC substation or via the A18 to access parts of the cable route to the south.
- 9.7.5 Screening tests were applied to identify those parts of the network where there is a potential for significant transport environmental impacts. Screening tests are applied to both total vehicle flows and changes in HGV flows. The results of the screening tests show that the overall changes in total traffic flows resulting from the proposed development do not require further assessments and that it is the change in HGV flows during construction which is the focus of further assessment work.

- 9.7.6 The transport environmental impacts assessed as part of the work comprise the standard categories of driver delay, severance, pedestrian delay and amenity, fear and intimidation, road safety and unusual loads. The magnitude of transport environmental impacts relates to the extent of changes in traffic flows. The extent allows for the size of changes in traffic flows, the duration of changes, the frequency of changes and their reversibility. The determination of the sensitivity of receptors to environmental effects is broadly based on the criteria of value, adaptability, tolerance and reversibility. In terms of transport impacts, receptors comprise people living in an area, using facilities in an area and using transport networks in an area. Given that all persons are deemed to be of equal value, sensitivity to changes in transport conditions is generally focused on vulnerable user groups who are less able to tolerate, adapt to and recover from those changes. Vulnerable groups would include school children and the elderly. The significance of a transport environmental effect is determined by correlating the magnitude of the impact to the sensitivity of the receptor.
- 9.7.7 A number of measures will be adopted as part of the project to minimise the significance of transport environmental impacts. These measures will ensure that construction sites lead to no material increase in risk for other highway users. HGV routes are identified and, where necessary, restrictions on the times of HGV movements are proposed. Where the cable route crosses roads, measures will be implemented to minimise delays to other highway users and the time over which delays could be experienced.
- 9.7.8 The results of the assessments indicate a number of transport environmental effects with the proposed measures implemented as part of the project. There is expected to be a temporary and short term effect of **minor adverse** significance (not significant in EIA terms) in terms of driver delay where the cable route crosses the A16. There is expected to be a temporary effect of **minor adverse** significance (not significant in EIA terms) in terms of severance and fear and intimidation caused by the passage of HGVs through North Thoresby and Tetney although it is expected that there will be restrictions on HGV operating times to avoid school opening and closing periods. Further restrictions on HGV operating times are proposed on the B1210 in the vicinity of Immingham, again to avoid school opening and closing times.
- 9.7.9 All transport environmental effects during the operational and decommissioning phases will be of **negligible** significance (not significant in EIA terms).
- 9.7.10 The assessment of cumulative schemes indicates that there will be no significant new or exacerbated transport environmental impacts resulting from cumulative scheme impacts. Discussions with the Highways Agency with regard to the A160/A180 Improvement Scheme that coincides spatially with the cable route in the vicinity of the A160 have identified several feasible approaches relating to the relative timings of the schemes that will not prejudice the A160/A180 scheme in terms of timescale, implementation or cost.

- 9.7.11 No transboundary effects with regard to traffic and transport associated with Project One on the interests of other EEA States were predicted.

9.8 Noise and Vibration

- 9.8.1 Noise and vibration considers the potential effects from noise and vibration generated during the construction, operation and decommissioning of the onshore elements of Project One. These have been predicted and assessed in accordance with international, national and local standards and guidance.
- 9.8.2 Surveys have been undertaken to determine the baseline noise levels at locations representative of the potentially most affected noise sensitive receptors. Long term baseline noise monitoring was undertaken in April 2008 and November 2011.
- 9.8.3 The project includes measures to control construction noise and vibration impacts. 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 construction of the onshore elements would be **negligible to moderate** significance (not significant in EIA terms). Temporary effects of **moderate adverse significance** (significant in EIA terms) are only predicted during HDD works at crossing points such as at major roads and railway lines.
- 9.8.4 Detailed modelling of the HVDC converter/HVAC substation indicates that the significance of the noise and vibration effects due to the operation of the project would be **negligible to minor** (not significant in EIA terms).
- 9.8.5 During decommissioning, effects would be limited to activities at the landfall and at the HDVC converter/HVAC substation site. It has been assumed that effects arising along the cable route may be similar to those during construction. Taking this into account, the results of the noise and vibration assessment indicate that the significance of noise and vibration effects from decommissioning of the cable route and the HVDC converter/HVAC substation would be **negligible to minor** (not significant in EIA terms).

9.8.6 The assessment of cumulative schemes indicates that cumulative effects from Project One and other schemes would not be significant. Project Two HVDC converter/HVAC substation is likely to be located to the immediate south of the Project One HVDC converter/HVAC substation. The cumulative assessment has assumed that the HVDC converter/HVAC substation noise immissions associated with Project Two are the same as those for Project One, but has considered three cumulative combinations for the operational scenario:

- Project One HVDC converter and Project Two HVDC converter results in a cumulative noise effect which is of negligible to minor significance, which is not significant in EIA terms;
- Project One HVAC substation and Project Two HVAC substation results in a cumulative noise effect which is of negligible to minor significance, which is not significant in EIA terms; and
- Project One HVDC converter and Project Two HVAC substation or vice versa results in a cumulative noise effect which is of negligible to minor significance, which is not significant in EIA terms.

9.8.7 No transboundary effects with regard to onshore noise and vibration from Project One on the interests of other EEA States are predicted.

9.9 Air Quality and Health

Air Quality

9.9.1 The air quality assessment considers the potential for changes in air quality as a result of Project One. The air quality assessment identified two potential air quality impacts: from larger dust particles (greater than 10 µm in diameter) released during construction and from exhaust emissions of traffic-related pollutants from vehicle movements generated by Project One. Potential impacts from construction dusts have been assessed using a qualitative risk-based method and potential impacts from vehicle emissions have been assessed using quantitative modelling.

9.9.2 Existing air quality in the predominantly rural project area is good, with monitored concentrations of fine particles well below the objectives set by the National Air Quality Strategy to protect health.

9.9.3 The main potential air quality impact is from larger dust particles released during construction. A qualitative risk-based assessment of potential impacts from dusts has been undertaken. The significance of dust effects after implementation of proposed control measures is expected to be **negligible** (not significant in EIA terms). Fine particles may be of concern with regard to potential effects on health. Dust from construction of this project is not expected to cause the National Air Quality Strategy objectives to be exceeded. Proposed control measures include re-vegetation of earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as

practicable, ensuring all vehicle engines are switched off when stationary (no idling) and the use of water-assisted sweepers on the access and local roads to remove any material tracked out of the site/s. It is anticipated that significant effects to air quality are not likely during operation, maintenance or decommissioning phases of the project.

9.9.4 For nuisance dust, the main potential impact could be the soiling of surfaces, particularly window sills, cars and laundry. Any such impacts arising would be temporary and localised. The risk of dust exposure is related to the wind direction, location and distance of the receptor from the proposed works. High sensitivity receptors include residential properties, schools, hospitals, clinics, care homes and retirement homes. Those highly-sensitive receptors downwind and within 100 m of the construction activities are at high risk of impacts from nuisance dusts. However, the onshore infrastructure works would incorporate a range of measures adopted to control dust based on 'good housekeeping' site practices and other measures that would greatly reduce emissions of nuisance dusts. These measures are expected to be sufficient to control dust to a level where no nuisance effects would be expected.

9.9.5 Additionally, the levels of dust would be significantly below the suggested level at which ecological receptors would be affected.

9.9.6 A quantitative assessment of potential impacts from vehicle emissions has been undertaken using the detailed dispersion model ADMS-Roads. Criteria set out in Environmental Protection UK's guidance document Development Control: Planning for Air Quality (EPUK, 2010) state that an air quality assessment is likely to be considered necessary where construction-related activities generate more than 200 movements of Heavy Goods Vehicles (HGVs) per day, over a period of a year or more. The only road link where the number of vehicles generated by construction-related activities is expected to exceed 200 movements per day, over a period of a year or more is the M180 between junctions 4 and 5. Therefore, an air quality assessment of the effect on local air quality, at human health receptors and European and Nationally designated ecological sites has been undertaken for this road link.

9.9.7 Air quality modelling was undertaken to assess the impact to local air quality, at human health receptors and designated sites, from construction vehicles using the M180 between junctions 4 and 5 and the results indicate that the effect at these sites would be **negligible** (not significant in EIA terms).

9.9.8 Dust from construction more than 700 m away is unlikely to have a cumulative air quality impact. However, the potential for additional effects from other development sites is only likely to be significant if construction activities take place during the same period as the onshore infrastructure associated with Project One. In the event that the construction programmes overlap, the most significant issue in relation to local air quality effects would relate to the deposition of dust during the construction phase and with appropriate mitigation such impacts are expected to be minimal.

9.9.9 Due to the large separation distance between the UK and other EEA States, the development is not likely to have a significant effect on the environment in another EEA State in terms of local air quality.

Health

9.9.10 The Project One HVDC or HVAC onshore electricity transmission cable circuits and onshore HVDC converter/HVAC substation will generate electric and magnetic fields (EMF). Strong electric or magnetic fields have the potential to cause adverse human health impacts. Guideline public exposure limits that are set to protect against known health effects have been adopted in the UK. Compliance with the exposure limit guidelines has been assessed based on anticipated maximum field strength from the Project One onshore grid connection infrastructure.

9.9.11 Electric and magnetic fields arise from generation, transmission, distribution and use of electricity and will occur around all equipment that carries electricity. Time-varying (AC) magnetic fields are separate to the Earth's natural static magnetic field, which has a strength of approximately 50 μ T in England.

9.9.12 The cable sheath and trench fill material will provide complete screening of the electric field from the cables, and no electric field from the cables will be experienced above ground level.

9.9.13 The maximum magnetic field strength has been calculated for HVAC and HVDC cables, based on scenarios for trench depth, cable design and load (developed from details provided in the project description) that would lead to the greatest peak magnetic field strength.

9.9.14 The strongest source of electric and magnetic fields at a substation boundary is typically from cables or overhead lines where they enter and exit it. The maximum magnetic field strength from the underground cable, and a hypothetical maximum electric field strength from a 400 kV overhead line published by National Grid, have been used as proxies for maximum field strengths around the substation.

9.9.15 The results of the assessment show that maximum magnetic and electric field strengths would fall well below the relevant guideline exposure values, published by the International Commission on Non-Ionizing Radiation Protection and adopted in the UK on the advice of the Health Protection Agency (HPA), which are set to protect health. Based on the current scientific evidence base and Government guidance, the proposed infrastructure would comply with guidance set to protect health, and have no measurable human health impact due to EMF exposure.

9.9.16 Electric and magnetic field strength decreases rapidly with distance from the source. As such, no significant cumulative impacts from other existing sources are anticipated. The vector nature of electric and magnetic fields means that the combined field strength from multiple sources would not typically be as great as the scalar sum of their maximum strength.

9.9.17 Cumulative impacts from the static field from a DC Project One cable and Earth's magnetic field, and cumulative impacts between the multiple cables of Project One and Project Two, have been assessed. Based on the current scientific evidence base and Government guidance, the proposed infrastructure would comply with guidance set to protect health, and have no measurable human health impact due to EMF exposure.

9.9.18 EMF from the onshore development would be localised to the cable(s) and the proposed onshore HVDC converter/HVAC substation. No transboundary effects are possible.

9.10 Socio-economics

9.10.1 The socio-economic assessment draws 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. Alongside quantifiable economic effects, the socio-economic assessment considers wider effects on business sectors which could be affected by the development and the potential effects on community vitality and viability (for example by considering how additional economic activity might result in increased demand for accommodation and services in areas local to the Project One development).

9.10.2 Performance in the Local Impact Area for some key socio-economic indicators lags behind the national average. The comparatively smaller working age population as a proportion of total population suggests that the area's economy does not create enough employment to support its working age population. This is echoed in the low employment density of 633 jobs per 1,000 working age residents, which is 90 jobs per 1,000 residents lower than the national average. The unemployment rate of 9% is slightly above the national average (8%), although there are parts of the Local Impact Area where the rate is significantly greater. Residents and workers in the Project One Local Impact 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.

9.10.3 These challenges point towards a need to create employment opportunities within the Local Impact Area, particularly in high value sectors with growth potential. Across the Local Impact Area, opportunities relating to renewable energy are seen as being particularly important to economic development. Existing sector specialisms together with a series of planned investments in the sector locally (for example the proposed Green Port Hull facility will include a turbine manufacturing facility at Alexandra Dock) means that the area is well placed to benefit from the Project One development.

9.10.4 The socio-economic assessment is based around impact scenarios which reflect the uncertainty associated with the geography of the development's supply chain (and as a result, the areas in which socio-economic impacts will materialise). The scenarios provide an illustration of the scale of impact which could be expected in the UK and Local Impact Area under low, medium and high socio-economic impact scenarios. The potential socio-economic impacts which may arise in each of the three phases of development, namely construction, operation and maintenance, and decommissioning, are considered separately.

9.10.5 The effects associated with the following receptors should be noted:

Gross Value Added (GVA) Supported by Construction Activity: Project One Local Impact Area

9.10.6 Depending on the impact scenario, construction activity is expected to support between £7 million per year under the low impact scenario, £57 million under the medium impact scenario and £115 million per year under the high impacts scenario. These impacts result in effects which would be of **minor beneficial** significance (not significant in EIA terms) if the low and medium impact scenarios were realised and **moderate beneficial** significance (significant in EIA terms) if the high impact scenario was realised.

Access to Construction Related Employment amongst Local Residents: Project One Local Impact Area

9.10.7 The expected effects are as follows:

- Under the low impact scenario, the relatively modest employment creation locally (in the region of 120 full time equivalent jobs per year) will mean that an effect of **minor beneficial** significance (not significant in EIA terms) will be expected;
- Under the medium impact scenario, where the level of employment creation in the local impact area is slightly greater (1000 full time equivalent jobs per year) the effect would be of **moderate beneficial** significance (significant in EIA terms); and
- The high impact scenario, which delivers the largest amount of additional employment (in the region of 2,230 full time equivalent positions each year during the construction phase), would result in effects of **major beneficial** significance (significant in EIA terms).

Performance of the Renewable Energy Sector: Project One Local Impact Area

9.10.8 The additional economic activity arising through the construction phase could stimulate improved performance in the renewables sector locally as a result of additional investment (for example in workforce skills, capital equipment and premises) and enhanced expertise and access to new markets that the additional economic activity would bring with it. These effects could in turn help to attract inward investors to the area, who would be attracted by the availability of skills and expertise in the supply chain. The benefits delivered for the wider renewable energy sector are expected to materialise as a result of the cumulative effects of a number of developments locally, rather than be attributable to a single development. However, under the higher impact scenarios where the level of local sourcing is more significant, it is expected that the volume of activity associated with Project One could underpin and support wider sector growth.

Employment in Operation and Maintenance and the Operation and Maintenance Supply Chain: Project One Local Impact Area

9.10.9 The absolute level of employment supported each year during the operation and maintenance phase includes both those employed directly by the Developer as well as supply chain spend on operation and maintenance related goods and services. Unlike impacts associated with the construction phase, the employment impacts in the operation and maintenance phase would be long term in duration. The low impact scenario is not expected to lead to any change in the size of the sector locally and is therefore deemed to be an effect of **negligible** significance (not significant in EIA terms). The medium and high impacts scenarios are expected to lead to a noticeable impact on the size of the energy sector in the Project One Local Impact Area, although this would be driven to some extent by the limited size of the sector locally. The significance of effect under these impact scenarios is assessed to be of **moderate beneficial** significance (significant in EIA terms).

9.10.10 Cumulative impacts for the UK and Project One Local Impact Area which are associated with construction and operation and maintenance activity were predicted to result in beneficial effects most notably in relation to the employment generated as a result of construction activity.

9.10.11 Transboundary effects will be likely to arise as a result of construction, operation and maintenance, and decommissioning activity but these effects will be largely beneficial. The scale and significance of transboundary effects will be driven by the geography of the development's supply chain, location of construction and operation and maintenance ports and procurement of turbines. There will be some non-UK supply chain spend which will generate socio-economic benefits overseas in the same way as it is expected to in the UK. There is uncertainty over the likely geography of the development's international supply chain which means that it is not possible to be definitive about the spatial distribution of supply chain spend. This

uncertainty means that the scale of this non-UK impact as well as the countries that would benefit from it will be difficult to capture.

9.11 Inter-related Effects (Onshore)

- 9.11.1 The EIA for Project One has also assessed the potential for inter-related effects to arise. 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, such as noise, air quality and visual change, affect a single receptor, for example local residents.
- 9.11.2 Based on the detailed assessments undertaken in the individual Environmental Statement chapters, potential inter-related effects have been identified. The potential for inter-related effects is expected to be greatest for people living in dwellings closest to the onshore HVDC converter/HVAC substation where visual effects of **major adverse** significance (significant in EIA terms) could combine with traffic, noise and air quality effects of **negligible** and **minor adverse** significance (not significant in EIA terms).
- 9.11.3 Due to concurrent multiple activities, the construction phase presents the most likely opportunity for effects combining on occupiers of the nearest dwellings. During the construction phase, there are ten properties within 300 m of HDD locations which could experience noise effects of **moderate adverse** significance (significant in EIA terms) and visual effects of **major adverse** significance (also significant in EIA terms). These temporary significant effects could combine with concurrent traffic effects of **negligible** and **minor adverse** significance (not significant in EIA terms), as well as other noise and visual effects.
- 9.11.4 It is anticipated that PRoW would be closed temporarily during the construction phase causing effects of **minor** and **moderate adverse** significance (not significant to significant in EIA terms) on these users. During construction, these short term effects could combine with visual effects of **major adverse** significance (significant in EIA terms) and noise effects of **negligible** to **minor adverse** significance (not significant to significant in EIA terms). For all PRoW users of other linear routes, such as the permissive path along the sea defences, inter-related effects would be intermittent as users move through the area.
- 1.1.1 Non-seabird migrants could be affected by collision risk offshore and disturbance and displacement impacts within the intertidal and onshore area. Collision mortality numbers for non-seabird migrants were predicted to be very low and it is not anticipated that these impacts will interact with onshore impacts in such a way as to increase any levels of significance of effect for this receptor group.

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